PM<sub>2.5</sub> SIP Evaluation Report – Nucor Steel

UTAH PM<sub>2.5</sub> SIP SERIOUS SIP

Salt Lake City Nonattainment Area

Utah Division of Air Quality Major New Source Review Section

July 1, 2018

# DAQ-2018-007162

## PM<sub>2.5</sub> SIP EVALUATION REPORT NUCOR STEEL

#### 1.0 Introduction-Purpose

The following is an updated version of the original RACT evaluation that was completed on October 1, 2013 as a part of the Technical Support Documentation for Section IX, Parts H.11, 12 and 13 of the Utah SIP; to address the Salt Lake City PM2.5 and Provo, Utah PM2.5 Nonattainment Areas.

During the period of the development of the PM<sub>2.5</sub> SIP for moderate nonattainment, UDAQ also processed an application submitted by Nucor for a major modification. Nucor is a PSD source that is located in a newly designated nonattainment area for PM<sub>2.5</sub>. In their application Nucor addressed BACT for the entire source for total emissions (not incremental increases) for all existing sources, and, as required by regulation for new emission sources located in a nonattainment area, Lowest Achievable Emission Rate (LAER) for any new emission sources, which was approved under Approval Order DAOE-AN100080041-18. Further, modeling was completed for all pollutants using the best representative background data including for the pollutant PM<sub>2.5</sub>. No exceedances of NAAQS were found to occur in the area of Nucor operations. Background concentrations plus Nucor's impact does not result in an exceedance of the NAAQS for any pollutant at their location. Since Nucor is located within a boundary chosen as a nonattainment area, offsets were purchased by Nucor and utilized so that an Approval Order dated December 3, 2013 could be issued. Because of this permitting action, BACT has recently been analyzed for the entire Nucor operation. No grandfathered emission units which did not meet current BACT were allowed by the newly issued Approval Order. This analysis reassesses BACT status for the period since the issuance of the recent Approval Order where BACT was addressed.

## 1.1 Facility Identification

Name: Nucor Steel Utah Address: West Nucor Rd PO Box 100 Plymouth, Utah 84330 Owner/Operator: Nucor Corporation UTM coordinates: 401,000 m Easting; 4,637,500 m Northing

#### 1.2 Facility Process Summary

Nucor Steel (Nucor) is an Electric Arc Furnace (EAF) shop, commonly known as a minimill. The facility is a recycling center which utilizes scrap steel as a raw feedstock. Scrap steel is purchased from a number of sources and sorted. The steel is loaded into charge buckets and transported to one of two EAFs. Oxyfuel burners and electricity are

used to melt the steel into a liquid form. Alloys are added until the desired product is achieved. The molten material is then continuously molded and cut into billets for stockpiling. The billets are then reheated and transferred to the rolling mill to be shaped and shipped to the customer.

## 1.3 Facility 2016 Baseline Emissions

Plant-wide 2016 Actual Emissions (tons/yr)

PM <sub>2.5</sub>	NO <sub>x</sub>	$SO_2$	VOC
31.20	162.91	116.87	39.61

## 1.4 Facility Criteria Air Pollutant Emissions Sources

Emission Unit	Current Plant-wide Potential to Emit (tons/yr)			
	PM <sub>2.5</sub>	NO <sub>x</sub>	SO <sub>2</sub>	VOC
Electric Arc	87.40	247.99	325.93	97.24
Furnace Baghouse				
EAF Meltshop	13.55	7.44	9.78	2.76
Fugitives				
Caster Spray				
Chamber Exhaust	0.90			
Lime Silos 1&2				
Baghouse				
(Outdoor)	0.36			
EAF 1 Carbon Silo				
Bin Vent	0.36			
EAF 2 Carbon Silo				
Bin Vent	0.36			
Scrap Stockpiles	0.12			
Alloy Stockpiles	0.005			
Lime Stock Piles	0.005			
Alloy Railcar				
Unloading NE	0.005			
Alloy Railcar				
Unloading				
Meltshop Belly				
Dump/Hopper				
System	0.005			
Slag Stockpiles 1				
& 2	0.005			
Slag Loading to				
Truck	0.01			
Lime Unloading	0.02			
EAF Baghouse				
Miscellaneous	2.14			

PSD PTE				
Reheat #1 Stack	5.02	61.88	0.40	3.63
Reheat #2 Stack	2.79	21.94	0.22	2.02
Reheat Fugitives	0.93	7.31	0.07	0.67
Hot Steel Rolling	0.83			
Abrasive Saw	0.00			
Stack	5.40			
Jump Mill				
Baghouse Stack to				
Outdoors	2.88			
Heat Retention				
Boxes	0.33	2.19	0.03	0.24
Roll Mill Roll Line				
1 Baghouse	18.00			
Roll Mill PSD				
PTE	36.18	93.32	0.72	6.57
Truck Scale				
Emergency	0.01			
Generator	0.01	0.08	0.01	0.01
Main Office				
Emergency	0.01	0.00	0.01	0.01
Generator	0.01	0.08	0.01	0.01
Caster Emergency	0.01	0.08	0.01	0.01
Veguerator	0.01	0.08	0.01	0.01
Vacuulli Degassel	0.33	0.25	0.25	0.25
Financial Gas Fired				
Concretor 1	0.00	0.01	0.00	0.01
Natural Gas Fired	0.00	0.01	0.00	0.01
Emergency				
Generator 2	0.00	0.01	0.00	0.01
Desalination	0.00	0.01	0.00	0.01
Plant/Plantwide				
Chlorine				
Emissions	0.00	0.00	0.00	0.00
Roll Mill Contact				
Cooling Water				
Tower				
Arrangement	0.05			
Roll Mill Non-				
Contact Cooling				
Tower				
Arrangement	0.03			
Caster Water				
Cooling Tower	0.07			

Arrangement				
DEC Water				
Cooling Tower				
Arrangement	0.14			
Plantwide				
Torching/Lancing	1.31	0.42	0.00	0.02
Plantwide HVAC	0.08	0.94	0.01	0.00
Sandblasting	0.001			
Paints and				
Solvents	0.00	0.00	0.00	8.50
Gasoline/Diesel				
Storage Tanks	0.00	0.00	0.00	1.50
Plantwide				
Miscellaneous				
PSD PTE	2.03	1.87	0.27	10.31
Paved and				
Unpaved Roads	1.36			
Pickups, haul				
trucks, welders,				
miscellaneous				
portable equipment	3.55	46.30	5.20	8.66

The following emission units are not source specific. A separate BACT analysis has been conducted on these common emission units. The technical support for these sources is in the  $PM_{2.5}$  Serious SIP – BACT for Small Source document ("PM2.5 Serious SIP – BACT for Small Sources.," 2017).

Lime Silo #1 and #2 Baghouse Vents	Paved Roadway Fugitives
SAND: Sandblasting operations	Generators and Pumps
Roll Mill	Roll Mill #1 Baghouse
Abrasive Saw Baghouse	Jump Mill Baghouse
Contact/Non-Contact Cooling Towers	DEC Cooling Towers
Caster Cooling Tower	Unpaved Roadway Fugitives
TANKS: Miscellaneous tank emissions	Raw Material Fugitive Sources
MISC VOC: Painting and solvent cleaning a	activities
Miscellaneous emissions from desalination	plant, acetylene combustion, natural
gas/propane combustion for comfort heating	g, and lab

#### 2.0 BACT Selection Methodology

The general procedure for identifying and selecting BACT is through use of a process commonly referred to as the "top-down" BACT analysis. The top-down process consists of five steps which consecutively identify control measures, and gradually eliminate less effective or infeasible options until only the best option remains. This process is performed for each emission unit and each pollutant of concern. The five steps are as follows:

- 1. Identify All Existing and Potential Emission Control Technologies: UDAQ evaluated various resources to identify the various controls and emission rates. These include, but are not limited to: federal regulations, Utah regulations, regulations of other states, the RBLC, recently issued permits, and emission unit vendors.
- 2. Eliminate Technically Infeasible Options: Any control options determined to be technically infeasible are eliminated in this step. This includes eliminating those options with physical or technological problems that cannot be overcome, as well as eliminating those options that cannot be installed in the projected attainment timeframe.
- 3. Evaluate Control Effectiveness of Remaining Control Technologies: The remaining control options are ranked in the third step of the BACT analysis. Combinations of various controls are also included.
- 4. Evaluate Most Effective Controls and Document Results: The fourth step of the BACT analysis evaluates the economic feasibility of the highest ranked options. This evaluation includes energy, environmental, and economic impacts of the control option.
- 5. Selection of BACT: The fifth step in the BACT analysis selects the "best" option. This step also includes the necessary justification to support the UDAQ's decision.

Should a particular step reduce the available options to zero (0), no additional analysis is required. Similarly, if the most effective control option is already installed, no further analysis is needed.

The final BACT evaluations for the Nucor site were performed using data that Nucor submitted (Douglas Jones, 2017), (Douglas Jones, 2018a)comments received from Techlaw on the Nucor BACT submittal, comments received from EPA, comments received from individuals, AOs, and the Title V permit.

## 2.1 Emission Unit (EU) and Existing Controls

#### 2.1.1 Electric Arc Furnace

#### **Description:**

The existing electric arc furnaces (EAFs) operate in a batch mode whereby the scrap steel and potentially scrap substitutes are charged, melted, and tapped. Nucor is subject to 40 CFR 60, Subpart AAa, Standards of Performance for Steel Plants: Electric Arc Furnaces and Argon-Oxygen Decarburization Vessels Constructed After August 17, 1983 (Environmental Protection & Agency, 2005). During normal operation, cold scrap metal and scrap substitutes, carbon and fluxing agents are charged into the EAF shell, powered by a high-powered transformer. A large electrical potential is applied to the carbon electrodes. The combination of the heat from the arcing process, burners, and carbon sources melt the scrap and scrap substitutes into molten steel. The temperature of the exhaust gas from the EAF increases appreciably as the scrap begins to melt. As melting progresses, oxygen lancing and carbon injection are performed, the temperature of the exhaust gas stream can approach 3,000 °F, which is approximately the temperature of molten steel. This operational cycle is repeated for each batch, which can take up to one hour to complete.

The capture system for exhaust gases from the EAF is a direct evacuation control (DEC) and an overhead roof exhaust system consisting of a canopy hood. The DEC duct locally evacuates the exhaust gases directly from the furnace to the main duct system directed to the EAF baghouse. The roof exhaust system evacuates fugitive fumes from the closed roof plenums located over the EAF and direct them through the main duct system directed to the EAF baghouse.

The air moving mechanism for the system consists of multiple blowers. Nucor Steel has installed a Continuous Emissions Monitoring System (CEMS) for the pollutants CO,  $NO_x$ , and  $SO_2$  and a bag leak detection system (BLDS) for particulates.

#### **Emissions Summary:**

The potential to emit emissions (tons/yr) for both EAF 1 and EAF 2 are as follows:

PM <sub>2.5</sub>	$SO_2$	NO <sub>x</sub>	VOC	NH <sub>3</sub>
87.40	325.93	247.99	97.24	0.00

## Pollutant [NO<sub>x</sub>]

 $NO_x$  is formed from the chemical reaction between nitrogen and oxygen at high temperatures.  $NO_x$  formation occurs by different mechanisms. In the case of EAF,  $NO_x$ predominantly forms from thermal dissociation and subsequent reaction of nitrogen and oxygen molecules in the combustion air. This mechanism of  $NO_x$  formation is referred to as thermal  $NO_x$ . The other mechanisms of  $NO_x$  formation such as fuel  $NO_x$  (due to the evolution and reaction of fuel-bound nitrogen compounds with oxygen) and prompt  $NO_x$ (due to the formation of HCN followed by oxidation to  $NO_x$ ) are thought to have lesser contributions to  $NO_x$  emissions from EAFs.

Based on a review of the RBLC database and discussions with various individuals knowledgeable about steel mill operations, it was revealed that control technologies for  $NO_x$  abatement have not been successfully implemented for EAF emissions. However,  $NO_x$  control technologies are currently available for fossil-fueled boilers, stationary combustion engines and turbines. Thus, these control alternatives are potentially available to control NO<sub>x</sub> from an EAF. These control options have been reviewed for technical feasibility in this BACT analysis. Due to the lack of successful application of such controls to an EAF, they are considered a "technology transfer". The present limit (about 0.32 lb/ton) is at the lower end of the BACT range for EAFs.

#### **Control Options:**

The alternatives available to control NO<sub>x</sub> emissions from the existing EAF include the following:

Combustion Control options -Low Excess Air (LEA); Oxyfuel Burner; Overfire Air (OFA); Burners Out Of Service (BOOS): Reduced Combustion Air Temperature; Load Reduction; Flue Gas Recirculation (FGR) Selective Catalytic Reduction (SCR); Non-Selective Catalytic Reduction (NSCR); SCONOx Catalytic Oxidation/Absorption; Shell DeNOx System (modified SCR); Selective Non-Catalytic Reduction (SNCR) options -Exxon's Thermal DeNO<sub>x</sub><sup>®</sup> Nalco Fuel Tech's NO<sub>x</sub>OUT<sup>®</sup> Low Temperature Oxidation (LTO)

#### **Technological Feasibility:**

The LEA option is typically used in conjunction with some of the other options. The use of this option will result in the generation of additional CO emissions. In addition, LEA is not very effective for implementation in EAFs which do not operate with combustion air feeds, since the combustion process is not modulated with the near-atmospheric furnace conditions. Thus, this option is considered technically infeasible for this application.

The Nucor Utah EAF's are equipped with oxy-fuel burners in conjunction with oxygen lances. Oxy-fuel burners provide oxygen to the burner, as opposed to air.  $NO_x$  emissions from burners are caused with high peak flame temperatures in the presence of nitrogen. Oxy-fuel burners obtain all of the needed oxygen to support combustion from pure oxygen injected into the burner, reducing the amount of nitrogen present in the vessel and inhibiting the formation of  $NO_x$ .

The OFA option is geared primarily for fuel  $NO_x$  reduction. Fuel  $NO_x$  is not a significant portion of the total  $NO_x$  generated in a furnace. OFA is not feasible in an EAF because of the high turbulence in the furnace environment.

The BOOS and Load Reduction (or Deration) options incorporate a reduction in furnace load, thereby, potentially reducing  $NO_x$  formation. This reduction must be balanced, however, against a longer period of  $NO_x$  generation resulting from the furnace's inability

to efficiently melt scrap and scrap substitutes. Furthermore, both BOOS and Load Reduction are fundamentally inconsistent with the design criterion for the furnace, which is to increase furnace loadings to achieve enhanced production. The furnace would need to be over-designed to allow this technology to operate. Accordingly, these options are judged technically infeasible for this particular application.

The Reduced Combustion Air Temperature option inhibits thermal  $NO_x$  production. However, the option is limited to equipment with combustion air preheaters which are not applicable to EAFs. Thus, this option is considered technically infeasible for this application.

The FGR option involves recycling a portion of the cooled exit flue gas back into the primary combustion zone. Typically, FGR is useful in reducing thermal  $NO_x$  formation by lowering the oxygen concentration in the combustion zone. The primary limitation of FGR is that it alters the distribution of heat (resulting in cold spots) and lowers the efficiency of the furnace. Since it may be necessary to add additional burners (hence, increasing emissions of other pollutants) to the EAF to reduce the formation of cold spots, FGR technology to reduce EAF  $NO_x$  emissions is not considered feasible. Since the EAF does not operate on burner combustion, but relies upon the electric arc and chemical energy for oxidation, neither pathway is amenable to FGR application. Thus, this option is considered technically infeasible for this application.

In the SCR ammonia  $(NH_3)$  is usually diluted with air or steam, and is injected through a grid system into the exhaust gas stream upstream of a catalyst bed. On the catalyst surface the  $NH_3$  reacts with  $NO_x$  to form molecular nitrogen and water. Technical factors related to this technology include the catalyst reactor design, optimum operating temperature, sulfur content of the charge, catalyst deactivation due to aging, ammonia slip emissions and design of the ammonia injection system.

In order for an SCR system to effectively reduce  $NO_x$  emissions, the exhaust gas stream should have relatively stable gas flow rates,  $NO_x$  concentrations, and temperature. In addition, certain elements such as iron, nickel, chrome, and zinc can react with platinum catalysts to form compounds or alloys which are not catalytically active. These reactions are termed "catalytic poisoning", and can result in premature replacement of the catalyst. An EAF flue gas may contain a number of these catalytic poisons. In addition, any solid material in the gas stream can form deposits and result in fouling or masking of the catalyst. Masking occurs when solids obstruct the cell openings within the catalyst. Masking occurs when a film forms on the surface of catalyst over time. The film prevents contact between the catalytic surface and the flue gas. Both of these conditions can result in frequent cleaning and/or replacement requirements. Due to the above effective technical applicability constraints, SCR technology has never been applied to EAF operations. The SCR option is considered technically infeasible for applications related to an EAF.

The NSCR system is a post-combustion add-on exhaust gas treatment system. It is often referred to as a "three-way conversion" catalyst since it reduces  $NO_x$ , unburned

hydrocarbons (UBH), and CO simultaneously. In order to operate properly, the combustion process must be stoichiometric or near-stoichiometric which is not maintained in an EAF and varies widely under regular operation. Under stoichiometric conditions, in the presence of the catalyst,  $NO_x$  is reduced by CO, resulting in nitrogen and carbon dioxide. Currently, NSCR systems are limited to rich-burn IC engines with fuel rich ignition system applications. Moreover, potential problems with NSCR systems include catalyst poisoning by oil additives such as phosphorus and zinc (present in galvanized scrap steel charged in the EAF). In view of the above limitations, the NSCR option is considered technically infeasible for this application.

SCONOx-Catalytic Oxidation/Absorption, this is a catalytic oxidation/absorption technology that has been applied for reductions of NO<sub>x</sub>, CO and VOC from an assortment of combustion applications that mostly include – small turbines, boilers and lean burn engines. However, this technology has never been applied for steel mill EAFs. The technology was developed as an alternative to traditional SCR applications which utilize ammonia resulting in additional operational safeguards, unfavorable environmental impacts and excessive costs. The SCONOx technology is not readily adaptable to high temperature applications outside the 300-700 °F range and is susceptible to thermal cycling that will be experienced in the EAF application. This technology has never been proposed nor successfully implemented for similar industry applications. SCONOx is considered technically infeasible for the EAF application.

Shell DeNOx System is a variant of traditional SCR technology which utilizes a high activity dedicated ammonia oxidation catalyst based on a combination of metal oxides. The system is comprised of a catalyst contained in a modular reactor housing where in the presence of ammonia  $NO_x$  in the exhaust gas is converted to nitrogen and water. The catalyst is contained in a low pressure drop lateral flow reactor (LFR) which makes best use of the plot space available. Due to the intrinsically high activity of the catalyst, the technology is suited for NO<sub>x</sub> conversions at lower temperatures with a typical operating range of 250 - 660°F. If the system was placed downstream of the EAF baghouse, it still does not render it completely safe from the prospect of particulate fouling. The catalyst will still be exposed to particulates which can inflict a masking effect impairing the effective control efficiency of the system. Optimum Shell DeNOx operation is predicated by stable gas flow rates, NO<sub>x</sub> concentrations and temperature. The nature of EAF operations do not afford any of these conditions which will significantly impair the effective control efficiency of the Shell DeNOx system. The Shell DeNOx option is considered technically infeasible with unresolved technical issues for the use on controlling NO<sub>x</sub> emission from an EAF.

Exxon's Thermal DeNOx® system is a non-catalytic process for NO<sub>x</sub> reduction. The process involves the injection of gas-phase ammonia (NH<sub>3</sub>) into the exhaust gas stream to react with NO<sub>x</sub>. The temperature of the exhaust gas stream is the primary criterion controlling the reaction. The optimum temperature window for the Thermal DeNOx® process is approximately 1,600-1,900 °F. The above reaction temperature window can be shifted down to approximately 1,300 - 1,500 °F with the introduction of readily

oxidizable hydrogen gas. In addition, the process also requires a minimum of 1.0 second residence time in the desired temperature window for any significant  $NO_x$  reduction. In order for the Thermal DeNOx® system to effectively reduce  $NO_x$  emissions, the exhaust gas stream should have relatively stable gas flow rates; ensuring the required residence time and be within the prescribed temperature range. Therefore, any projected application of the process to EAF operations would be considered a "technology transfer". Thermal deNO<sub>x</sub> technology is considered technically infeasible.

The Nalco Fuel Tech's  $NO_xOUT^{(B)}$  process is very similar in principle to the Thermal DeNOx<sup>(B)</sup> process, except that it involves the injection of a liquid urea into the high temperature combustion zone to promote  $NO_x$  reduction. However, the process still has similar constraints as the Thermal DeNOx<sup>(B)</sup> system. A  $NO_xOUT^{(B)}$  system requires steady gas flows and prescribed residence times, thermal cycling and the ability of the control option to load-follow varying pollutant concentrations. This would make it impossible to continually comply with an hourly emission rate for an EAF application. If the required residence time or other optimum operation parameters are not available, secondary production ammonia will be released directly to the atmosphere. The use of  $NO_xOUT^{(B)}$  technology to control  $NO_x$  emissions from steel mill EAF operations is not known. Therefore, any projected application of the process to the Nucor application would be considered a "technology transfer". With the requirements listed above and the fact that it has not been used on an EAF application, the  $NO_xOUT^{(B)}$  option is considered technically infeasible.

LTO technology is mainly used for industrial boilers and cogeneration gas turbines. The technology is a variant of SNCR technology using ozone. The ozone is injected into the gas stream and the NO<sub>x</sub> in the gas stream is oxidized to nitrogen pentoxide vapor which is absorbed in the scrubber as dilute nitric acid. The nitric acid is then neutralized with caustic (NaOH) in the scrubber water forming sodium nitrate. For optimal performance, the technology requires stable gas flows, lack of thermal cycling, invariant pollutant concentrations and residence times on the order of 1 - 1.5 seconds. In addition, LTO technology requires frequent calibration of analytical instruments which sense the  $NO_x$ concentrations for proper adjustment of ozone injection. Since LTO uses ozone injection, it has a potential for ozone slip which can vary between 5 - 10 ppmv. Also, the technology requires a cooler flue gas of less than 300 °F at the point of ozone injection, otherwise the reactive gas is rendered redundant. The technology is neither applicable nor proven for steel mill EAF applications and attendant limitations render it technically infeasible in its current manifestation. After reviewing the requirements for an LTO control system, the LTO control option is considered technically infeasible for controlling NO<sub>x</sub> from an EAF.

Ranking is not required because only one option is feasible – Oxy-fuel burners

#### **Economic Feasibility:**

Economic feasibility was not performed because all control options are considered technically infeasible except oxy-fuel burners.

## **BACT Selection:**

The only feasible control option for controlling  $NO_x$  emissions from the Nucor EAFs is oxy-fuel burners. BACT for the EAFs at Nucor is natural gas oxy-fuel fired burners and oxygen lances"

#### **Implementation Schedule:**

The EAFs at Nucor Steel are already equipped with oxy fuel burners.

#### Startup/Shutdown Considerations

The EAF and associated equipment are designed to operate on a continuous basis. The operations are in shutdown or startup modes during scheduled maintenance, plant shutdowns and during periods of natural gas or electric curtailments

The emissions for the EAF are limited during startup/shutdown by hour short term limits for  $NO_x$  and/or  $SO_2$  that are monitored by CEMs.

Startup and shutdown operations are regulated by EPA's NESHAP YYYYY which requires procedures to be followed which ensure proper operation of the EAF baghouse during these events. Specific procedures for startup and shutdown have been developed for the EAF and record keeping is completed. These procedures are developed based on design of its operations and best management practices specific to Nucor's operation.

## Pollutant [PM<sub>2.5</sub>]

Particulate emissions from the EAF will be captured by the DEC and a roof exhaust system and ultimately exhausted through a baghouse.

The capture system for exhaust gases from the EAF is a DEC and an overhead roof exhaust system consisting of a canopy hood. The DEC duct locally evacuates the exhaust gases directly from the furnace to the main duct system directed to the EAF baghouse.

The dust collection equipment for the EAF baghouse consists of a reverse-air type multicompartment positive pressure baghouse. Each module currently contains multiple bags, with all necessary bag cleaning mechanisms, gas flow control, and collected material transfer and removal equipment. The design of the multi-compartment EAF baghouse will allow for on-line maintenance and cleaning.

The New Source Performance Standard (NSPS) for particulate matter emissions from an EAF is 0.0052 grains/dscf of total PM. Fabric filtration in baghouses is the predominant control device for EAFs. The  $PM_{2.5}$  emissions are currently controlled by the EAF baghouse. At the time the NSPS was developed, condensables were not considered. More recently, condensables have been identified as a concern, and is now incorporated

into the NSPS limitation, effectively reducing the combined amount that can be emitted.

#### **Control Options:**

Scrubbers Baghouses Electrostatic Precipitators Cyclones

#### **Technological Feasibility:**

Fabric filtration is the predominant control option for abatement of particulate emissions (PM,  $PM_{10}$ ,  $PM_{2.5}$ ) from an EAF application. Other particulate control options are not considered as effective or technically feasible for an EAF application. Based on a review of the information resources referenced earlier, it was revealed that these control alternatives have not been successfully implemented to reduce particulate emissions from EAFs. Thus, the projected use of any of these technologies would be considered a "technology transfer." Since, only a single control option was ascertained to be technically feasible, no ranking of control alternatives has been provided.

#### **Economic Feasibility:**

Since, only a single control option was ascertained to be technically feasible, an economic feasibility was not performed.

## **BACT Selection:**

A review of the RBLC database revealed that other steel mills have a similar emission limit. None of the steel mills reviewed in this analysis have proposed or successfully implemented any controls besides fabric filtration. The other control options have been shown to be technically infeasible.

Based on a review of similar EAF melt shop applications, the use of a baghouse for controlling  $PM_{2.5}$  emissions and a baghouse emission limit represent BACT for the EAF melt shop application.

## **Implementation Schedule:**

The EAFs at Nucor Steel are already equipped with baghouses.

## Startup/Shutdown Considerations

The EAF and associated equipment are designed to operate on a continuous basis. The operations are in shutdown or startup modes during scheduled maintenance, plant shutdowns and during periods of natural gas or electric curtailments

Startup and shutdown operations are regulated by EPA's NESHAP YYYYY which requires procedures to be followed which ensure proper operation of the EAF baghouse during these events. Specific procedures for startup and shutdown have been developed for the EAF and record keeping is completed. These procedures are developed based on design of its operations and best management practices specific to Nucor's operation.

## Pollutant [VOC]

VOC emissions from the EAF will be intermittent and limited to the brief period during EAF charging when organic compounds such as oil or paint present in the scrap are volatilized. The combustion controls of having a DEC furnace shell evacuation system, with cooling, and a combustion air gap is essentially what all EAF furnaces have, including Nucor Plymouth. A combustion gap is necessary to control CO emissions, and does contribute to incineration of VOC's.

## **Control Options:**

Catalytic or Thermal Oxidation; Degreasing of scrap metal prior to charging in the EAF Scrap management program.

## **Technological Feasibility:**

Based upon a review of the EAF sites, there is no known application of oxidation catalysts to control VOC emissions from an EAF. The optimal working temperature range for VOC oxidation catalysts is approximately 850 - 1,100 °F with a minimum exhaust gas stream temperature of 500 °F for minimally acceptable control. Exhaust gases from the EAF will undergo rapid cooling as they are ducted from the furnace. Thus, the temperature will be far below the minimum 500 °F threshold for effective operation of CO oxidation catalysts. Additionally, the particulate loading in the exhaust gas stream is anticipated to be too high for efficient operation of an oxidation catalyst. Masking effects such as plugging and coating of the catalyst surface would almost certainly result in impractical maintenance requirements, and would significantly degrade the performance of the catalyst. Consequently, this control alternative is considered technically infeasible for this application.

Degreasing of scrap metal prior to charging in the EAF is impractical. The amount of pollution generated by degreasing scrap would be greater than the amount of pollution generated by melting the scrap. There would be thousands of gallons of solvent required to degrease the large amount of scrap used annually in the EAFs. Therefore, this control option is considered technically infeasible.

The mill utilizes a scrap management program to eliminate the purchase of scrap steel that is heavily oiled. The scrap is inspected before it is received. An EPA regulation NESHAP YYYYY is applicable to mini mills and prohibits the receipt of free oils in scrap steel charged to EAFs. This regulation applies to Nucor, including inspection and

recordkeeping requirements.

#### **Economic Feasibility:**

Since only a single control option was ascertained to be technically feasible, an economic feasibility was not performed. The technically feasible control has already been implemented at Nucor.

#### **BACT Selection:**

EAF steel mills reviewed for this BACT analysis have not successfully implemented any controls besides scrap management. Scrap management constitutes BACT for the Nucor Steel EAF operations.

#### **Implementation Schedule:**

The scrap management plan for the EAFs at Nucor Steel is already being implemented.

#### Startup/Shutdown Considerations

The EAF and associated equipment are designed to operate on a continuous basis. The operations are in shutdown or startup modes during scheduled maintenance, plant shutdowns and during periods of natural gas or electric curtailments

Startup and shutdown operations are regulated by EPA's NESHAP YYYYY. Specific procedures for startup and shutdown have been developed for the EAF and record keeping is completed. These procedures are developed based on design of its operations and best management practices specific to Nucor's operation.

#### Pollutant [SO<sub>2</sub>]

 $SO_2$  emissions from the EAF come from the sulfur content of the raw materials that are charged in the EAF, primarily sulfur contained in the steel itself. The sulfur content of oil on the scrap steel also contributes to the  $SO_2$  emissions but to a lesser extent.

#### **Control Options:**

Scrap Management Lower-Sulfur Charge Substitution Flue Gas Desulfurization (FGD) options: Wet Scrubbing Spray Dryer Absorption (SDA) Dry Sorbent Injection (DSI)

## **Technological Feasibility:**

Lower-Sulfur Charge Substitution.

Charge substitution with lower sulfur bearing raw materials is not practical due to inconsistent availability of the raw materials. Changing the sulfur content of charge materials and carbon is infeasible.

Flue Gas Desulfurization -- FGD systems currently in use for  $SO_2$  abatement can be classified as wet and dry systems. FGD system control technologies have not been successfully implemented for controlling  $SO_2$  emissions from EAFs.

Wet scrubbers are regenerative processes which are designed to maximize contact between the exhaust gas and an absorbing liquid. Wet scrubbing has never been successfully implemented for EAF steel mill applications. The wet scrubber option is considered technically infeasible for the Nucor EAF operation.

Dry scrubbing or spray-dryer absorption (SDA) is an alternative to wet scrubbing. As in wet scrubbing, the gas-phase  $SO_2$  is removed by intimate contact with a suitable absorbing solution. SDA has never been successfully implemented for similar steel mill applications. This makes SDA technically infeasible for this application.

Dry Sorbent Injection (DSI) involves the injection of dry powders into either the furnace or post-furnace region of utility-sized boilers. DSI has never been successfully implemented for EAF steel mill applications. The DSI dry scrubbing option is considered technically infeasible for the EAF steel mill operation.

## **Economic Feasibility:**

Since, only a single control option was ascertained to be technically feasible, an economic feasibility was not performed. The technically feasible control has already been implemented at Nucor.

#### **BACT Selection:**

BACT for controlling EAF  $SO_2$  emissions is a scrap management program with a limitation on the  $SO_2$  emissions monitored through the use of CEMs.

#### **Implementation Schedule:**

The scrap management plan for the EAFs at Nucor Steel is already being implemented.

#### Startup/Shutdown Considerations

The EAF and associated equipment are designed to operate on a continuous basis. The operations are in shutdown or startup modes during scheduled maintenance, plant shutdowns and during periods of natural gas or electric curtailments

The emissions for the EAF are limited during startup/shutdown by hour short term limits

for  $NO_x$  and/or  $SO_2$  that are monitored by CEMs.

Startup and shutdown operations are regulated by EPA's NESHAP YYYYY. Specific procedures for startup and shutdown have been developed for the EAF and record keeping is completed. These procedures are developed based on design of its operations and best management practices specific to Nucor's operation.

#### 2.1.2 Caster and Caster Steam Vent emission

#### **Description:**

The caster forms a solid continuous slab as molten steel passes through a water-cooled mold. Fugitive PM emissions may be generated during the casting of hot metal; however, the emissions are evacuated to the EAF melt shop baghouse. A small amount of fugitive PM emissions is included with the emissions from the melt shop building.

The caster steam vent is a forced air evacuation of the caster spray chamber. The caster spray chamber is a large box where billets exit the caster molds. In the mold, the surface of the steel is cooled enough to be a solid, while liquid steel remaining inside the billet as it exits. In the spray chamber, water is sprayed on the billets to further cool them so that the liquid steel inside the billet is cooled enough to also solidify. When the billet reaches the torch tables, the entire billet is a solid so that it may be cut to length.

While the purpose of the spray chamber is for cooling of billets, it is essentially a wet scrubber. The nozzles for the water spray make cone shaped patterns of water droplets to evenly distribute for needed cooling. These sprays, through contact with the billet, remove particulate (oxidizing steel or scale) that forms on the surface of the billets at their high temperatures. Further, the droplets present in the spray chamber box capture airborne particulates in the box. The water from the spray system falling through the chamber carry this particulate into the circulating water system, where the particulates are removed first through settling basins then through the use of sand filters.

The spray chamber functions as a wet scrubber. Wet scrubbers are an emission control device. Therefore the caster steam vent is exhaust from an emission control device.

#### Pollutant [PM<sub>2.5</sub>]

#### **Control Options:**

Baghouse

#### **Technological Feasibility:**

Further add-on emission control with a fabric filter for the caster vent emissions cannot be achieved. Very high temperatures exist near hot billets so that some water exists as a gas at those areas, but much of the temperatures within the chamber is below the boiling point of water, as is needed to achieve cooling. The chamber is evacuated by fans and the temperature of the exhaust is below water boiling temperature causing any steam to condense as a fine water droplet. The exhaust from the caster steam vent contains condensed water vapor. A noticeable condensed water vapor plume exists much of the time (winter and nighttime year round for example). Fabric filters would immediately plug when moisture is present. Further add on control is not feasible.

#### **Economic Feasibility:**

A baghouse is already used for the caster emissions that are vented to the melt shop.

Additional controls are technically infeasible for the caster vent emissions. Therefore, an economic feasibility was not performed.

#### **BACT Selection:**

The use of a baghouse to control emissions from the caster operations that are vented to the EAF melt shop is BACT.

#### **Implementation Schedule:**

Baghouse control is already in place.

#### **Startup/Shutdown Considerations**

The EAF and associated equipment are designed to operate on a continuous basis. The operations are in shutdown or startup modes during scheduled maintenance, plant shutdowns and during periods of natural gas or electric curtailments

Startup and shutdown operations are regulated by EPA's NESHAP YYYYY. Specific procedures for startup and shutdown have been developed for the EAF and record keeping is completed. These procedures are developed based on design of its operations and best management practices specific to Nucor's operation.

## 2.1.3 Caster Area Roof Emissions

#### **Description:**

The caster emissions include emissions from the tundish and ladle preheating, skull lancing, ladle stirring, and other caster operations. The preheating of the ladle and tundish is done with natural gas fired burners. The skull lancing is an operation that removes excess steel from the tundish and ladles through the use of cutting torches. This process takes place inside the caster building and some of the emissions are assumed to escape the building. This source is not in continuous operation.

The original Moffit brand ventilator originally serviced the caster area for the purposes of

reducing heat loads in the area of the west side of the meltshop. This ventilator also allowed some smoke to exit directly above the caster, until a modification was made to duct both the heat and smoke to the EAF baghouse. The old ventilator serves as both a high-temperature-air reservoir being the highest point as well as a large collection duct for the evacuation system that finally discharges through the stack of the EAF baghouse.

#### Pollutant [PM<sub>2.5</sub>]

#### **Control Options:**

Control of fugitive PM<sub>2.5</sub> emissions Scrubbers, Baghouses Electrostatic Precipitators Cyclones

#### **Technological Feasibility:**

As outlined in the EAF BACT analysis, additional controls are technically infeasible for the EAF baghouse, which the caster roof emissions are vented to.

#### **Economic Feasibility:**

As outlined in the EAF BACT analysis, additional controls are technically infeasible for the EAF baghouse, which the caster roof emissions are vented to. Therefore, an economic feasibility was not performed.

#### **BACT Selection:**

Use of the meltshop evacuation system which vents to the EAF baghouse is BACT.

#### **Implementation Schedule:**

Baghouse control is already in place.

#### Startup/Shutdown Considerations

The EAF and associated equipment are designed to operate on a continuous basis. The operations are in shutdown or startup modes during scheduled maintenance, plant shutdowns and during periods of natural gas or electric curtailments.

Startup and shutdown operations are regulated by EPA's NESHAP YYYYY. Specific procedures for startup and shutdown have been developed for the EAF and record keeping is completed. These procedures are developed based on design of its operations and best management practices specific to Nucor's operation.

## Pollutant [NO<sub>x</sub>, SO<sub>2</sub>, and VOC]

## **Control Options:**

Combustion emissions from preheating Diesel Natural gas

## **Technological Feasibility:**

All fuels for ladle preheating are technically feasible.

#### **Economic Feasibility:**

Natural gas is already in use for the preheating operations. Therefore, it is more cost effective to use natural gas as a fuel for preheating.

#### **BACT Selection:**

The use of natural gas for preheating is BACT as use of other fuels represent higher emission rates.

#### **Implementation Schedule:**

Controls are already in place.

## Startup/Shutdown Considerations

The EAF and associated equipment are designed to operate on a continuous basis. The operations are in shutdown or startup modes during scheduled maintenance, plant shutdowns and during periods of natural gas or electric curtailments.

Startup and shutdown operations are regulated by EPA's NESHAP YYYYY. Specific procedures for startup and shutdown have been developed for the EAF and record keeping is completed. These procedures are developed based on design of its operations and best management practices specific to Nucor's operation.

## 2.1.4 Billet Reheat Furnaces

#### **Description:**

After cooling, the slab, bloom, or billet must be reheated and "softened" for the next forming operation (such as rolling, forging, or extrusion) by raising its temperature to a range of 1,600 - 2,500°F. This process is performed in a reheat furnace, a steel structure protected internally by refractory materials. There are many different reheat furnace

designs, a walking beam furnace, a walking hearth furnace, a rotary hearth furnace, a pusher-type furnace, and a batch-type furnace. Each of these furnace types varies in length, capacity, width, temperature profile, and refractory design, depending upon the configuration and temperature requirements of the product being heat-treated. Nucor utilizes two furnaces, one is a pusher-type furnace and the other is a walking beam type furnace.

Nucor has two reheat furnaces. Reheat furnace No. 1 is rated at a maximum of 160 MMBtu/hr; limited to 1,320,000,000 ft<sup>3</sup> natural gas/year and has a NO<sub>x</sub> emission rate of 0.09375 lb/MMBtu. Reheat furnace No. 2 is rated at a maximum of 134 MMBtu/hr; limited to 980,000,000 ft<sup>3</sup> natural gas /year and has a NO<sub>x</sub> emission rate of 0.0597 lb/MMBtu.

#### Pollutant [NO<sub>x</sub>]

#### **Control Options:**

Low NO<sub>x</sub> Burners Ultra-Low NO<sub>x</sub> Burners Furnace Replacement

#### **Technical Fesibility:**

The amount of NO<sub>x</sub> emissions from reheat furnaces is dependent on the overall design of the furnace itself. Reheat furnaces can be over fired, side fired, and end fired, and usually consist of a combination of burner placements. Both the type of burner design and the general size of the furnace itself are factors in determining what can be achieved, with other factors considered. Not all  $NO_x$  in a furnace is generated at the burner itself. The high temperature environment of the furnace, the presence of tramp air introduced through exits and entrances, as well as excess air for burner combustion, all contribute to  $NO_x$  formation.  $NO_x$  is formed in most areas of the furnace. Billets in the furnace are typically heated to near 2,000 °F for an appropriate rolling temperature, requiring the atmosphere in the furnace to be at a much hotter temperature.  $NO_x$  begins to form at temperatures of 1,800  $^{\circ}$ F. Because of this, even if burners that generate no NO<sub>x</sub> could be used (ex. electric heating), NO<sub>x</sub> emissions would still exist because of the conversion of nitrogen in the air at high temperatures. Because of the final temperature of the product needed, the consideration of NO<sub>x</sub> emissions (lb/mmBtu or ppmv) is considerably different than a home water heater, for example. Reheat furnaces have NO<sub>x</sub> emissions associated with the furnace, not specifically the burners used.

One major factor that must be considered is burner impingement on the product being heated. Because of quality issues and production issues, burner impingement must be avoided. Low  $NO_x$  burners achieve high peak flame temperatures through either staged air or staged fuel combustion, resulting in a longer flame with lower peak temperatures with nearly the same total heat provided. Because impingement must be avoided, and a longer flame is associated with Low  $NO_x$  burners, greater space is required between the

burner and the product. Greater space means a larger furnace with more free space. A larger furnace means less efficiency, because a greater space exists and heat is lost through the walls of the furnace. It can be compensated for with greater fuel consumption, but increasing the volume of gas consumed only for being able to claim less NO<sub>x</sub> per unit volume can be somewhat counterproductive to the overall goal

Recently designed furnaces can be engineered for lower  $NO_x$  emission burners to reduce  $NO_x$  by considering burner placement to avoid impingement even with a longer flame. The burners can be placed preferentially in the sides to avoid impingement rather than the top while minimizing free space with efficiency consideration in mind. However, to achieve the necessary even heating, it is often found necessary to place burners in areas where a longer flame cannot be used. Retrofitting older designed furnaces that utilized standard burners is considerably more difficult. Being able to install different Low  $NO_x$  designed burners, and their associated burner block in locations where a standard burner was previously installed can be a retrofit that may not be able to be achieved, even if the use of the Low  $NO_x$  burner at that location wouldn't cause impingement issues.

In addition, newer furnaces are likely to be "Pusher" type furnaces, with a solid hearth where billets are skidded across the bottom solid hearth from the entry to the exit. Older furnaces are likely to be walking hearth or walking beam furnaces where portions of the bottom of the furnace first raise, then move forward, then lower to the hearth again. to "walk" the billets through the furnace. These walking furnaces tend to be less efficient because gaps in the hearth are necessary, which lose heat as well as allow additional tramp air to enter the furnace, contributing to further NOx emissions.

For these reasons, a retrofit furnace with the intent of lower  $NO_x$  emissions, vs. a new furnace can be expected to have different  $NO_x$  performance characteristics.

Nucor has a newer pusher type furnace in one mill designed for reduced  $NO_x$  burners. This is Reheat Furnace #2. This furnace was installed for the purpose of lowering  $NO_x$  emissions by replacing a furnace that had a higher  $NO_x$  emission rate. The permitted  $NO_x$  emission rate of this furnace is a lbs/hr rate based on 0.07 lb/mmBtu.

The second reheat furnace utilized is a walking type furnace which has been modified to lower  $NO_x$  emissions. This is Reheat Furnace #1. The modification included installing a new raised roof to accommodate longer flame and differently designed burners so that impingement issues would not occur. As a retrofit of an older furnace, this furnace is permitted at a  $NO_x$  lbs/hr emission rate that is based on a  $NO_x$  rate of 0.09 lb/mmBtu.

The most common reference document for emission permitting emission calculations, EPA's AP-42, quantify emission rate Low NOx burners (as well as uncontrolled and FGR controlled) for Large Wall Fired Boilers greater than 100 mmBTU. This factor is most representative of reheat furnaces because both of Nucor's reheat furnaces are greater than 100 mmBTU/hr. It should be noted here, as was discussed in the section above, there are other types of external combustion sources described in this document with much different emission rates also described as resulting from the use of Low NOx

burners. This difference in emissions between equipment (of smaller size) with the same technology demonstrates that Low NOx burners achieve vastly different emission rates utilizing Low NOx burners. For large units, AP-42, Table 1.4-1, describes Low NOx burners as achieving the following:

Low NOx Burners	140 lb/mmscf.	
Converted to lb/mmBtu	0.137	
Approximate PPMV Conversion	113 ppmv	

Nucor's permitted NOx emission rates (lbs/hr) are based on the following performance  $NO_x$  emission rates with burners designed for reduced  $NO_x$ .

Reheat Furnace 1		
0.09 lb/mmBtu		
Converted to lb/MMscf	91.8	
Converted to ppmv	74	
Reheat Furnace 2		
0.07 lb/mmBtu		
Converted to lb/mmscf	71.4	
Converted to ppmv 58		

The permitted NOx emission rate for Reheat Furnace 1, and Reheat Furnace 2, is 65% and 51%, respectively, of the emissions defined by that achieved by Low NOx burners. The permitted rates for these furnaces should be considered "Ultra Low NOx" demonstrated by this analysis alone.

EPA's RACT/BACT/LAER clearinghouse includes a category of steel manufacturing. Three reheat furnaces could be identified in this category. One identified a reheat furnace installation of <u>Ultra</u> Low NOx burners with a permitted rate of 0.07 lb/mmscf. Likely the correct unit should be lb/mmBtu for this identified unit. A second installation also referenced <u>Ultra</u> Low NOx burners at 0.07 lb/mmBtu. The third and last comparable installation in this search found an installation with <u>Ultra</u> Low NOx Burners with a rate of 0.10 lb/mmBTU.

Both of Nucor's reheat furnaces are within the range of what is a defined emission rate of <u>Ultra</u> Low NOx burners for reheat furnaces in the RBLC clearinghouse, including the

retrofit furnace which can be expected to have higher emissions. Nucor's furnaces are already permitted to not exceed emission rates of this performance standard.

In 2007 Nucor replaced Reheat Furnace #2, a pusher type reheat furnace, to achieve the  $NO_x$  emission rate of 0.07 lb/mmBTU. Reheat Furnace #1, a walking beam type reheat furnace, achieved a 30% reduction in  $NO_x$  emissions when it was modified in 2007 and the current emission rate is 0.09 lb/mmbtu. It would need to be replaced in order to achieve the same emission rate as Reheat Furnace #2 while maintaining the current production capacity. As discussed above, if Reheat Furnace #1 was replaced it would need to be a larger furnace.

Currently Reheat Furnace #1 has an actual  $NO_x$  emission rate of 50 tpy. If the emission rate was reduced from 0.09 lb/mmBTU to 0.07 lb/mmBTU, the actual emissions would be 39 tpy. This is a reduction of 11 tpy.

A review of technologies applied to other reheat furnaces found that in all cases, reduced  $NO_x$  burners are utilized to meet BACT. Other technologies are not used to achieve the lowest  $NO_x$  emission rates.

It is technically feasible to replace reheat Furnace #1.

## **Economic Feasibility:**

Additional controls have not been applied to reheat furnaces. Therefore, an economic feasibility was not performed on additional controls.

## **BACT Selection:**

Ultra-Low  $NO_x$  burners are BACT. Reheat furnace #1 is an existing original reheat furnace and it has been retrofitted with new burners with comparable emissions defined as Ultra-Low  $NO_x$  in the RACT/BACT/LAER Clearinghouse. It meets the emission limit of 0.09 lb  $NO_x$ /MMBtu

Reheat furnace #2 is a replacement reheat furnace and it has new reduced NO<sub>x</sub> burners meeting emission rates defined as that achieved by Ultra-Low NO<sub>x</sub> Burners in the RACT/BACT/LAER Clearinghouse. It meets the emission limit of 0.07 lb NO<sub>x</sub>/MMBtu.

#### **Implementation Schedule:**

The reheat furnaces at Nucor Steel are already retrofitted or designed to utilize reduced NO<sub>x</sub> burners to minimize NO<sub>x</sub> emissions.

#### **Startup/Shutdown Considerations**

The Reheat furnaces #1 and #2 are designed to operate on a continuous basis. The operations are in shutdown or startup modes (primarily idle modes) during scheduled

maintenance, plant shutdowns and during periods of natural gas curtailments

These furnaces are natural gas fired and operated using automatic computer control systems that regulate proper combustion with appropriate air fuel ratios. Startup and shutdown emissions are not a concern with this type of equipment.

## Pollutant [SO<sub>2</sub>, VOC, and PM<sub>2.5</sub>]

#### **Control Options:**

Use of pipeline quality natural gas Good combustion practices Good design and proper operation

#### **Technological Feasibility:**

All control technologies are technically feasible

#### **Economic Feasibility:**

An economic feasibility analysis was not performed for these activities as they are already being performed.

#### **BACT Selection:**

Use of pipeline quality natural gas, good combustion practices, good design and proper operation of the reheat furnaces constitute BACT for this emission source.

#### **Implementation Schedule:**

The reheat furnaces at Nucor Steel already use pipeline quality natural gas, good combustion practices, and have been designed for lower emissions. They conduct proper operation of the reheat furnaces.

#### **Startup/Shutdown Considerations**

The Reheat furnaces #1 and #2 are designed to operate on a continuous basis. The operations are in shutdown or startup modes (primarily idle modes) during scheduled maintenance, plant shutdowns and during periods of natural gas curtailments

These furnaces are natural gas fired and operated using automatic computer control systems that regulate proper combustion with appropriate air fuel ratios. Startup and shutdown emissions are not a concern with this type of equipment.

## 2.1.5 Natural Gas-Fired Preheaters and Dryers

## **Description:**

Nucor's natural gas fired preheaters and dryers are located and exhausted in the melt shop building. Emissions from these small preheaters and dryers primarily result from combustion by-product of the fuel.

#### Pollutants [NO<sub>X</sub>, SO<sub>2</sub>, VOC, and PM<sub>2.5</sub>]

These emission sources exhaust through the EAF baghouse. Nucor's EAF emission rates are already established as BACT. The emissions of the Preheaters and Dryers are added to the EAF emissions and included in the compliance limit for the EAF baghouse. Based on a review of similar natural gas fired applications, the proposed emission limit for the EAF baghouse, including the Preheaters and Dryers, represents BACT for the burners and dryers.

#### **Control Options:**

Use of pipeline quality natural gas Good combustion practices Good design and proper operation

#### **Technological Feasibility:**

Due to the relatively small emissions from natural gas combustion, the application of add-on controls is considered infeasible. A review of steel mills did not indicate the application of add-on control alternatives for  $NO_x$  control from similar sized natural gas-fired combustion equipment in other industries.

#### **Economic Feasibility:**

An economic feasibility analysis was not performed for these activities as they are already being performed.

#### **BACT Selection:**

Use of pipeline quality natural gas, good combustion practices, good design and proper operation of the reheat furnaces constitute BACT for this emission source.

#### **Implementation Schedule:**

The preheaters and dryers already use pipeline quality natural gas, good combustion practices, and have been designed for lower emissions. They conduct proper operation of the reheat furnaces.

#### **Startup/Shutdown Considerations**

There are no startup/shutdown operations to be considered for these sources.

#### 2.1.6 Plant Wide Torches and Lancing

#### **Description:**

Nucor conducts various torching and lancing throughout the mill utilizing either acetylene or natural gas as a fuel.

Lancing occurs on site in the EAF process and the Caster process. In the EAF as melting progresses, oxygen lancing is performed, and in the caster building, skull lancing is performed to remove excess steel from the tundish and ladles.

#### Pollutant [NO<sub>x</sub>, SO<sub>2</sub>, and VOC]

 $NO_x$ ,  $SO_2$  and emissions from these torches primarily result from combustion by-product of the fuel.

#### **Control Options:**

A review of the similar sources did not indicate the application of add-on control alternatives for  $NO_x$ ,  $SO_2$  and VOCs emissions control for torches.

#### **Technological Feasibility:**

Due to the relatively small emissions from combustion, the application of add-on controls is considered infeasible.

#### **Economic Feasibility:**

Additional controls are technically infeasible for the torches and lances. Therefore, an economic feasibility was not performed. The technically feasible control has already been implemented at Nucor.

#### **BACT Selection:**

Proper operation of the torches and lances constitute BACT for this emission source.

#### **Implementation Schedule:**

Proper operations are already in place.

#### **Startup/Shutdown Considerations**

There are no startup/shutdown operations to be considered for these sources.

## Pollutant [PM<sub>2,5</sub>]

Particulate matter emissions from these torches primarily result from carryover of noncombustible trace constituents in the fuel and particulate from the burning of steel. Based on a review of the previously listed information, no other control technologies for particulate abatement have been successfully implemented for small torches.

Torching operations are conducted plant wide both within large buildings and outdoors. Mostly the torching operations are intermittent at various locations where capturing these emissions is not practical. Torches utilized at the caster at a permanent location are located below a ventilation system where much of the emissions are captured and passed through the EAF baghouse which controls particulate emissions.

## **Control Options:**

A review of the similar sources did not indicate the application of add-on control alternatives for  $PM_{2.5}$  emissions from torches and lances.

## **Technological Feasibility:**

Due to the relatively small emissions from combustion, the application of add-on controls is considered infeasible.

## **Economic Feasibility:**

Additional controls are technically infeasible for the torches and lances. Therefore, an economic feasibility was not performed.

## **BACT Selection:**

Proper operation of the torches and lances constitute BACT for this emission source.

#### **Implementation Schedule:**

Proper operations are already in place.

#### Startup/Shutdown Considerations

There are no startup/shutdown operations to be considered for these sources.

## 2.1.7 Rolling Mill

#### **Description:**

Fumes in roll mill are associated with the hot steel rolling process. The steel is sprayed with water to reduce its temperature and minimize  $PM_{2.5}$  emissions. A high level of control is assumed due to continuous water spray and because the operation is contained within a building. Because oils are lost to the water and the water contacts hot steel, some VOC emissions result from the vaporization of the heavy oils.

The two roll mills, packaging, warehousing, and shipping cover a single roof in an open building of approximately 13 acres. The height averages approximately 30 feet. Some emissions occur from rolling operations. And some is from mobile equipment that is operated within the building. To meet ventilation requirements for safety, the roll mills have a ridge type vent over the rolling operations. The rest of the building is ventilated through open doorways.

## Pollutant [PM<sub>2.5</sub> and VOC]

PM<sub>2.5</sub> and VOC emissions from the roll mills are from vapors and vaporization of oils.

## **Control Options:**

Baghouse Scrubber

## **Technological Feasibility:**

To manage heat loads for proper working conditions, exposures to fumes and dust, etc. it is estimated that the proper air change rate of at least 50 air changes per hour. So, a baghouse would need to be sized for approximately 20,000,000 acfm. Because of the large area of the emission source within the building and the large volume of air to be evacuated, it is not practical to capture particulate and VOC emissions from the rolling operations.

## **Economic Feasibility:**

Additional controls are technically infeasible for the roll mills. Therefore, an economic feasibility was not performed.

## **BACT Selection:**

The best operational practices currently implemented and the current designs of the processes also represent the most stringent measure for the roll mills.

## **Implementation Schedule:**

Proper operations are already in place.

## Startup/Shutdown Considerations

There are no startup/shutdown operations to be considered for these sources.

## 2.1.8 Material Handling and Stockpiles

#### **Description:**

Scrap Steel handling can cause emissions of  $PM_{2.5}$  resulting from dirt and rust on the steel. Existing BACT controls are in place that consists of the following: direct from railcar; handled from covered truck dump; handled to and from stockpiles; and handled from uncovered truck dump.

Material handling consists of the following: Scrap steel handling; alloy/lime stockpiles (3-sided roofed bin); alloy handling railcar unloading NE (Water sprays); alloy handling railcar unloading melt shop belly dump (within building); small slag storage pile for truck bed lining (controlled by size); slag transfer to truck transfer below grade; and belly dump lime unloading at melt shop.

## Pollutant [PM<sub>2.5</sub>]

Stockpile or Handling Point	Potential PM <sub>2.5</sub> Emissions (tpy)
Scrap Stockpiles	0.11
Alloy Stockpiles	0.005
Lime Stockpiles	0.005
Alloy Railcar Unloading (2)	0.005
Slag Stockpiles	0.005
Slag Loading to Truck	0.01
Lime Unloading	0.02
EAF Dust Handling	0.005

## **Control Options:**

Buildings enclosing the stockpiles equipped with a baghouse Water sprays

## Scrap Steel Stockpiles

The scrap stock piles are the primary raw material for the product of Nucor. Scrap steel stockpiles are used to balance the non-steady delivery of scrap steel to feed the 24-hour operation of the meltshop. The area covered by scrap steel is about 15 acres, in individual stockpiles. These stockpiles are loaded and unloaded with large dump trucks, or by a crawler crane. Open ended buildings for rail access, truck access, and crane

access would be needed, thereby lowering the overall effectiveness of reducing dirt, dust and rust from accumulating. Given that the building or buildings would need to be 40 to 50 feet tall, cover 15 acres, and be open ended it can be concluded that utilizing buildings for scrap steel stockpiling would be infeasible because of the ineffectiveness of an open building for control of PM<sub>2.5</sub> emissions.

The majority of scrap processed by Nucor is not stockpiled but rather loaded directly to charge buckets from railcars, or dumped in a below grade pit. Further, emission controls are in place with water misting sprays utilized in the truck dump pit, and water soaking/spraying of scrap is completed for open stockpiles as necessary to meet the more stringent opacity regulations for fugitive emissions in the nonattainment area. These controls are already in place.

#### Slag Loading to a Truck

Slag is retrieved from within the meltshop building with a loader. The meltshop building is evacuated to the EAF baghouse, and the slag is at a very high temperature. The buoyant particulate emissions resulting from picking up the slag, do in part rise through openings in the meltshop building slag pit area to the EAF baghouse hood, which is directly above the furnaces/slag pit. The loader backs out of doorways in the meltshop building slag pit area to empty the bucket into a truck that is located below grade. The fact that the truck loading portion of the operation is below grade greatly minimizes emissions because of the minimized exposure to ambient winds. Slag loading emissions are already substantially controlled.

Slag that is processed outside is handled as an orange-hot material with specialty equipped loaders and large mine haul trucks. Enclosing this operation in a building would require large volumes of air to be evacuated through a baghouse to manage high heat loads that would exist. Adding a building with a baghouse to the outdoor portion of handling slag is not feasible.

#### Lime Unloading

Lime unloading is completed in a building which is an extension of the meltshop building. The meltshop building is evacuated to the EAF baghouse. These emissions are substantially controlled in this manner. Further, lime is received in either belly dump hopper railcars or trucks where the unloading process is to unload into a below-grade pit in the building. The lime is removed from the pit by an enclosed auger system. Emissions escaping to the atmosphere from normal lime delivery is minimal.

Infrequently, excess lime may be received where space is not available in the storage silos. This lime is placed on concrete surfaces with the belly dump trucks by opening the gates and driving forward so that a string of lime can be deposited. This method of unloading has very little emissions. The concrete surface is adjacent to the stockpile of lime that is enclosed in a roofed, three sided, storage bunker. Emissions from the storage bunker stockpile are greatly reduced because of the minimal exposure to wind. The

stockpile is loaded by moving the placed lime to the storage pile with a loader.

The majority of lime material handling emissions are controlled by a baghouse. Stockpile and associated handling emissions are managed in a manner where emissions are minimized and an added building with a baghouse is not warranted.

## **Technological Feasibility:**

All controls are technically feasible.

#### **Economic Feasibility:**

The best operational practices currently implemented and the current designs of the processes also represent the most stringent control for the material handling and stockpiles. Therefore, an economic feasibility was not performed.

## **BACT Selection:**

Unloading Scrap Steel

Processing a majority of scrap steel as it is unloaded, with backup piles to facilitate the continued EAF operation, is the process utilized by Nucor.

#### Furnace Slag Unloading

Emptying the furnace of slag is conducted inside the meltshop building with the meltshop being exhausted to the EAF baghouse.

Unloading of Lime

Unloading of lime in a building with the air being exhausted to the EAF baghouse and placing excess lime in storage bunker.

## **Implementation Schedule:**

Proper operations and controls are already in place.

## Startup/Shutdown Considerations

There are no startup/shutdown operations to be considered for these sources.

## 2.1.9 Paved/Unpaved Roads

#### **Description:**

The mill has paved and unpaved roads for the transportation of raw materials and slag, in addition to other miscellaneous vehicle travel. Nucor reduces PM2.5 emissions associated with vehicular traffic on paved roadways by periodically sweeping or water flushing. Permanent, heavy use, roads have been paved. 97% of the vehicle miles

traveled at the plant are on paved roads.

The  $PM_{2.5}$  emissions from vehicular traffic on unpaved roadways is reduced by water spray and/or chemical treatment .

## Pollutant [PM<sub>2.5</sub>]

#### **Control Options:**

Paved Roads – Sweeping or water spray Unpaved roads – Paving, water spray and/or chemical treatment

#### **Technological Feasibility:**

Unpaved roads that are not suitable for paving are the roads that have scrap steel delivery trucks traveling on the same surfaces that heavy tracked crawler cranes travel. Paved surfaces would immediately be torn up by the tracked equipment on these surfaces. Areas where both scrap steel and finished steel are stored frequently change location making paving infeasible.

#### **Economic Feasibility:**

All controls are currently being implemented. Therefore, an economic feasibility was not performed.

## **BACT Selection:**

All roads that are not used by heavy equipment, are currently paved, which is considered BACT for fugitive  $PM_{2.5}$  emissions from haul roads.

Using chemical treatment and water sprays on unpaved roads.

#### **Implementation Schedule:**

Proper operations and controls are already in place.

#### **Startup/Shutdown Considerations**

There are no startup/shutdown operations to be considered for these sources.

## 2.1.10 Cooling Towers

#### **Description:**

Nucor has the following cooling tower installations: roll mill contact (8,000 gpm); roll mill and melt shop non contact (4,600 gpm); DEC (10,000 gpm); and the caster system

(4,000 gpm). The cooling towers are equipped with drift mist eliminators that have a drift rate of 0.0006 percent, except for the DEC system which has a drift rate of 0.001 percent. The maximum PM emissions associated with the towers are 1.57 tpy and assumed all  $PM_{2.5}$ . PM emissions were calculated using the factor of 0.16 presented in the technical paper "Calculating Realistic  $PM_{10}$  Emissions from Cooling Towers" (Reisman and Frisbie).

## **Control Options:**

## PM<sub>2.5</sub> Emissions

 $PM_{2.5}$  emissions are generated as water evaporates from a cooling tower and small droplets of water become entrained in the air stream and are carried out as drift droplets. The drift droplets will often contain impurities from the water flowing through the system, so they are considered a type of emission (USEPA, 2015). These impurities are often from water treatment additives, such as anti-fouling or anti-corrosion additives, or from direct contact between the cooling water and the process fluid (Brady et al., 1998).

## **RBLC** and Technical Documents

The following control technologies were identified as available options for PM2.5 emissions from cooling towers:

- Use of dry cooling (no water circulation) heat exchanger units
- High efficiency drift eliminators
- Limitations on TDS in the circulating water

## Dry Cooling Towers

Dry cooling towers use fans to move dry ambient air through the towers and cool the process stream. Because these towers do not rely on the evaporation of water for heat transfer, they do not generate drift emissions (Baker et al., 2001).

## Drift Eliminators

High efficiency drift eliminators remove droplets before the air is discharged to the atmosphere. Drift eliminators are rated by the percentage of emissions from the cooling tower water circulation rate. The drift rates in the RBLC database range between 0.0005% and 0.02%; the majority of drift rates reported are under 0.001%.

## Limitations on TDS in Circulating Water

Dissolved solids in the circulating water increase in concentrations as the circulating water evaporates (USEPA, 2015). TDS can also occur as a result of the addition of anticorrosion or anti-biocide additives. A filtration system can be used to reduce TDS concentrations in circulating water (Reisman & Frisbie, 2002). Monitoring the TDS content in circulation water is an effective approach to ensure that excess emissions are not generated as a result of high TDS levels in circulation water. The TDS concentration limitations in the RBLC database range between 1,000 mg/L and 6,009 mg/L.

#### **VOC Emissions**

VOC emissions are caused when a VOC-containing process stream contaminates circulation water due to a leak in the system or if the circulation water is treated with VOC-containing material (TCEQ, 2003). VOC emissions from cooling towers are more likely to occur in petroleum refineries or chemical manufacturing

#### **RBLC** and Technical Documents

Identifying leaks by routinely monitoring VOC concentrations in circulation water was the only control technology identified as an available option for VOC control from cooling towers.

Elevated VOC concentrations can be an indication of leaks in the system. By routinely monitoring VOC concentrations in circulation water, leaks can be identified and repaired. The El Paso Method is commonly used to monitor VOC concentrations in circulation water (TCEQ, 2003). TCEQ established a VOC concentration of 0.08 ppmw for identifying a leak in the system. The RBLC database identified a VOC limit of 0.05 ppm.

#### **BACT Selection:**

Evaluation of Findings & Control Selection:

The cooling towers operating at major sources in the  $PM_{2.5}$  nonattainment area are equipped with drift eliminators with loss rates ranging from 0.2% to 0.0005%. Routine monitoring of TDS concentrations in circulating water is a common operating practice for these cooling towers.

DAQ has determined that BACT for PM2.5 emissions from cooling towers is drift eliminators combined with TDS limitations. A specific drift eliminator efficiency and TDS limitation is not specified in this BACT analysis as these limitations are dependent on the specific cooling tower design and the industrial process.

DAQ has determined that BACT for VOC emissions from cooling towers is implementation of a leak detection program, in accordance to an applicable Subpart and/or with the El Paso Method. This is only applicable to process streams that may contain VOC or if the circulated water is treated with VOC-containing materials.

#### 2.1.11 Emergency Generators and Pumps

#### **Description:**

Nucor operates diesel-fueled, gasoline powered, and natural gas fired generators. As emergency generators, they are seldom used with periodic maintenance firing and occasional use with loss of power. The majority are hand carry sized used to backup UPS systems for computers in the event of extended loss of power. Some larger generators are installed in stationary locations to handle critical operations such as emergency equipment or molten steel. All stationary generators meet the applicable requirements for generators contained in EPA's NESHAP or NSPS, which is BACT for generators. These federal regulations address NO<sub>x</sub>, organic emissions, and particulates.

The generator with the highest use, providing power to the data center/clinic, has been converted to natural gas. Permitting was completed with an Approval Order dated March 9, 2015. Previously, emergency power was supplied by a permitted diesel fired generator. This location is the most appropriate location for a change in the type of fuel fired because this generator is the most critical and frequently used. Power outages can cause critical loss of data and operating programs needed to operate the facility. Further, the clinic, supported by this generator, is important to address emergency considerations as well as the need for refrigeration of medical supplies kept at this clinic. For these reasons, this generator is used most frequently. The previous diesel generator that was used for the data center and clinic was relocated to a location where there would be limited use as a means of reducing emissions.

The second most frequently used emergency engine is the mold water pump (not a generator). This engine is also natural gas fired. Because the meltshop equipment utilizing cooling water is processing liquid steel, a loss of cooling can cause catastrophic equipment damage if cooling is lost. This pump is test fired as frequently as daily, though its run time is typically 1 minute or less.

Two other stationary diesel fired engines are also not generators, but emergency pumps. One ran approximately 100 hours and the other approximately 80 hours, in calendar year 2016 Replacing these low use engines in not cost effective. Emissions from these engines are addressed through RICE regulations, whether through NESHAP or NSPS, to allowed time of use and maintenance practices to minimize emissions. These regulations meet BACT requirements.

## **Control Options:**

Control Options for PM<sub>2.5</sub>:

- Catalyzed Diesel Particulate Filter (CleanAIR Systems, 2009)
- Diesel Oxidation Catalyst (CS, 2009)
- Diesel Particulate Filter (CS, 2009)

Control Options for NO<sub>x</sub>:

- Exhaust Gas Recirculation (CS, 2009)
- NOX Adsorber Catalyst (CS, 2009)
- Selective Catalytic Reduction (CS, 2009)
- Turbocharging and aftercooling (US EPA, 1993)
- Engine Ignition Timing Retardation (US EPA, 1993)
- Modifying air-to-fuel ratio (US EPA, 1993)

Control Options for SO<sub>2</sub>:

• Ultra-Low Sulfur Diesel Fuel (Bradley Nelson, 2010)
Control Options for VOC:

- Catalyzed Diesel Particulate Filter (CS, 2009)
- Diesel Oxidation Catalyst (CS, 2009)

# **BACT Selection:**

Evaluation of Findings & Control Selection:

Control Options for  $PM_{2.5}$ : The DAQ did not find any  $PM_{2.5}$  controls that were cost effective for controlling  $PM_{2.5}$  emissions. Therefore, BACT for direct  $PM_{2.5}$  emissions is proper maintenance and operation of the emergency stationary diesel engine.

Control Options for  $NO_x$ : The installation of a new emergency stationary diesel engine subject to the newest requirements for stationary emergency engines as specified in 40 CFR 60 Subpart IIII could potentially be cost effective and feasible for this source category, depending on a site-by-site analysis. This is assuming an old engine that is not currently subject to 40 CFR 60 Subpart IIII. This control selection is not applicable to newer engines. In the absence of replacing an old engine with a new engine, the installation of exhaust gas recirculation technology on older engines could be cost effective and feasible, again depending on a site-by-site basis of actual cost to retrofit the stationary emergency diesel engine on site. This control selection is assuming an old engine that is not currently subject to 40 CFR 60 Subpart IIII.

Control Options for  $SO_2$ : The DAQ recommends the use of ultra-low sulfur diesel fuel as BACT for  $SO_2$  control.

Control Options for VOC: The DAQ did not find any VOC controls that were cost effective for controlling VOC emissions. Depending on the age of the engine and site-specific information, a diesel oxidation catalyst could be cost effective for controlling VOC emissions. However, the DAQ does not recommend a diesel oxidation catalyst as BACT for this source category due to the fact this control option is probably not cost effective. Therefore, the DAQ recommends proper maintenance and operation of the emergency stationary diesel engine as BACT for control of VOC emissions. A site-specific cost/ton removed could be derived for making a determination on the requirement of installing a diesel oxidation catalyst.

# 2.1.12 Miscellaneous Painting

# **Description:**

# BACT Analysis for Miscellaneous Painting

Nucor has miscellaneous painting and solvent use. Painting is conducted plant wide on buildings, equipment, for safety markings, and to identify products. Present VOC emissions are included in plantwide permit limitations for the amounts that can be purchased or used. Typically, a BACT analysis for painting operations identifies that a paint booth with particulate filters is necessary to meet BACT. VOC emissions control is

not considered feasible, due to the small emissions levels from the miscellaneous painting. Because painting is conducted plant wide a specific paint booth with add-on control is not possible for miscellaneous painting operations. However, spray most painting is performed inside a building which greatly limits the PM emissions to the atmosphere. Similarly, miscellaneous solvent use is utilized plant wide. Miscellaneous solvent use is distinguished from the utilization of parts washers in that solvents are used at the location of the repair. The majority of these solvents used are in aerosol cans which are sprayed on the equipment part at the operating location where it may be repaired on-line or at a designated repair location. The equipment is typically too large to be placed in a parts washer with a closing lid.

# **Control Options:**

Paint booth with particulate filters Use of low VOC paint

# **Technological Feasibility:**

Because painting is conducted plant wide a specific paint booth with add-on control is not possible for miscellaneous painting operations.

# **Economic Feasibility:**

All remaining controls are economically feasible.

# **BACT Selection:**

Nucor does have a painting process at the operation for providing painted product to customers. This process was installed as a dip operation, instead of a spray operation, to minimize  $PM_{2.5}$  emissions. As part of the process, this painting operation is limited to the types of paint that can be used to limit VOC emissions. The rule is applicable in nonattainment areas and is 2.3 lbs/VOC per gallon of paint. Nucor utilizes a water based paint to comply with this rule. Compliance with this rule meets VOC BACT for painting used in a process. As a dip process is already installed no particulate emissions result where a BACT analysis is necessary.

# Implementation Schedule:

Proper operations and controls are already in place.

# Startup/Shutdown Considerations

There are no startup/shutdown operations to be considered for these sources.

#### 2.1.13 Sandblasting

#### **Description:**

Sandblasting can represent significant emissions of PM if substantial sandblasting is completed and the operations are uncontrolled. Nucor conducts sandblasting within a 3-sided building with a roof. Sand blasting is not part of Nucor's manufacturing process. Rather it is used for equipment maintenance or functionality. The amount of  $PM_{2.5}$  is very limited due to the small utilization and containment within buildings. Control is achieved by limiting air movement around the operations so that PM settles in the immediate area. Nucor's controls meet the sandblasting requirements contained in R307-206, UAC and BACT.

#### **Control Options:**

#### **RBLC** and Technical Documents

No control options were identified in the RBLC database. The following control options were identified from technical documents as potential controls for  $PM_{2.5}$  emissions from abrasive blasting:

#### Blast Enclosures Controlled By Baghouses

Enclosed abrasive blasting operations are conducted in a confined area designed to contain blast debris and restrict pollutants from being emitted to the atmosphere. Emissions are vented through a baghouse prior to being discharged to the atmosphere. This is a common control used in a variety of applications (USEPA, 1997a).

#### **Reclaim Systems**

Reclaim systems capture abrasive media and debris. The abrasive media in these systems can be reused. These systems are typically found in vacuum blasters. Vacuum blasters collect surface coatings and abrasive blasting materials with a capture and collection system surrounding the blast nozzle (USEPA, 1997a).

#### Drapes or Curtains

This control consists of drapes or curtains installed around the blast area to contain blasting media and debris. These curtains are available in a variety of materials (HDPE, polyester, or fabric) and can be installed in a variety of configurations. Drapes are relatively inexpensive but are not very effective. This technique is commonly applied to unconfined blasting operations or for large items (USEPA, 1997a).

# Water Curtains

Water curtains consist of a series of nozzles installed around the blasting area. Water is sprayed downward confining the blasting media and debris to the area enclosed by the nozzles and washing down the blasting media and debris to the ground. This technique is highly effective but consumes a lot of water. Furthermore, the water and washed out debris requires an additional clean-up or collection system (USEPA, 1997a).

#### Wet Blasting

Wet blasting systems use high pressure water alone or high pressure water combined with an abrasive media. Abrasive media typically used in wet blasting consists of materials that will remain suspended in water, such as glass beads or sand (USEPA, 1997a).

#### Use of Low Dust Abrasives

Low dust abrasives include coal slag, copper slag, nickel slag, steel grit, steel shot, or other media with a free silica content of less than 1.0%.

#### **BACT Selection:**

The majority of blasting operations conducted at major sources in the  $PM_{2.5}$  nonattainment area are enclosed and controlled by a baghouse.

BACT for  $PM_{2.5}$  emissions from abrasive blasting operations is to conduct blasting in an enclosed area controlled by a baghouse. BACT for baghouses is discussed in Section 3.

Unconfined abrasive blasting operations may only be conducted if the item to be blasted exceeds 8 feet in any dimension or the surface being blasted is situated at its permanent location. Unconfined abrasive blasting must be conducted using wet abrasive blasting, blasting with reclaim systems, or the abrasives defined in R307-306-6(2).

#### 2.1.14 Volatile Organic Storage Tanks

#### **Description:**

There are 2 diesel storage tanks and one gasoline storage tank. Emissions associated with these tanks are calculated with the USEPA TANKS program. These tanks are equipped with pressure relief devices to reduce breathing losses. VOC emissions are very small. Due to the small emissions associated with the filling and evaporative losses due to these tanks, no further control is necessary to meet BACT.

#### **Control Options:**

#### Fuel Oil

- Submerged Fill Pipes
- Vapor Control System

#### Gasoline

- Stage I Vapor Recovery
- Stage II Vapor Recovery

# **BACT Selection:**

Evaluation of Findings & Control Selection:

Due to the minimal emissions associated with fuel oil storage tanks the only option that is feasible would be the use of submerged fill pipes. This is considered to be BACT for controlling fuel oil storage tanks less than 30,000 gallons.

Stage I recovery systems are both economically and technically feasible to implement for controlling VOC emissions from gasoline fueling operations. Due to the truck maintenance required to keep them in working order to pass either a MACT or NSPS level vacuum test, this testing is not economically feasible. A 70% control efficiency is still achievable with no testing and was selected as BACT for sources that have gasoline fueling operations.

Stage II recovery systems are not economically feasible.

# 2.1.15 Solvent Cleaning

#### **Description:**

Solvent degreasers are used to remove various contaminants from pieces of equipment. Solvent degreasing is the physical process of using an organic or inorganic solvent to remove tars, greases, fats, oils, waxes, or soil from metal, plastic, printed circuit boards, or other surfaces. This cleaning is typically done prior to such processes as painting, plating, heat treating, and machining, or as part of maintenance operations. The solvent containers can be horizontal or vertical. The solvent may be agitated. Agitation increases the cleaning efficiency of the solvent. Agitation can be used with pumping, compressed air, vertical motion, or ultrasonics.

# **Control Options:**

- Carbon adsorption
- Refrigerated primary condensers
- Increased freeboard ratio
- Combination of covers
- Water covers
- Internal Draining Rack
- Spray hose/spray nozzle
- Reduced room drafts
- Selected operation and maintenance practices

# **BACT Selection:**

Compliance with the requirements of R307-335 is considered BACT for solvent degreasers.

# 2.1.16 Vacuum Ladle Degasser

#### **Description:**

Nucor has permitted, but not yet installed, a vacuum ladle degasser that will process the molten steel in the melt shop. The vacuum degasser will be limited to 100,000 tons/year and approximately 1,500 hours/year. The exhaust gas will be ducted to a flare.

# Pollutant [NO<sub>x</sub>, PM<sub>2.5</sub>, SOo<sub>2</sub> and VOC]

BACT Control of Oxides of Nitrogen (NO<sub>x</sub>) Emissions

 $NO_x$  emissions from the vacuum degasser result from the degassing of the liquid steel and due to combustion by-product of the fuel in the flare (used for CO emissions control).

This equipment is included in the permit, but has not yet been installed. The vacuum ladle degasser included in the permit was selected because of the reduced emissions over the commonly found alternative. Many degassers installed at similar type steel manufacturing plants utilize a boiler to create a vacuum. The permitted degasser included in the permit is a mechanical type where vacuum is created without the combustion of fuels. The equipment selected represents emission reduction technology available for vacuum degassers.

#### **Control Options:**

Using a boiler to create a vacuum Using a Mechanical degasser to create a vacuum

#### **Technological Feasibility:**

All controls are technically feasible

# **Economic Feasibility:**

All controls are economically feasible.

# **BACT Selection:**

Use of a mechanical degasser to create a vacuum creates less emissions. Therefore, the mechanical degasser meets BACT.

#### **Implementation Schedule:**

The ladle degasser with the mechanical vacuum system would be implemented after December 2018.

# Startup/Shutdown Considerations

There are no startup/shutdown operations to be considered for the degasser.

#### 2.1.17 Roll Mill

#### **Description:**

Fumes in roll mill are associated with the hot steel rolling process. The steel is spray with water to reduce its temperature and minimize  $PM_{2.5}$  emissions.

Because of the large area of the emission source within the building and the large volume of air to be evacuated, it is not practical to capture particulate and VOC emissions from the rolling operations to meet BACT.

#### Pollutant [VOC]

A high level of control is assumed (99.9%) due to continuous water spray and because the operation is contained within a building. Because oils are lost to the water and the water contacts hot steel, some VOC emissions result from the vaporization of the heavy oils. These VOC emissions are addressed through a mass balance quantification methods by studies conducted by Nucor Corporation.

#### **Control Options:**

Using a boiler to create a vacuum Using a Mechanical degasser to create a vacuum

#### **Technological Feasibility:**

Because of the large area of the emission source within the building and the large volume of air to be evacuated, it is not practical to capture particulate and VOC emissions from the rolling operations to meet BACT. All controls are technically infeasible

#### **Economic Feasibility:**

All technically feasible controls are currently being implemented. Therefore, an economic feasibility was not performed.

#### **BACT Selection:**

Use of low VOC paint.

#### **Implementation Schedule:**

The used of low VOC paint is already being implemented.

# Startup/Shutdown Considerations

There are no startup/shutdown operations to be considered for the Roll Mill.

# 2.1.18 Abrasive Saw Baghouse, Roll Mill #1 Baghouse, Jump Mill Baghouse

# **Description:**

Baghouses are used at a source to control particulate emissions. Pollutant laden air is forced through a chamber containing fabric filters (bags), which capture and remove particulates. Baghouses contain groups of fabric bags. The porous openings in the fabric bags allow air to flow through the bags but prevent particulate matter from passing through the bags. Systems also include a collection hopper that stores collected dust until the dust can be removed ("EPA-CICA Fact Sheet- Fabric Filters"). The number of bags in a baghouse is dependent on size, airflow (cfm), and air-to-cloth ratio design requirements.

Baghouse operations are dependent on the air pressure through the system; therefore, pressure drop parameters are monitored to ensure proper airflow. As the pressure moves out of the designated range, the bags are cleaned in one of two ways. Reverse-air baghouses use a reverse airflow to push captured particulates into a collection system. Pulsejet baghouses target individual bags within the baghouse with pulsed air to clean individual bags("APTI: Baghouse Plan Review," 1982).

Baghouses are used as a control device for multiple applications across many industries. State and federal regulations for baghouses are dependent on the type of operations controlled. Specific requirements are dependent on the federal and state applicability to these operations. For example, 40 CFR 63 subpart X, §63.548, specifies requirements for baghouses controlling lead smelting. The subpart requires best practices, including a source baghouse leak procedure. The procedures for these sources include daily pressure gauge inspections, weekly visual inspections of the dust collection hoppers, and quarterly inspections of the physical integrity of the bags and fans ("40 CFR 63.548").

# Pollutant [PM<sub>2.5</sub>]

# BACT Control of PM2.5 Emissions

Baghouses are considered a control for multiple source categories. There are no federal or state requirements that regulate baghouse selection or filter type. Typically, baghouse filters are rated with a control efficiency of 99%. Therefore, one percent of a source's emissions are vented into ambient air.

# **Control Options:**

Potential controls for the emitted particulates include using a more efficient filter in the baghouse. While fabric filters are typically rated at 99% efficiency, newer filters are available with a rating at 99.9% ("San Joaquin SIP," 2015,"PTFE Membrane Baghouse Filters," 2017).

# **Technological Feasibility:**

Replacing bags after wear and tear or at the end of a bag's lifespan is the normal procedure for a baghouse. Baghouse filters have a manufacturer recommended replacement date. In addition, filters may require replacement for potential operating failures. The replacement of polyester bags with high efficiency bags can be implemented during this change. However, based on phone conversations in July of 2017 with the company U.S. Air Filtration, Inc. (U.S Air) and Utah sources, different systems have different operational needs. According to U.S. Air, high efficiency filters such as PTFE bags operate with a different air-to-cloth ratio than the traditional system setups. Because of this difference, a greater differential pressure is present with high efficiency bags. U.S. Air, a company that specializes in filter setups, notes that these bags cannot operate within systems already designed to operate under high pressure.

# **Economic Feasibility:**

All controls are economically feasible.

# **BACT Selection:**

The use of 99.9% efficient filters is more efficient than the 99% fabric filters in controlling PM emissions. Proper maintenance and operation ensures that the baghouse is meeting the intended efficiency controls.

In some cases, using a more efficient filter is a cost effective, technically feasible control option that reduces particulate emissions. The higher efficiency filter bags require no additional operational or maintenance changes. The increased efficiency bags will reduce emissions and are considered BACT for this operation.

However, there are other operations where a higher efficiency bag is not technically feasible and/or cost effective.

Each site must evaluate the feasibility based on operation type and design.

In all operations, to ensure control efficiencies, operators must follow manufacturer recommended operation and maintenance. This includes monitoring and maintaining the pressure drop across filter bags, cleaning the filters, and replacing the filters as needed. This is considered standard practice for baghouse operations. (State of New Jersey Department of Environmental Protection, 2011).

In 40 CRF 63 Subpart X, §63.548, best practices include the development of a source baghouse leak procedure. The procedure includes daily pressure gauge inspections, weekly visual inspections of the dust collection hoppers, and quarterly inspections of the physical integrity of the bags and fans ("40 CFR 63.548"). This procedure could be implemented to all source categories using baghouses for controls.

#### **Implementation Schedule:**

The use of baghouses is already being implemented..

#### Startup/Shutdown Considerations

There are no startup/shutdown operations to be considered for the baghouse.

#### 2.2 Consideration of Ammonia

The only source of ammonia emissions (Douglas Jones, 2018b) at the Nucor site is from the combustion of natural gas. The unreacted ammonia can be treated as a  $PM_{2.5}$  precursor. Although currently not being considered as a precursor pollutant in Utah's  $PM_{2.5}$  Serious SIP, the source's BACT analysis did include an analysis of BACT for ammonia emissions, which is being included here for completeness.

#### **Control Options:**

Good combustion practices are the only control technology for minimizing NH<sub>3</sub> emissions from heaters.

# **Technological Feasibility:**

All identified control technologies are technically feasible.

#### **Economic Feasibility:**

All control technologies are economically feasible.

# **BACT Selection:**

The technology identified for controlling  $NH_3$  emissions from the ovens and heaters is the use of pipeline quality natural gas and good combustion practices.

# **Implementation Schedule:**

Proper operations are already in place.

#### **Startup/Shutdown Considerations**

There are no startup/shutdown operations to be considered for these sources.

#### 3.0 Conclusion- Emissions Reduction through BACT implementation

The existing controls at the Nucor Steel site are recommended to meet the requirements of BACT, therefore, there are no further emission reductions.

#### 4.0 Implementation Schedule and Testing Requirements

The controls at the Nucor Steel site have already been implemented and the testing requirements are outlined in Section 5.0 below.

#### 5.0 PM<sub>2.5</sub> SIP – Nucor Steel Specific Requirements

The Nucor Steel specific conditions in Section IX.H.12.m address those limitations and requirements that apply only to the Nucor smelter in particular.

- m. Nucor Steel Mills
  - i. Emissions to the atmosphere from the indicated emission points shall not exceed the following rates:
    - A. Electric Arc Furnace Baghouse
      - I. PM<sub>2.5</sub>
        - 1. 17.4 lbs/hr (24 hr. average filterable)
        - 2. 29.53 lbs/hr (condensable)
      - II. SO<sub>2</sub>
        - 1. 93.98 lbs/hr (3 hr. rolling average)
        - 2. 89.0 lbs/hr (daily average)
      - III. NO<sub>x</sub> 59.5 lbs/hr (calendar-day average)
      - IV. VOC 22.20 lbs/hr
    - B. Reheat Furnace #1 NO<sub>x</sub> 15.0 lb/hr
    - C. Reheat Furnace #2

NO<sub>x</sub> 8.0 lb/hr

ii. Stack testing to show compliance with the emissions limitations of Condition (i) above shall be performed as outlined in IX.H.11.e and as specified below:

	EMISSION POINT	POLLUTANT	TEST FREQUENCY
A.	Electric Arc Furnace Baghouse	PM <sub>2.5</sub> SO <sub>2</sub> NO <sub>x</sub> VOC	every year CEM CEM every year
B.	Reheat Furnace #1	NO <sub>x</sub>	every year
C.	Reheat Furnace #2	NO <sub>x</sub>	every year

- iii. Testing Status (To be applied to (i) and (ii) above)
  - A. To demonstrate compliance with the Electric Arc Furnace stack mass emissions limits for  $SO_2$  and  $NO_x$  of Condition (i)(A) above, Nucor shall calibrate, maintain and operate the measurement systems for continuously monitoring for  $SO_2$  and  $NO_x$  concentrations and stack gas volumetric flow rates in the Electric Arc Furnace stack. Such measurement systems shall meet the requirements of R307-170.
  - B. For  $PM_{2.5}$  testing, 40 CFR 60, Appendix A, Method 5D, or another EPA approved method acceptable to the Director, shall be used to determine total TSP emissions. If TSP emissions are below the  $PM_{2.5}$  limit, that will constitute compliance with the  $PM_{2.5}$  limit. If TSP emissions are not below the  $PM_{2.5}$  limit, the owner/operator shall retest using EPA approved methods specified for PM2.5 testing, within 120 days.
  - C. Startup/shutdown NO<sub>x</sub> and SO<sub>2</sub> emissions are monitored by CEMS.

#### 6.0 References

Douglas Jones. (2017, March 27). BACM/BACT Response Nucor Steel Utah.

Douglas Jones. (2018a, February 13). Further Response - Serious Nonattainment BACT.

Douglas Jones. (2018b, April 12). Nucor Steel Ammonia Emissions.

Environmental Protection, & Agency. (2005, February 22). Standards of Performance for Steel

Plants: Electric Arc Furnaces and Argon-Oxygen Decarburization Vessels Constructed

After August 17, 1983.

PM2.5 Serious SIP – BACT for Small Sources. (2017, August 11). Utah DAQ Minor Source NSR.



PLYMOUTH DIVISION

UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY

JUN 2 1 2017

DIVISION OF AIR QUALITY

June 16, 2017

Bryce Bird –Director Utah Division of Air Quality P.O. Box 144820 Salt Lake City, Utah 84114-4820

Attn: Nando Meli

Re: BACM/BACT Supplemental Response Nucor Steel Utah

Dear Mr. Bird:

Enclosed is Nucor's response to Nando Meli's emailed questions sent earlier this month. The questions we received are identified in **bold** text. Our response to each question immediately follows.

If you need any further information please do not hesitate to contact me at 435-458-2415.

Sincerel **Douglas** Jones

Environmental Manager Nucor Steel Utah, Kingman Arizona

attachment

#### Nucor BACT Response

#### <u>EAF</u>

# According to the BACT analysis, oxyfuel burners is the only technically feasible option for controlling NOx from the EAFs. Are oxy-fuel burners in use at both EAFs at Plymouth? They are not identified for the EAFs at Nucor?

Each of the two Arc Furnaces are equipped with oxy fuel burners. They are already specifically required by the permits. "*Two carbon electrode furnaces, equipped with natural gas oxy-fuel fired burners and oxygen lances*"

Oxy fuel burners are known to decrease NOx emissions because using oxygen instead of air eliminates the nitrogen that is carried along with the needed oxygen in air. Much of that nitrogen in air burners would be converted to NOx with the high firing temperatures. By using purchased oxygen, that portion of nitrogen is eliminated.

This emission reduction equipment is being utilized.

#### **Caster and Caster Steam Vent**

#### Why can't a baghouse be used for the vent?

The caster steam vent is a forced air evacuation of the caster spray chamber. The caster spray chamber is a large box where billets exit the caster molds. In the mold, the surface of the steel is cooled enough to be a solid, with liquid remaining inside the billet as it exits. In the spray chamber, water is sprayed on the billets to further cool them so that the liquid steel inside the billet is cooled enough to also solidify, so that by the time the billet reaches the torch tables, the entire billet is a solid so that it may be cut to length.

While the purpose of the spray chamber is for cooling of billets, it is essentially a wet scrubber. The nozzles for the water spray make water cone shaped patterns of water droplets to evenly distribute for needed cooling. These sprays, through contact with the billet, remove particulate (oxidizing steel or scale) that forms on the surface of the billets at their high temperatures. Further, the droplets present in the spray chamber box capture airborne particulates in the box. The water from the spray system falling through the chamber carry this particulate into the circulating water system, where the particulates are removed first through settling basins then through the use of sand filters.

The spray chamber functions as a wet scrubber. Wet scrubbers are an emission control device. Therefore the caster steam vent is exhaust from an emission control device.

Further add-on emission control with a fabric filter cannot be achieved. Very high temperatures exist near hot billets so that some water exists as a gas at those areas, but much of the temperatures within the chamber is below the boiling point of water, as is needed to achieve cooling. The chamber is evacuated by fans and the temperature of the exhaust is below water boiling temperature causing any steam to condense as a fine water droplet. The exhaust from the caster steam vent contains condensed water vapor. A noticeable condensed water vapor plume exists much of the time (winter and nighttime year round for example). Fabric filters would immediately plug when moisture is present.

Particulate emission control exists for the caster steam vent. Further add on control is not feasible.

#### **Caster Area Roof Emissions**

#### Can a collection system be installed to capture the fugitive emissions?

The caster area is equipped with emission controls. This change was made many years ago. The original Moffit brand ventilator originally serviced the caster area for the purposes of reducing heat loads in the area of the west side of the meltshop. This ventilator also allowed some smoke to exit directly above the caster. A project was undertaken to duct both the heat and smoke to the EAF baghouse. The exit openings of the ventilator were blocked. Dual 48" ducts were installed with fans that move approximately 80,000 acfm that lead from the blocked ventilator to the furnace EAF furnace penthouse, which is evacuated to the EAF baghouse. The old ventilator serves as both a high-temperature-air reservoir being the highest point (smoke is most associated with high temperature air) as well as a large collection duct for the evacuation system that finally discharges through the stack of the EAF baghouse.

Nucor continues to use the same emission factor for caster area roof emissions as was previously used prior to the installation of the caster area capture and evacuation system. Potential to emit calculations are not modified. Quantification of caster area roof emissions have been based on a representative factor that has been expected to be the most reasonably available factor, and while emissions are majority captured and controlled with the system in place, fugitive emissions of particulate, to a lesser extent, still exist. These emissions may exit through other openings such (doorways, crane access openings, and sheeting gaps) Nucor has not quantified and taken credit for the reduction in the PSD permit applications submitted since the capture system was installed. There is no apparent practical method of quantifying the original emissions, let alone the amount captured by the system which is in place.

#### Reheat furnace

#### Is it not economical or technically infeasible to install Ultra LNB on the reheat furnaces?

The amount of NOx emissions from reheat furnaces is dependent on the overall design of the furnace itself. Reheat furnaces can be over fired, side fired, and end fired, and usually consist of a combination of burner placements. Both the type of burner design and the general size of the furnace itself are factors in determining what can be achieved, with other factors considered. Not all NOx in a furnace is generated at the burner itself. The high temperature environment of the furnace, the presence of tramp air introduced through exits and entrances, as well as excess air for burner combustion, all contribute to NOx formation. NOx is formed in most areas of the furnace. Billets in the furnace are typically heated to near 2000 degrees Fahrenheit for an appropriate rolling temperature, requiring the atmosphere in the furnace to be at a much hotter temperature. NOx begins to form at temperatures of 1800 degrees Fahrenheit. Because of this, even if <u>NO</u> NOx burners could be used (ex. electric heating elements with fuel combustion emissions from electricity generation occurring somewhere else besides the site where heating is needed), NOx emissions would still exist because of the conversion of nitrogen in air at the high temperatures. Because of the final temperature of the product needed, the consideration of NOx emissions (lb/mmBtu or ppmv) is considerably different than a home water heater, for example. Reheat furnaces have NOx emissions associated with the furnace, not specifically the burners used.

One major factor that must be considered is burner impingement on the product being heated. Because of quality issues and production issues, burner impingement must be avoided. Lowered NOx burners achieve high peak flame temperatures through either staged air or staged fuel combustion, resulting in a longer flame with lower peak temperatures with nearly the same total heat provided. Because impingement must be avoided, and a longer flame is associated with Low NOx burners, greater space is required between the burner and the product. Greater space means a larger furnace with more free space. A larger furnace means less efficiency, because a greater space exists and heat is lost through the walls of

the furnace. It can be compensated for with greater fuel consumption, but increasing the volume of gas consumed only for being able to claim less NOx per unit volume can be somewhat counterproductive to the overall goal. In addition, it contributes to the consumption of natural resources, and increases all the emissions associated with producing the additional fuel and transporting the additional fuel to the site.

Recently designed furnaces can be engineered for modern day lower NOx emission burners to reduce NOx by considering burner placement to avoid impingement even with a longer flame. The burners can be placed preferentially in the sides to avoid impingement rather than the top while minimizing free space with efficiency consideration in mind. However, to achieve the necessary even heating, it is often found necessary to place burners in areas where a longer flame cannot be used. Retrofitting older designed furnaces that utilized standard burners is considerably more difficult. Being able to install different Low NOx designed burners, and their associated burner block in locations where a standard burner was previously installed can be a retrofit that may not be able to be achieved, even if the use of the Low NOx burner at that location wouldn't cause impingement issues.

In addition, newer furnaces are likely to be "Pusher" type furnaces, with a solid hearth where billets are skidded across the bottom solid hearth from the entry to the exit. Older furnaces are likely to be walking hearth or walking beam furnaces where portions of the bottom of the furnace first raise, then move forward, then lower to the hearth again. to "walk" the billets through the furnace. These walking furnaces tend to be less efficient because gaps in the hearth are necessary, which lose heat as well as allow additional tramp air (with nitrogen) to enter the furnace, contributing to further NOx emissions.

For these reasons, a retrofit furnace with the intent of Lower NOx emissions, vs. a new furnace can be expected to have different NOx performance characteristics, all things considered.

Nucor has a newer pusher type furnace in one mill designed for reduced NOx burners. This furnace was installed for the purpose of lowering NOx emissions by replacing a furnace that had a higher NOx emission rate. The permitted NOx emission rate of this furnace is a lbs/hr rate based on 0.07 lb/mmBtu.

The second reheat furnace utilized is a walking type furnace which has been modified to lower NOx emissions. The modification included installing a new raised roof to accommodate longer flame and differently designed burners so that impingement issues would not occur. As a retrofit of an older furnace this furnace is permitted at a lbs/hr rate based on a NOx rate of 0.09 lb/mmBtu.

Both furnaces have had, or will have during the remainder of 2017, some replacement burners installed that are rated at 0.05 lb/mmBtu. Less than the majority of the total furnace burners of each furnace will be replaced with these burners. That, plus the fact that not all NOx created by a furnace is the result of burner operation itself, may not result in an emission change that can be measured. However, a NOx emission reduction has or will occur during calendar year 2017.

#### Does consent decree outline the reason why ULNB cannot be installed?

The term Ultra Low NOx Burners seems to be a term that is applied to anything that achieves a lower emission rate than what was previously considered Low NOx.

The most common reference document for emission permitting emission calculations, EPA's AP-42, quantify emission rate Low NOx burners (as well as uncontrolled and FGR controlled) for Large Wall Fired Boilers greater than 100 mmBTU. This factor is most representative of reheat furnaces because both of Nucor's reheat furnaces are greater than 100 mmBTU/hr. It should be noted here, as was discussed in the section above, there are other types of external combustion sources described in this document with much different emission rates also described as resulting from the use of Low NOx

burners. This difference in emissions between equipment (of smaller size) with the same technology demonstrates that Low NOx burners achieve vastly different emission rates utilizing Low NOx burners. For large units, AP-42, Table 1.4-1, describes Low NOx burners as achieving the following:

Low NOx Burners	140 lb/mmscf.
Converted to lb/mmBtu	0.137
Approximate PPMV Conversion	113 ppmv

Nucor's permitted NOx emission rates (lbs/hr) are based on the as following performance NOx Emission rates with burners designed for reduced NOx

Reheat Furnace 1	
0.09 lb/mmBtu	
Converted to lb/MMscf	91.8
Converted to ppmv	74
Reheat Furnace 2	
0.07 lb/mmBtu	
Converted to lb/mmscf	71.4
Converted to ppmv	58

The permitted NOx emission rate for Reheat Furnace 1, and Reheat Furnace 2, is 65% and 51%, respectively, of the emissions defined by that achieved by Low NOx burners. The permitted rates for these furnaces should be considered "Ultra Low NOx" demonstrated by this analysis alone.

To conduct further research, during the month of June, 2017, Nucor conducted a new review of the RACT/BACT clearinghouse. With the search of steel manufacturing, three reheat furnaces could be identified. One identified a reheat furnace installation of <u>Ultra</u> Low NOx burners with a permitted rate of 0.07 lb/mmscf. We anticipate that there is a typo and that the correct unit should be lb/mmBtu. A second installation also referenced <u>Ultra</u> Low NOx burners at 0.07 lb/mmBtu. The third and last comparable installation in this search found an installation with <u>Ultra</u> Low NOx Burners with a rate of 0.10 lb/mmBTU. The information for these three facilities is attached.

Both of Nucor's reheat furnaces are within the range of what is a defined emission rate of <u>Ultra</u> Low NOx burners for reheat furnaces in the RBLC clearinghouse, including the retrofit furnace which can be expected to have higer emissions. Nucor's furnaces are already permitted to not exceed emission rates of this performance standard.

The Nucor-EPA consent decree defined a performance standard for NOx, rather than the term of Ultra Low NOx. The performance standard meets what has been found with other Ultra Low NOx installations. To clarify further, the Consent Decree did not define the technology to use to achieve the performance, whether it be FGR, SCR, or burner technology. It was found by Nucor that alternative

controls to reduced NOx burners was not feasible and that selecting burners for both the new and retrofit furnaces was the best and maybe the only option to meet the NOx performance standard..

#### Preheaters and Dryers

#### Can ULNB be installed on the preheaters and dryers?

Nucor has addressed all emissions from all activities taking place in the meltshop building through the BACT analysis for the EAF baghouse. The meltshop building is evacuated to this baghouse. Activities conducted within the building are mostly captured through large overhead hoods, both, over the caster at the west end and the penthouse, and, over the EAF's near the east end of the building. While Nucor has anticipated and accounted for some fugitive emissions escaping the building, the estimated capture efficiency is 97%. Particulates from meltshop activities are controlled by the baghouse, and gaseous emissions are a pass through. All gaseous emissions exiting the stack of the baghouse are continuously measured by CEMS.

The ladle walls are located within the meltshop between the caster and the furnaces. Tundish dryers are located west and near the caster. NOx emissions are therefore primarily passed through the EAF baghouse and included in measurements by the CEMS.

The previous BACT exercises completed by Nucor have addressed the meltshop NOx emissions from the baghouse for all pollutants, including NOx generated from the ladle heaters and tundish dryers. The permit limit established has addressed these emissions as a BACT limit.

There is no data available regarding NOx emissions for the existing burners in 5 of the ladle walls. The 6<sup>th</sup> ladle dryer was added and permitted individually, requiring BACT, at that time. The NOx emission rate for this burner when permitted was identified by the manufacturer at 0.077 lb/mmBtu as an achievable emission rate for a burner in this application.

A serious nonattainment area requires that BACT be addressed. The RACT/BACT/LAER Clearinghouse was searched to determine what other facilities have determined to be BACT for NOx for Ladle heaters and dryers. The results are as follows:

Location	<u>Unit</u>		Emission Rate	Comment
Consteellium	eel	Ladle Preheat	0.05 lb/mmBTU	Dual Unit – BACT
Mid American Ste		Heater/Dryer	0.10 lb/mmBtu	Unspecified number of units - BACT
Gerdau Ameristee		Ladle Dryers	0.10 lb/mmBtu	3 separate listings, 6 units total - BACT

A copy of the RACT/BACT/LAER Clearinghouse information is attached.

The identified emission rate for the recently added burner is lower than the multiple heaters/dryers found in the Clearinghouse, and in the middle of the range found for all listings. The burner meets BACT by this comparison. In addition, all activities in the meltshop meet BACT by the existing emission limits for the EAF baghouse.

#### Not economically or technically feasible to install SCR?

Most of the ladle heating stations are located in the open areas of the meltshop building. The emissions from natural gas combustion are verned freely from the ladle into the indoor air. Ladles are placed at the stations with an overhead crane. Crane travel with loads pass over these ladle heating stations. These

heating stations are horizontal, meaning the ladles are tipped on their sides by the cranes for proper placement in the stations.

Because SCR requires a stack, (as well as other exhaust gas treatment methods), individual stacks or a combined stack on this equipment is not feasible because of the interference it would cause with overhead crane use.

One station is used a refractory curing station. For this installation, a lid has been designed which ducts the emissions high indoors.

#### Not economically or technically feasible to install baghouse for PM control?

As discussed above, PM from ladle heaters and dryers is controlled with a baghouse. These units are located within the meltshop, Ducts and hoods capture PM emissions from all activities and pass them through the EAF baghouse.

#### Heat Retention Boxes Can ULNB be installed?

This equipment has not yet been installed.

Reduced NOx burners were proposed in the permit application for this equipment at a rate of 50 lb/mmscf of gas (0.049 lb/mmBtu) This is a specification that is a lower NOx rate than standard Low NOx burners typically cited as 0.07 lb/mm/Btu, and therefore can be described as Ultra Low NOx. The permit issued for these burners met LAER requirements for new equipment. Emissions from heat retention boxes has been correctly addressed for SIP purposes (needing BACT).

#### **Rolling Mill**

#### Capture system technically or economically infeasible?

The two roll mills, packaging, warehousing, and shipping cover a single roof open building of approximately 13 acres. The height averages approximately 30 feet. Some emissions occur from rolling operations. Mobile equipment is operated within the building. To meet ventilation requirements, the roll mills have a ridge type vent over the rolling operations. The rest of the building is ventilated through open doorways.

To manage heat loads for proper working conditions, exposures to fumes and dust, etc. it is estimated that the proper air change rate of at least 50 air changes per hour. So, a baghouse would need to be sized for approximately 20,000,000 acfm. Using a standard baghouse purchase estimate of \$25 per cfm, the capital investment would need to be approximately \$480 MM. Assuming a life of 12 years it is \$40 MM per year. Our energy cost to operate our existing 1,000,000 CFM EAF baghouse is \$250/hr. Scaling it up for a baghouse of this size, would be \$5000/hr or approximately \$40 MM/yr. Our operation and maintenance cost for the baghouse we operate for the EAF is estimated as equal to the energy cost. If that were the case for this baghouse, another \$40 MM/year. Total cost per year approximately \$120 MM. We have estimated that total emissions from the Roll Mill are 8 tons per year for PM10, and 10% of that is PM2.5. The rough cost analysis here for PM 2.5 is in excess \$120 MM/per ton of removal.

Certainly this analysis could be refined and cost reduced greatly. However, no further detailed analysis is necessary because of the extreme cost per ton of removal that would be found. Further, controlling the 0.8 tpy emissions to something less, alone, would cause any business to not be profitable (not exist). Any calculations for a baghouse at even the best baghouse emission rates would show a substantial emission

increase (ex. 20 MM cfm, 0.005 grains/scf,, 8000 hrs per year calculates to over 700,000 tpy emissions, even with less than 1 ton being introduced to the baghouse). It could not be permitted.

A better method than a baghouse for the entire building is localized baghouses with hoods over points with highest visible emissions. Not all stands or other processes have equal emissions. Nucor has addressed these specific points in the last permitting exercise. An abrasive saw baghouse is operational. A jump mill baghouse was permitted but has not been installed to vent outdoors. A trial baghouse for the jumpmill that vents indoors has been installed with some limited success. Emissions are already substantially controlled with water sprays at the emission points. Unfortunately, because of the way emissions are calculated for baghouses, calculations show the baghouse increases emissions, rather than control them. Nucor's potential to emit calculations for these baghouse already permitted show an emission rate of approximately 3 tons per year of PM10 and PM 2.5. In the case of PM 2.5, this is higher than the estimate of the entire two roll lines put together, even though these baghouses control emissions from two specific points in the mill.

#### Roll Mill 1 Saw Shack Baghouse Can the filter medium be upgraded?

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Attached is the test report for the bags purchased for the RM Saw Shack baghouse. This particular baghouse has proven to be a difficult baghouse to operate. The material captured from the abrasive saw operation is itself highly abrasive. The bags used need to be very durable as with the bag type being used. Membrane type bags, with membranes being fragile, do not perform with the material being captured.

Even the bags being used now cause considerable downtime. Nucor has installed a broken bag alarm system on this baghouse. With this system, increased levels of particulates sensed passing the stack cause an audible/visual alarm. The alarm is set at a point approximately equal to when slightly visible emissions start to occur. The alarm causes the operators to shutdown to repair the bags. The frequency is excessive, causing considerable downtime in the mills. Nucor has been actively seeking a more durable bag that meets the emission rates contained in the permit application, without success to date. Utilizing a more efficient bag such as a membrane bag would only compound the problem.

#### Roll Mill 1 Jump Mill Baghouse Can the filter medium be upgraded?

This baghouse has not been installed. As described above, trials have proven to have limited success. A future installation may occur if we find one can be successfully operated.

#### <u>Storage Silos</u>

#### Can the filter medium be upgraded?

The baghouses or silo vents utilized for the carbon and lime silos were permitted at rates meeting BACT at a rate of 0.01 grains/dscf. Attached is a RACT/BACT/LAER Clearinghouse information that demonstrates these determinations have been made at similar operations. BACT is required for existing sources in nonattainment areas and the rate established for Nucor's permit meet these requirements.

The bags used by Nucor for control of silo emissions do have a rating that is below BACT rate by a factor of more than 5 (0.00180 grains/dscf). The performance of the bags being used exceeds BACT requirements.

The silo vent emissions are very small, the emission rate contained in the permit meets BACT, and, the bags utilized exceed to performance needed for BACT.

#### Unpaved haul roads Can they be paved?

Permanent, heavy use, roads have been paved. Nucor's potential to emit calculations included a detailed analysis of the types of vehicles traveling on various roads within the plant. Those calculations show that <u>97% of the vehicle miles traveled at the plant are on paved roads.</u>

The remaining roads are primarily roads that are not suitable for paving. For example, some scrap steel delivery trucks travel on the same surfaces that heavy tracked crawler cranes travel. Paved surfaces would immediately be torn up by the tracked equipment on these surfaces. Other roads are infrequent use, or may be relocated. Areas where both scrap steel and finished steel are stored frequently change location making paving not justifiable.

One thing that should be considered here is the issue which is attempting to be resolved with development of the SIP. There are wintertime inversion periods in certain areas of Utah which exceed the short term (not annual) health standard. The Division should consider whether seeking paved roads for helping the wintertime inversion period issue is counter the goal. Unpaved roads in the wintertime have very little emissions. Moisture remains on the roads essentially through the winter season. Vehicles traveling on frozen unpaved roads in inversion periods (associated with an ice crystal fog collecting on soils) can be seen in field observations to typically have no visible emissions with no control efforts incorporated. In contrast paved roads take considerable effort. Whatever fine particle is on top of a paved surface does seem to dry, and road sweeping control is necessary to minimize particulate emissions.

Further, depending on control efficiency estimates, calculations show very little difference between paved and unpaved roads if looking at above freezing conditions where emissions from unpaved roads can be a concern (times not including inversion periods). Example calculations are attached.

#### <u>Material Handling and Stockpiles</u> Can the areas be enclosed with a baghouse?

Potential emissions were calculated at the following levels for the most recent PSD Permit application.

Stockpile or Handling Point	Potential PM2.5 Emissions (tpy)
Scrap Stockpiles	0.11
Alloy Stockpiles	0.00
Lime Stockpiles	0.00
Alloy Railcar Unloading (2)	0.00
Slag Stockpiles	0.00
Slag Loading to Truck	0.01
Lime Unloading	0.02
EAF Dust Handling	0.00

Emissions are calculated to two decimal places (tons per year). For the above values, emissions shown that are less than 0.00 tpy are small emission sources which, when rounded, are closer to zero than they are to one hundredth of a ton. Actual emissions are even less than the potential emissions. These small emission sources are not addressed further because of their small size. The remaining sources to address are: Scrap stockpiles; slag loading to a truck, and; lime unloading.

Scrap Steel Stockpiles

The scrap stock piles are material handling of scrap steel which is the primary raw material for the product of Nucor. Scrap steel stockpiles are used to balance the non-steady delivery of scrap steel to feed the 24-7 operation of the meltshop. Further, if the Monday through Friday delivery of scrap were interrupted for some reason (ex. market fluctuations, loss of trucking or rail service), scrap stockpiles may allow continued operation. The area covered by scrap steel is estimated as 15 acres, in a maximum of 5000 ton individual stockpiles. These stockpiles are loaded and unloaded with large dump trucks (with a very high bed height when dumping), or by a crawler crane with a very high boom height. Any building for scrap handling would likely need to be 40' high or more for the type of equipment used to handle scrap steel. Open ended buildings for rail access, truck access, and crane access would be needed, thereby lowering the overall effectiveness. Given that the building or buildings for scrap steel stockpiling would be both cost prohibitive and ineffective in emission control. Any baghouse would need to have a flow rate that is excessive, and the calculations for any baghouse emissions using grains/dscf, even with the best possible efficiency bags, would represent a huge calculated emission <u>increase</u>.

It should be pointed out here that the majority of scrap processed by Nucor is not stockpiled but rather loaded directly to charge buckets from railcars, or dumped in a below grade pit (minimized wind exposure). Further, emission controls are in place with water misting sprays utilized in the truck dump pit, and water soaking/spraying of scrap is completed for open stockpiles as necessary to meet opacity requirements. These controls that are already in place are more effective at controlling emissions than any open ended baghouse equipped building could achieve.

#### Slag Loading to a Truck

Slag is retrieved from within the meltshop building with a loader. The meltshop building is evacuated to the EAF baghouse, The slag is at very high temperature. The buoyant particulate emissions resulting from picking up the slag do in part rise through openings in the meltshop building slag pit area to the EAF baghouse hood, which is directly above the furnaces/slag pit. The loader backs out of doorways in the meltshop building slag pit area to empty the bucket into a truck that is in a below grade location. The fact that the truck loading portion of the operation is below grade greatly minimizes emissions because of the minimized exposure to ambient winds. Slag loading emissions are already substantially controlled.

Slag is handled as an orange-hot material with specialty equipped loaders and large mine haul truck trucks. Enclosing this operation in a building would require large volumes of air to be evacuated through a baghouse to manage high heat loads that would exist. Baghouse emission calculations of a baghouse needed would demonstrate an increase in emissions, not a decrease. Adding a building with a baghouse to the outdoor portion of handling slag is not practical, feasible, or achievable to demonstrate an emission reduction.

#### Lime Unloading

Lime unloading is completed in a building which is an extension of the meltshop building. The meltshop building is evacuated to the EAF baghouse. These emissions are substantially controlled in this manner. Further, lime is received in either belly dump hopper railcars or trucks where the unloading process is to unload into a below-grade pit in the building. The lime is removed from the pit by an enclosed auger system. Emissions escaping to the atmosphere from normal lime delivery is minimal.

Infrequently, excess lime may be received where space is not available in the storage silos. This lime is placed on concrete surfaces with the belly dump trucks by opening the gates and driving forward so that a string of lime can be deposited. This method of unloading has very little emissions. The concrete surface

is adjacent to the stockpile of lime that is enclosed in a roofed, three sided, storage bunker. Emissions from the storage bunker stockpile are greatly reduced because of the minimal exposure to wind. The stockpile is loaded by moving the placed lime to the storage pile with a loader.

The majority of lime material handling emissions are controlled by a baghouse. Stockpile and associated handling emissions are managed in a manner where emissions are minimized and an added building with a baghouse is not warranted. The difference in emissions captured would be negligible.

#### **Cooling Towers**

# The cooling towers are equipped with drift mist eliminators have a drift rate of 0.0006 percent, and the DEC system has a drift rate of 0.001 percent. Can the towers be upgraded to a lower drift rate?

The difference in expressed drift rate is a difference in rounding. 0.0006 rounds to 0.001. Nucor used the manufacturer's information for the individual systems in the permit application.

#### **Emergency Diesel Generators**

#### Can the diesel-fired generators be upgraded to natural gas or propane?

The generator with the highest use, providing power to the data center/clinic, has been converted to natural gas. Permitting was completed with an Approval Order dated March 9 2015. Previously, emergency power was supplied by a permitted diesel fired generator. This location is the most appropriate location for a change in the type of fuel fired because this generator is the most critical and frequently used. Power outages can cause critical loss of data and operating programs needed to operate the facility. Further, the clinic, supported by this generator, is important to address emergency considerations as well as the need for refrigeration of medical supplies kept at this clinic. For these reasons, this generator is used most frequently. The previous diesel generator that was used for the data center and clinic was relocated to a location where there would be limited use as a means of reducing emissions.

The second most frequently used emergency engine is the mold water pump (not a generator). This engine is also natural gas fired. Because the meltshop equipment utilizing cooling water is processing liquid steel, a loss of cooling can cause catastrophic equipment damage if cooling is lost. This pump is test fired as frequently as daily, though its run time is typically 1 minute or less.

Two other stationary diesel fired engines are also not generators, but emergency pumps. One ran approximately 100 hours and the other approximately 80 hours, in calendar year 2016 Replacing these low use engines in not cost effective. Emissions from these engines are addressed through RICE regulations, whether through NESHAP or NSPS, to allowed time of use and maintenance practices to minimize emissions. These regulations meet BACT requirements.

Other diesel generators listed in the permit have not yet been installed.

#### **Miscellaneous Painting and Solvent Cleaning**

There was no specific question asked here. However, VOC emissions from miscellaneous solvent use and painting are being addressed below.

<u>Parts washers.</u> Nucor has converted the stationary parts washers from the previous use of a low volatility solvent to a non-VOC solvent.

<u>Painting process.</u> Nucor does utilize paint in a process in the fence post manufacture operation. Some customers require the product to be painted. Nucor complies with the rules developed for the nonattainment area by utilizing a water based paint. The VOC in the paints used are less than 2.3 lbs/gallon (less water), meeting the requirements of the nonattainment area rule. Significant quantities of paint is used in this process and even with the small amount of VOC in the paints used contributes substantially to the plant wide limit of VOC allowed.

<u>Miscellaneous painting</u> Nucor conducts miscellaneous painting plant wide. Much of this is marking paint used in the form of small aerosol cans. Other use includes painting for safety purposes (handrails, etc.) and paints are used for general good housekeeping. In terms of total consumption, paint used in this manner is small when compared to the amount of paint used in the painting process described above, and how Nucor limits the resulting VOC from paint use at the facility.

<u>Miscellaneous solvent</u> Miscellaneous solvents are used plant wide for various purposes, typically for cleaning critical parts and electrical equipment. Solvent rules specifically for nonattainment areas are being developed by UDAQ that will apply to Nucor. Nucor is actively participating in the development of these rules. Compliance with these rules as they are developed will address miscellaneous solvent use.

#### **Sandblasting**

#### Can the areas be enclosed with a baghouse?

Sandblasting is primarily conducted inside buildings, and normally conducted in one of the buildings that is evacuated by the EAF baghouse. However, it is done with portable units that may also be used in other buildings. Sandblasting is conducted on large equipment where it is not practical to move the equipment, necessitating the need to conduct the activity at various locations. Constructing a building with a baghouse just for sandblasting is not practical. VEO's are conducted on sandblasting once every 6 months. Rarely are any emissions observed, and always the emissions are found to be within the regulation (and permit) requirements.

# Volatile Organic Storage Tanks

# Can a VOC control such as incineration, oxidation or adsorption be used?

Fuel storage tanks represent very little emissions. Combined potential emissions are less than one ton per year, and actual emissions are lower. Tanks are are equipped with pressure relief valves that limit the amount a tank breathes, thereby reducing the amount of emissions that otherwise would result. The tanks are painted a light color to further reduce emissions. No further controls are warranted.

#### <u>Vacuum Ladle Degasser</u> Can add on controls be used? Are the technically or economically infeasible?

This equipment is included in the permit, but has not yet been installed. The vacuum ladle degasser included in the permit was selected because of the reduced emissions over the commonly found alternative. Many degassers installed at similar type steel manufacturing plants utilize a boiler to create a vacuum. The permitted degasser included in the permit is a mechanical type where vacuum is created without the combustion of fuels. The equipment selected represents emission reduction technology available for vacuum degassers.

Reheat Furnace RACT/BACT/LAER Clearinghouse Information



Technology Transfer Network Clean Air Technology Center - RACT/BACT LAES Clearinghouse

#### Pollutant Information

Click on the Process Information button to see more information about the process associated with this pollutant. Or click on the Process List button to return to the list of processes.								
RBLC Home	New Search	Search Results	Facility Information	Process List	Process Information			
Pollutant Information								

Help FINAL RBLC ID: OH-0316 Corporate/Company: V & M STAR Facility Name: V & M STAR Process: BILLET REHEAT FURNACE CAS Number: 10.02 Pollutant: Nitrogen Oxides (NOx) Pollutant Group (s): InOrganic Compounds, Oxides Substance Registry System: Nitrogen Oxides (NOx) of Nitrogen (NOx), Particulate Matter (PM), Pollution Prevention/Add-on Control Equipment/Both/No Con \_ Feasible: P P2/Add-on Description: ULTRA-LOW NOX BURNERS EPA/CIAR Methods Test Method: All Other Methods Unspecified Percent Efficiency: 0 Compliance Verified: No EMISSION LIMITS: Case-by-Case Basis: BACT-PSD Other Applicable Requirements: SIP Other Factors Influence Decision: Unknown Emission Limit 1: 29.0000 LB/H 89.3000 T/YR AS A 2-MONTH SUMMATION Emission Limit 2: 0.1000 LB/MMBTU Standard Emission Limit: COST DATA: Cost Verified? No Dollar Year Used in Cost Estimates: Cost Effectiveness: 0 \$/ton Incremental Cost Effectiveness: 0 \$/ton Pollutant Notes:

| Process Information - Details | RACT/BACT/LAER Clearinghouse | Clean Air Technolo... Page 1 of 1



Technology Transfer Network Clean Air Technology Center - RACT/BACT/LAER Clearinghouse

# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

Help FINAL

RBLC ID: MI-0404 Corporate/Company: GERDAU MACSTEEL, INC. Facility Name: GERDAU MACSTEEL, INC. Process: Walking Beam Billet Reheat Furance (EUBILLET-REHEAT)

# Pollutant Information - List of Pollutants

				neip
	Pollutant	Primary Emission Limit	Basis	Verified
Primary Fuel: Natural gas 260.70 MMBTU/H total	Carbon Dioxide Equivalent (CO2e)	119.0000 LB/MMBTU	BACT- PSD	NO
Process Code: 81.290	Carbon Monoxide	84.0000 LB/MMSCF	BACT- PSD	NO
	<u>Nitrogen Oxides</u> (NOx)	0.0700 LB/MMSCF	BACT- PSD	NO
	<u>Particulate</u> matter, total < 10 μ (TPM10)	0	BACT- PSD	NO
	<u>Sulfur Dioxide</u> (SO2)	0	BACT- PSD	NO
	Visible Emissions (VE)	5.0000 % OPACITY	BACT- PSD	NO
	<u>Volatile Organic</u> Compounds (VOC)	5.5000 LB/MMSCF	BACT- PSD	NO

Process Notes: A walking beam billet reheat furnace equipped with Ultra-Low NOx burners with the total heat input capacity of 260.7 MMBTU/H.



Technology Transfer Network Clean Air Technology Center - RACT/BACT/LAER Clearinghouse

# **Pollutant Information**

Click on the Process Information button to see more information about the process associated with this pollutant. Or click on the Process List button to return to the list of processes.								
RBLC Home	New Search	Search Results	Facility Information	Process List	Process Information			
Pollutant Information								

		Help
RBLC ID: OH-0316 Corporate/Company: V & M STAR Facility Name: V & M STAR Process: BILLET PREHEAT I	FURNACE	
Pollutant: Nitrogen Oxides (NOx)		CAS Number: 10102
Pollutant Group(s): InOrganic Compo of Nitrogen (NC Particulate Mat	unds, Oxides x), ter (PM),	Substance Registry System: <u>Nitrogen Oxides (NOx)</u>
Pollution Prevention/Add-on Control	Equipment/Both/	No Control = Feasible: P
P2/Add-on Description: ULTRA-LOW N	NOX BURNERS	
Test Method:	Unspecified	EPA/DAR Methods Ail Other Methods
Percent Efficiency:	0	
Compliance Verified:	Unknown	
EMISSION LIMITS:		· · · ·
Case-by-Case Basis:	BACT-PSD	
Other Applicable Requirements:	SIP	
Other Factors Influence Decision:	Unknown	
Emission Limit 1:	12.6000 LB/H	
Emission Limit 2:	30.4000 T/YR /	AS A RC 7 13 _2-MONTH SUMMATION
Standard Emission Limit:	0.0700 LB/MMB	ſU
COST DATA:		
Cost Verified?	No	
Dollar Year Used in Cost Estimate	s:	
Cost Effectiveness:	0 \$/ton	
Incremental Cost Effectiveness:	0 \$/ton	
Pollutant Notes:		



Technology Transfer Network Clean Air Technology Center - RACT/BACT LAER Clearinghouse

# Pollutant Information

Click on the P pollutant. Or click on th	Process Inform e Process List	nation button to button to return	see more informatio to the list of proces	n about the presses.	ocess associated with this
<b>RBLC Home</b>	New Search	Search Results	Facility Information	Process List	Process Information
Pollutant Info	rmation				

		FINAL
RBLC ID: GA-0142 Corporate/Company: OSCEOLA STEEL C Facility Name: OSCEOLA STEEL C Process: Reheat Furnace	0. 0.	
Pollutant: Nitrogen Oxides (NOx)		CAS Number: 10102
Pollutant Group(a): InOrganic Compou of Nitrogen (NO Particulate Mate	unds, Oxides x), ter (PM),	Substance Registry System: Nitrogen Oxides (NOx)
Pollution Prevention/Add-on Control	Equipment/Both	/No Controls Feasible: P
P2/Add-on Description: Low NOX burn	ers with FGR tech	inology and good compustion/operating practices.
Test Method:	Unspecified	EPARDAR Methods All Other Methods
Percent Efficiency:	0	
Compliance Verified:	Yes	
EMISSION LIMITS:		
Case-by-Case Basis:	BACT-PSD	
Other Applicable Requirements:	OPERATING PER	RMIT , SIT
Other Factors Influence Decision:	Unknown	
Emission Limit 1:	0.0750 LB/T 3	3 HOUR STACK TESTING
Emission Limit 2:	0	
Standard Emission Limit:	0	
COST DATA:		
Cost Verified?	No	
Dollar Year Used in Cost Estimates	3:	
Cost Effectiveness:	0 \$/ton	
Incremental Cost Effectiveness:	0 \$/ton	
Pollutant Notes:		

Ladle Heaters Dryers RACT/BACT/LAER Clearinghouse



Technology Transfer Network Clean Air Technology Center - RACT/BACT/LAER Clearinghouse

# Pollutant Information

Click on the Process Information button to see more information about the process associated with this pollutant. Or click on the Process List button to return to the list of processes.								
RBLC Home	New Search	Search Results	Facility Information	Process List	Process Information			
Pollutant Information								

RBLC ID: OK-0128 Corporate/Company: MID AMERICAN STEEL AND WIRE COMPANY Facility Name: MID AMERICAN STEEL ROLLING MILL Process: Ladle pre-beater and refractory drving							
Pollutant: Nitrogen Oxides (NOx)		CAS Number: 10102					
<pre>Pollutant Group(s): InOrganic Compounds, Oxides</pre>		nds, Oxides ), er (PM),	Substance Registry System: <u>Nitrogen Oxides (NOx)</u>				
Pollution Prevention P2/Add-on Description	n/Add-on Control H on: natural gas fue	Equipment/Both/No	Controls Feas	sible: P			
Test Method:	Jaggenegen dage namen gan particular of a signal model space for	Unspecified	11	EPA/DAR Methods	All Other Methods		
Percent Efficiency:		0					
Compliance Verified		Unknown					
Case-by-Case Basi	6:	BACT-PSD					
Other Applicable	Requirements:						
Other Factors Inf.	luence Decision:	Unknown					
Emission Limit 1:		0.1000 LB/MMBTU					
Emission Limit 2:		0					
Standard Emission	Limit:	0					
COST DATA:							
Cost Verified?		No					
Dollar Year Used	in Cost Estimates:	:					
Cost Effectivenes	5:	0 \$/ton					
Incremental Cost ) Pollutant Notes:	Effectiveness:	0 \$/ton					

| Pollutant Information | RACT/BACT/LAER Clearinghouse | Clean Air Technology Cent... Page 1 of 1



Technology Transfer Network Clean Air Technology Center - RACT EACT LAER Clearinghouse

# Pollutant Information

Click on the Process Information button to see more information about the process associated with this pollutant. Or click on the Process List button to return to the list of processes.								
RBLC Home	New Search	Search Results	Facility Information	Process List	Process Information			
Pollutant Information								

				Help		
RBLC ID: IA-0087 Corporate/Company: GERDAU AMERIST Facility Name: GERDAU AMERIST Process: NORTH LADLE DR	FINAL					
Pollutant: Nitrogen Oxides (NOx)		CAS Number: 10102				
<pre>Pollutant Group(s): InOrganic Compounds, Oxides</pre>		Subs se Registry System: Nitrogen Oxides (NOx)				
Pollution Prevention/Add-on Control P2/Add-on Description: GOOD COMBL	Equipment/Both	/No Conti Fea	asible: P			
Test Method:	Unspecified		EPA/DAR Methods	All Other Methods		
Percent Efficiency:	0					
Compliance Verified: EMISSION LIMITS:	Unknown					
Case-by-Case Basis:	BACT-PSD					
Other Applicable Requirements:	SIP					
Other Factors Influence Decision:	Unknown			00	11/	
Emission Limit 1:	100.0000 LB/N	MCFF	HREE 3 RUNS	0.048	10/mmistu	
Emission Limit 2:	2.1900 T/H RC	DLLIN	VIAI		/1.11.0.10	
Standard Emission Limit:	0					
COST DATA:						
Cost Verified?	No					
Dollar Year Used in Cost Estimates	s:					
Cost Effectiveness:	0 \$/ton					
Incremental Cost Effectiveness: Pollutant Notes:	0 \$/ton					

| Process Information - Details | RACT/BACT/LAER Clearingnouse | Clean Air Technolo... Page 1 of 1



Technology Transfer Network Clean Air Technology Center - RACT/BACT/LAER Clearinghouse

# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

RBLC ID: IA-0087 Corporate/Company: GERDAU AMERISTEEL WILTON Facility Name: GERDAU AMERISTEEL WILTON Process: SOUTH LADLE DRYERS AND PREHEATERS

> Portutant Information - List of Pollutants Primary Fuel: NATURAL GAS Help Throughput: 5.00 MMBTU/H Process Code: 81.340 Primary Pallutant Emission **Basis Verified** Limit 84.0000 BACT-Carbo UNKNOWN LB/. MCF PSD MORCKIGE UNKNOWN 0,098 15/mmBTU 100.0000 BACT-Nitrogen Oxides (1 LB/MMCF PSD

Help FINAL

Process Notes: THERE ARE THREE (3) UNITS A D C CH IS RATED AT 5 MMBTU/HR.



Technology Transfer Network Clean Air Technology Center - RACT/BACT/LAER Clearinghouse

# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

RBLC ID: IA-0087 Corporate/Company: GERDAU AMERISTEEL WILTON Facility Name: GERDAU AMERISTEEL WILTON Process: NORTHWEST LADLE DRYERS

> Primary Fuel: NATURAL GAS Throughput: 5.00 MMBTU/H Process Code: 81.390

Pollutant Information - List of Pollutants

Pollulian	Primary Emission Limit	<b>Basis</b>	Verified		
MULUXIL	84.0000 _B/ .1CF	BACT- SD	UNKNOWN		
Oxide A	100.0000 LB/MMCF	BACT- PSD	UNKNOWN	0,098 16/mmBtu	

Help FINAL

Process Notes: THERE ARE TWO (2) UNITS EACH AN ED AT 5 MMBTU/H.

| Process Information - Details | RACT/BACT/LAER Clearinghouse | Clean Air Technolo... Page 1 of 1



Technology Transfer Network Clean Air Technology Center - RACT/BACT/LAER Clearinghouse

# **Process Information - Details**

 For information about the pollutants related to this process, click on the specific pollutant in the list below.

 RBLC Home
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 Search Results
 Facility Information
 Process List
 Process Information

Help

RBLC ID: AL-0306 Corporate/Company: CONSTELLIUM Facility Name: ELEMENT 13 Process: DUAL LADLE PREHEAT STATION

					Help
Primary Fuel: Throughput:	NATURAL GAS 8.00 MMBTU/H	Pellicent	Primary Emission Limit	Basis	Verified
Process Code:	82.129	<u>eduvalent</u> (CO20)	4098.0000 T/YR	BACT- PSD	JNKNOWN
		<u>Carpor</u> Monoxide	Ω	BACT- PSD	UNKNOWN
		Jxides	U.USUU LB/MBTU	JACT- PSD	UNKNOWN
		<u>, V 1</u>	Ū	BACT- PSD	UNKNOWN

Pollutant Information - List of Pollutants

**Process Notes:**
# Abrasive Saw Baghouse Bag Test Report





Silo Vent RACT/BACT/LAER Clearinghouse information



Technology Transfer Network Clean Air Technology Center - RACT/BACT/LAER Clearinghouse

# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below.						
RBLC Home	New Search	Search Results	Facility Information	Process List	Process Information	

Help FINAL

RBLC ID: IN-0235 Corporate/Company: STEEL DYNAMICS INC. - FLAT ROLL DIVISION Facility Name: STEEL DYNAMICS INC. - FLAT ROLL DIVISION Process: LIME / CARBON STORAGE SILOS

		Pollutant Inform	nation - List	of Pollut	Help
Primary Fuel: Throughput: Process Code:	0.01 GR/DSCF 81.290	Pollutant	Primary Emission Limit	Basis	Verified
		<u>Particulate</u> <u>matter, filterable</u> (FPM)	0.0100 GR/DSCF	BACT- PSD	NO
		<u>Particulate</u> <u>matter, total &lt; 10</u> <u>µ (TPM10)</u>	0.0100 GR/DSCF	BACT- PSD	NO

Process Notes: 6 SILOS CONTROLLED BY 2 BIN VENTS

| Process Information - Details | RACT/BACT/LAER Clearinghouse | Clean Air Technolo... Page 1 of 1



Technology Transfer Network Clean Air Technology Center - RACT/BACT/LAER Clearinghouse

## **Process Information - Details**



Hel	p	
F	I	A

RBLC ID: IN-0156 Corporate/Company: STEEL DYNAMICS, INC. -STRUCTURAL AND RAIL DIVISION Facility Name: STEEL DYNAMICS, INC. - STRUCTURAL AND RAIL DIVISION Process: THREE STORAGE BIN/SILOS ID#12A, 12B, AND 12C

Primary Fuel:		Pollutant Informa	ation - List	of Pollut	Help
Throughput: Process Code:	0 81.290	Pollutant	Primary Emission Limit	Basis	Verified
		Particulate matter, filterable (FPM)	0.0100 GR/DSCF	BACT- PSD	NO
		<u>Particulate matter,</u> <u>filterable &lt; 10 μ</u> <u>(FPM10)</u>	0.0100 GR/DSCF	BACT- PSD	NO

Process Notes: THE BINS/SILOS ARE USED FOR STORAGE OF THE VARIOUS RAW MATERIALS NEEDED IN THE STEEL PROCESSING. EACH BIN/SILO IS CONTROLLED BY A SEPARATE BIN VENT FILTER Process Information - Details | RACT/BACT/LAER Clearinghouse | Clean Air Technolo... Page 1 of 1



Technology Transfer Network Clean Air Technology Center - RACT/BACT/LAER Clearinghouse

## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information



RBLC ID: LA-0248 Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC - NUCOR Facility Name: DIRECT REDUCTION IRON PLANT Process: DRI-212 - DRI Unit No. 2 Product storage silo Dust Collection

		Pollutant Inform	nation - List	of Pollu	Help
Primary Fuel: Throughput: Process Code:	2755778.00 tons/yr 81.290	Pollutant	Primary Emission Limit	Basis	Verified
		Carbon Monoxide	0.5700 LB/H	BACT- PSD	UNKNOWN
		Nitrogen Oxides (NOx)	0.9900 LB/H	BACT- PSD	UNKNOWN
		Particulate matter, filterable < 10 µ (FPM10)	0.9900 LB/H	BACT- PSD	UNKNOWN

**Process Notes:** the DRI Product exits the cooling zone of the shaft furnace and falls onto a waiting conveyor for transport to the product silos. Transfer into and out of the Silo has a high potential for dust generation, since any fines generated during the action of the pellets passing through the reactor are also discharged.

Process Information - Details | RACT/BACT/LAER Clearinghouse | Clean Air Technolo... Page 1 of 1



Technology Transfer Network Clean Air Technology Center - RACT/BACT/LAER Clearinghouse

## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information



RBLC ID: LA-0248 Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC - NUCOR Facility Name: DIRECT REDUCTION IRON PLANT Process: DRI-112 - DRI Unit No. 1 Product storage silo Dust Collection

		Pollutant Inform	nation - List	of Poll	utants Help
Primary Fuel: Throughput: Process Code:	2755778.00 tons/yr 81.290	Pollutant	Primary Emission Limit	Basis	Verified
		Carbon Monoxide	0.5700 LB/H	BACT- PSD	UNKNOWN
		<u>Nitrogen Oxides</u> (NOx)	0.9900 LB/H	BACT- PSD	UNKNOWN
		Particulate matter, filterable < 10 μ (FPM10)	0.9900 LB/H	BACT- PSD	UNKNOWN

**Process Notes:** the DRI Product exits the cooling zone of the shaft furnace and falls onto a waiting conveyor for transport to the product silos. Transfer into and out of the Silo has a high potential for dust generation, since any fines generated during the action of the pellets passing through the reactor are also discharged.



Technology Transfer Network Clean Air Technology Center - RACT/BACT/LAER Clearinghouse

# **Process Information - Details**

**RBLC ID: LA-0239** 

Facility Name: NUCOR STEEL LOUISIANA

For information about the pollutants related to this process, click on the specific pollutant in the list below.							
RBLC Home	New Search	Search Results	Facility Information	Process List	Process Information		

Help FINAL

Primary Fuel: Throughput:	175200.00 T/YR	Pollutant Inform	nation - List o	f Pollut	Help
Process Code:	81.290	Primary Pollutant Emission Basis Limit		Basis	Verified
		Particulate matter, filterable (FPM)	0.0700 LB/H	BACT- PSD	YES

Process Notes: Used to control sulfur dioxide emissions

Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC

Process: SIN-105 - Sinter FGD Lime Silo Unloading

Process Information - Details | RACT/BACT/LAER Clearinghouse | Clean Air Technolo... Page 1 of 1



Technology Transfer Network Clean Air Technology Center - RACT/BACT/LAER Clearinghouse

# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below.							
<b>RBLC Home</b>	New Search	Search Results	Facility Information	Process List	Process Information		

Help

	FINAL
RBLC ID: LA-0239	
Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC	
Facility Name: NUCOR STEEL LOUISIANA	
Process: SLG-408 - SLAG MILL PRODUCT SILO BAGHOUSE VENT	

Primary Fuel: Throughput:	75.40 T/H	Pollutant Info	ormation - List o	of Pollut	Help
Process Code:	81.290	Pollutant	Primary Emission Limit	Basis	Verified
		<u>Particulate</u> <u>matter, total</u> <u>(TPM)</u>	0.7500 LB/H	BACT- PSD	YES

Process Notes: TOTAL THROUGHPUT 1.92 MILLION TONS PER YEAR

| Process Information - Details | RACT/BACT/LAER Clearinghouse | Clean Air Technolo... Page 1 of 1



Technology Transfer Network Clean Air Technology Center - RACT/BACT/LAER Clearinghouse

# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below.							
RBLC Home	New Search	Search Results	Facility Information	Process List	Process Information		

Help	
FI	NAL

Link of Dallar

- -

RBLC ID: MN-0070 Corporate/Company: Facility Name: MINNESOTA STEEL INDUSTRIES, LLC Process: DRI PELLET SILOS

		Help				
Primary Fuel: Throughput:		Pollutant	Primary Emission Limit	Basis	Verified	
Process Code:	81.290	Fluorides, Total	50.0000 MG/KG	BACT- PSD	UNKNOWN	
		<u>Lead (Pb) /</u> Lead Compounds	20.0000 MG/KG	BACT- PSD	UNKNOWN	
		<u>Particulate</u> Matter (PM)	0.0025 GR/DSCF	BACT- PSD	UNKNOWN	
		Visible Emissions (VE)	5.0000 %	BACT- PSD	UNKNOWN	

**Process Notes:** 



Technology Transfer Network Clean Air Technology Center - RACT/BACT/LAER Clearinghouse

# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below.							
RBLC Home	New Search	Search Results	Facility Information	Process List	Process Information		

Help FINAL

RBLC ID: OK-0173 Corporate/Company: COMMERCIAL METALS COMPANY Facility Name: CMC STEEL OKLAHOMA Process: Materials Storage Silos

	Pollutant Infor	Pollutant Information - List of Pollutants Help				
Primary Fuel: Throughput: 0 Process Code: 81.390	Pollutant	Primary Emission Limit	Basis	Verified		
	Carbon Monoxide	0	N/A	UNKNOWN		
	<u>Particulate</u> matter, total < 10 µ (TPM10)	0.0100 GR/DSCF	BACT- PSD	UNKNOWN		
	Particulate matter, total < 2.5 µ (TPM2.5)	0.0100 GR/DSCF	BACT- PSD	UNKNOWN		

**Process Notes:** The facility will include three silos, two for raw materials and one for baghouse dust. BACT for these silos is selected as bin vent filters achieving 0.01 gr/DSCF. Since these filters are equivalent to the most efficient controls available for PM, no further BACT analysis is warranted.Throughput Capacity/Size deemed "Confidential by applicant.

Silo Vent Bag Test Report

# **DUST PENETRATION AND OUTLET EMISSIONS DATA**

			Dust Penetration (X 10 <sup>-5</sup> )					Dus
Test Inlet Dust Media Concentration (gr/ft <sup>3</sup> ; avg)	l <sup>st</sup> Cycle	2 <sup>nd</sup> Cycle	3 <sup>rd</sup> Cycle	4 <sup>th</sup> Cycle	Avg. Cycles #2-4	Dust Load (gr/ft <sup>3</sup> ) Cycles # 2-4	Collec Efficier Cycles	
*PE/PE 609/1 PS Code 9	2.93	31.7	9.9	4.9	3.2	6.0	0.00018	99.9
**PE/PE 559/1 Code 9	2.98	135	29.8	18.7	10.4	19.6	0.00059	99.9
Stnd. 16oz. Polyester Felt	2.92	146	103	54.1	37.5	61.7	0.00180	99.{

PE/PE 609/1 MPS Code 9 is an 18 oz. polyester felt with heavy scrim s PS high efficiency fibers, and Code 9 bath treatment.

\*PE/PE 559/1 Code 9 is a 16 oz. polyester felt with heavy scrim sup ense needling, and Code 9 treatment.

#### EST CONDITIONS

Test Dust:Ottawa Silica #45Average Particle Size:4.0 micronsDust Loading (nominal):3 gr/ft³Air-To-Cloth Ratio:6.0 fpmTemperature:Ambient (67 - 72°F)Relative Humidity:Ambient (56 - 60%)Pulsing Interval:5 minutes

Note: Testing performed by Grubb Filtration Testing Services, Inc.

Heavy Equipment Paved vs. Unpaved Road Calculations Example

۱	Paved Haul Road Cale	culations			
1	Table 13.2.1-3	Iron and St	eel Production		
	Mean Silt Content	(%)	12.5		
	Mean Loading	(lb/mi	1.75		
	Silt Loading	(g/sq m)	9.7		
1	PM2.5 (k)	(lb/VMT)	0.00054		
	Equation:				
1	E = k(sL)^0.91 X (W)	1.02			
1	Example Haul Vehicle	e is Scrap Ste	el 25 ton load, 25 ton emp	ty tru-	50 ton
1	PM.2.5 Emissions		0.230837 lb/VMT Und	controlled	
(	Controlled Emissions	. Assume 50	% control can be achieved t	thro g sweeping.	
(	Controlled Emission	Factor	0.115419 lb/	VNIT	
١	Unpaved Haul Road (	Calculations			
(	(Industrial Roads)				
1	k PM2.5 0.1	5			
i	a 0.	9			
	b 0.4	5			
	s (mean) 1	4	table 13.2.2-3 mean surface	ce si li cu litent	
1	W 5	0	Vehicle Weight		

Equation: E = k (s/12)^a \* (W/3)^b

PM2.5 Emissions 0.611189

Uncontrolled

Nucor's permit requires that upaved road surfaces be maintained in a mamp/moist condition" or chemical treatment Referencing Table 13.2.2-2 Control efficiency can be estimated at at least 75%

**Controlled Emission Factor :** 

0.152797 lb/VM

Appendix B

Analysis of the Technical Feasibility and Costs of After-Treatment Controls on New Emergency Standby Engines

This was a reference in Placoi's previous RACT Evaluation. Don't know if it is useful, but I hope it helps

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# I. ANALYSIS OF THE TECHNICAL FEASIBILITY AND COSTS OF AFTER-TREATMENT CONTROLS ON NEW EMERGENCY STANDBY ENGINES

In this appendix, ARB staff summarizes the results of an investigation into the technical feasibility, availability, costs, and operational considerations associated with DPFs and SCRs on emergency standby engines. ARB staff also provides an analysis of the estimated incremental costs associated with the transition from the Tier 2 or Tier 3 emission standards to Tier 4 standards for emergency standby engines.

#### A. Technical Feasibility and Operational Considerations for DPFs and SCR on Emergency Standby Applications

#### Diesel Particulate Filter Technology Description and Availability

DPFs are used in many applications to reduce emissions of diesel PM. In general, a DPF consists of a porous substrate that permits gases in the engine exhaust to pass through but collects or "traps" the diesel PM. Most DPFs employ some means to periodically remove the collected diesel PM. This is typically referred to as regenerating the DPF. During regeneration, the collected PM, which is mostly carbon, is burned off. Diesel PM emission reductions in excess of 85 percent are possible, depending on the associated engine's baseline emissions, fuel sulfur content, and emission test method or duty cycle. In addition, up to a 90 percent reduction in CO and a 95 percent reduction in HC can also be realized with DPFs. (ARB, 2003)

Particulate filters can employ active or passive systems. Active DPFs use a source of energy beyond the heat in the exhaust stream itself to help regeneration. Active DPF systems can be regenerated electrically, with fuel burners, with microwaves, or with the aid of additional fuel injection to increase exhaust gas temperature. Some active DPFs induce regeneration automatically onboard the vehicle or equipment when a specified engine back pressure is reached. Others simply indicate when to start the regeneration process. Some active systems collect and store diesel PM over the course of a full day or shift and are regenerated at the end of the day when the vehicle or equipment is no longer needed. Because they have greater control when regeneration occurs and are not as dependent on the engine exhaust temperatures, active DPFs have a much broader range of application and a much lower probability of getting plugged than passive DPFs.

A passive DPF is one in which a catalytic material, typically a platinum group metal, is applied to the substrate. The catalyst lowers the temperature at which trapped PM will oxidize to temperatures periodically reached in diesel exhaust. No additional source of energy is required for regeneration, hence the term "passive." Field experience has indicated that the success or failure of a passive DPF is primarily determined by the average exhaust temperature at the filter's inlet and the rate of PM generated by the engine. These two variables, however, are determined by a host of factors pertaining to both the details of the application and the state and type of engine being employed. As a result, the technical information that is readily accessible can sometimes serve as a

guide, but it may be insufficient to determine whether a passive DPF will be successful in a given application. (ARB, 2003)

There are at least 13 manufacturers of DPFs for use in stationary emergency standby applications. As shown in Table B-1, ten manufacturers have DPFs that have been verified through the ARB's Diesel Emission Control Strategies Verification Program for use on emergency standby engines. There are three manufacturers that also provide DPFs for emergency standby applications; however their systems have not been verified by ARB.

Company Name	DPF Type	ARB Verified
Catalytic Exhaust Products	Passive	Yes
CleanAir Systems	Passive	Yes
DCL International	Passive	Yes
GTE Industries	Passive	Yes
Johnson Mathey	Passive	Yes
Miratech	Passive	Yes
NETT Technologies	Passive	Yes
Rypos	Active	Yes
Sud-Chemie	Passive	Yes
Universal Emissions Technologies	Passive	Yes
Corning Environmental Technologies	Passive	No
Extengine	Active	No
Cleaire	Passive	No

### Table B-1: Manufacturers of DPFs for Emergency Standby Applications

#### **DPF** Operating Requirements

A DPF can collect PM for a set period of time before regeneration is required. The collection time will vary depending on the size, type, and manufacturer of the DPF but generally it ranges from 240 to 720 minutes (4-12 hours). Once this limit is reached the DPF system is designed to stop collecting PM and at this point, the filter should be regenerated. The manufacturer will stipulate the duration that the engine can operate between regeneration events. This is often specified as the number of cold starts and 30 minute idle sessions that the engine can perform before the DPF needs regeneration. Table B-2 below provides additional details pertaining to the manufacturer limits imposed on the passive DPFs for those systems verified through the ARB's Diesel Emission Control Strategies Verification Program. As shown in Table B-2, the number of cold starts that can be completed between regeneration events ranges from 10 to 30. Cold starts are commonly used to determine regeneration frequency because most emergency standby engine operation is associated with maintenance and testing operations, which generally entails short 15 to 30 minute engine operation at low or no loads. Regeneration requires exhaust temperatures ranging from 300 degrees celsius (°C) to 465 °C for 30 to 120 minute s depending on the DPF system.

#### Table B-2: Summary of Recommended Operating Requirements for Verified Passive DPFs

Parameters	General Operating Requirements
Minimum Exhaust Temperature for Filter Regeneration	300 ℃ to 465 ℃ for a duration of 30-120 minutes
Maximum Conservative Minutes Operating Below Passive Regeneration Required	240-720 Minutes
Number of Cold Starts & 30 Mins. Idle Sessions before Regeneration Required	10-30
Other Requirements	Engine cannot be equipped with exhaust gas recirculation

#### Operational Considerations for DPFs on Emergency Standby Engines

Typical operation of an emergency standby engine includes either weekly, biweekly, or monthly 30 minute maintenance and testing operations with low or no load to ensure the engine is operating properly.<sup>1</sup> As shown in Table B-2, the number of times that an engine can operate for maintenance and testing before regeneration can vary but typically is between 10 and 30 cold starts with 30 minute run sessions. For regeneration to occur, the exhaust temperature needs to be between 300  $\degree$  to 465  $\degree$ . To reach this temperature and for a regeneration cycle to be completed, the engine should operate for about 30 minutes at a 30 percent load. This longer maintenance and testing session at a higher load would need to be performed when the filters require regeneration. In most cases, this would only be once or twice in a year.

Active DPFs are independent of temperature and will work on emergency standby engines without the same regeneration concerns noted above for the passive systems. The active DPF uses an electrical current or fuel combustion to remove or burn off the collected PM.

<sup>&</sup>lt;sup>1</sup> A survey conducted by ARB staff revealed that the average number of hours operated for maintenance and testing is about 22 hours, 7 hours for emergencies, and 2 hours for DRP operation per year. (ARB, 2003)

#### Emergency Standby Engines with DPF Applications

Actual in-use experiences with the application of DPFs on emergency standby engines were previously investigated when the ATCM was originally adopted. (ARB, 2003) At that time, ARB staff found that there were about 50 emergency standby engines operating in California that had DPFs installed. In most cases, the DPFs were installed to meet district permit requirements or to address odor complaints from near-by neighbors. Operators indicated that there was little or no additional maintenance associated with the DPF. To determine how this has changed since the initial staff report, staff asked the local air quality control and air quality management districts (districts) to provide data on emergency engines equipped with after-treatment devices. Eight districts provided this data which collectively reported 300 DPFs equipped emergency standby engines. (District, 2010)

ARB staff continue to believe that the application of DPFs on emergency standby engines is technically feasible and can achieve significant diesel PM emission reductions. The operational considerations are minimal and can be easily accommodated by small adjustments in the routine monitoring of the engines and normal maintenance and testing procedures.

#### SCR Technology Description and Availability

SCR technology has been available for many years, primarily used on large power plants to lower NOx emissions. However SCR is becoming more commonplace in other applications due to the U.S. EPA and ARB on and off-road new compression-ignition diesel engine standards.<sup>2</sup> For off-road applications, the Tier 4 final (Tier 4f) standards which are phased in between 2011 and 2015, most engines with horsepower (hp) greater than 75 hp will require highly effective NOx controls such as SCR.

SCR uses a catalyst (commonly precious metals, vanadium, or zeolites) and injection of a reductant (liquid ammonia or urea) to convert the NOx in the diesel exhaust to water (H<sub>2</sub>O) and nitrogen (N<sub>2</sub>). The catalyst lowers the reaction temperature that NOx needs to convert to H<sub>2</sub>O and N<sub>2</sub>. The temperature range is specific to each SCR system but in general it is between 260  $\degree$  to 540  $\degree$ . Once the e xhaust temperature reaches the minimum operating temperature, the catalyst activates and the system begins to inject the reductant into the exhaust stream. The exhaust will then enter the catalyst where the conversion will take place. A well designed system can reduce the NOx emissions up to 95 percent.

<sup>&</sup>lt;sup>2</sup> U.S. EPA and ARB have adopted essentially the same emission standards for off-road engines. The ARB's Off-Road Compression Ignition Engine Standards (Off-Road Standards) can be found in title 13, CCR, section 2423. The U.S. EPA's Control of Emissions of Air Pollution from Nonroad Diesel Engines and Fuel, Final Rule June 29,2004 (Nonroad Standards) can be found at 40 CFR Parts 9,69, et. al. In both regulations, the diesel engine standards are phased in over several years and have Tiers, i.e. Tier 1, 2, 3 and 4; with increasing levels of stringency. The Tier 4 standards are broken into two subsets of emission standards, the Tier 4 interim (Tier 4i) and the Tier 4 final (Tier 4f). Generally, the Tier 4 istandards require the application of DPF technology and the Tier 4f the application of both DPF and SCR technologies.

As shown in Table B-3, there are at least eight manufacturers who have indicated they have SCR systems for installation on stationary diesel engines. In most cases, these systems were designed for application on prime generators but can be adapted to work on emergency standby engines.

CRI Catalyst
Ducon Technologies, Inc.
Epcon Industrial Services, LP
Foster Wheeler Energy Corp.
Johnson Matthey
Miratech Corporation
NETT Technologies
Universal Emissions Technologies

#### Table B-3: Manufacturers of Selective Catalytic Reduction Systems for Stationary Emergency Standby Engine Applications

#### SCR Operating Requirements

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As discussed earlier, SCR systems have two key operating variables that work together to achieve the NOx reductions. These are the exhaust temperature and the injection of the reductant (urea or ammonia). With respect to the exhaust temperature, the exhaust temperature must be between 260 °C to 540 °C for th e catalyst to operate properly. For this reason, SCR systems will not begin injection of urea or ammonia until the catalyst has reached the minimum operating temperature. During this warm-up period, the engine can operate but without the benefits of the NOx reductions from the SCR system. The urea or ammonia injection is also a critical component in determining the control efficiency of a SCR. It must be injected into the exhaust stream upstream of the SCR system. In the catalyst, it reacts to reduce the NOx to form N<sub>2</sub> and H<sub>2</sub>O. The reaction is able to take place because the catalyst lowers the reaction temperature necessary for NOx.

#### Operational Considerations for SCR Systems on Emergency Standby Engines

As mentioned above, SCR systems require an operating temperature between 260  $^{\circ}$  to 540  $^{\circ}$ . Reaching these temperatures may be difficult in routine maintenance and testing operations where the engine is typically operated at low load for short periods of testing. If this temperature is not met while the engine is running, there will not be any NOx emission reduction benefits. To circumvent this problem, the engine would need to be operated with higher loads and in many cases for longer periods of time. This could be a challenge for most emergency standby applications as most businesses do not have load banks in house and would have to create a larger load on the engine to get the catalyst up to operational temperature.

Urea handling and maintenance is also an important consideration. Urea crystallization in the lines can cause damage to the SCR system and to the engine itself. Crystallization in the lines is more likely in emergency standby engines due to their periodic and low hours of usage. Urea also has a shelf life of approximately two years. This could increase the cost of operating a SCR for emergency standby engines since the low number of annual hours of operation experienced by most emergency standby engines could lead to urea expiration. The urea would then have to be drained and replaced, creating an extra maintenance step and an increased cost to the end user.

#### Emergency Standby Engines with SCR Applications

There are a limited number of examples to draw upon for SCR installations in California. There are 7 facilities with SCR systems on 17 engines in California based on district permit data from eight districts. (District, 2010) These SCR systems were installed to comply with local district rules and regulations. ARB staff contacted operators of two facilities, one in California and one in Delaware, to obtain information on actual inuse experience with SCR systems on emergency standby engines. Brief summaries of what was reported are provided below.

<u>Raging Wire</u>: Raging Wire located in Sacramento, California, provides electronic data storage for businesses. They have equipped two of their diesel generators with SCR to meet the district's best available control technology (BACT) requirements for NOx. The SCR systems are installed on two Tier 1 two megawatt diesel engines and according to the district permit, are designed to reduce NOx between 35 and 60 percent. The two SCR systems are manufactured by Johnson Matthey. A Raging Wire representative provided ARB with their maintenance and testing records from the past two years. On average they operate about 20 hours per year for maintenance and testing procedures and 3 hours per year for emergency operation. It was indicated that a representative from Johnson Matthey must come out and service the SCR system twice a year to insure proper operation of the system.

<u>Verisign, Inc.</u>: ARB staff contacted representatives with Verisign, Inc. in New Castle, Delaware to discuss their experiences with SCR systems installed on six Caterpillar 3516 emergency standby diesel engines. Verisign, Inc. is a data and internet protection business. The engines have had an SCR system installed for approximately one year. The operator was very impressed with the system and was pleased with the results that he was seeing. For their SCR systems, the catalyst must reach 260 °C (500°F) to start to operate. When the engine is us ed at full load (2.2 MW) the SCR system begins to operate in approximately 10 minutes. Urea usage is 7-9 gallons per hour at full load. At very low load, the SCR system will not begin to operate for 30-40 minutes. It was their experience that occasionally the SCR system will not operate during an emergency because the loads are too low and the desired temperature is not reached. One major concern that they found with low use was that the urea had crystallized in the lines and leaked on multiple occasions. SCR systems have not yet seen wide application on emergency standby engines and SCR systems currently in-use are on large emergency standby diesel engines greater than 1,000 horsepower. ARB staff believes that while the current generation of SCR systems may be technically feasible, there are significant operational hurdles to overcome before routine use of SCR on emergency standby engines is practical. This is because the majority of operating hours for emergency standby engines occur during short 15 to 30 minute maintenance and testing checks are at low engine loads. In most cases, the temperature needed for the SCR catalyst to function will not be reached during this operation and the SCR will not provide the expected NOx reductions.

#### B. Incremental Costs Associated with DPF and SCR on Emergency Standby Engines

To determine the potential costs associated with the application of DPF and SCR technologies on emergency standby engines, ARB staff investigated the costs associated with five different "compliance pathways" or scenarios that resulted in the application of DPFs and/or SCRs on emergency standby generator engines (gen-set). Two scenarios were based on the end user retrofitting an existing Tier 2 or Tier 3 engines with after-treatment technologies and three scenarios were based on original equipment manufacturers (OEM) providing the engine with after treatment technology installed. The five scenarios are:

- Scenario 1) end user aftermarket retrofit of a Tier 2 or Tier 3 gen-set with a DPF;
- Scenario 2) end user aftermarket retrofit of a Tier 2 or Tier 3 gen-set with a DPF and SCR;
- Scenario 3) OEM supplied new Tier 4 interim (Tier 4i) gen-set (DPF only);
- Scenario 4) OEM supplied new Tier 2 or Tier 3 gen-set retrofitted with OEM supplied DPF; and,
- Scenario 5) OEM supplied new Tier 4 final gen-set (with DPF and SCR).

#### Approach for Estimating Costs

In each case, to determine the cost increase, we compared the cost of a new Tier 2 or Tier 3 gen-set with the cost of a gen-set equipped with after-treatment controls via the compliance path specified for each scenario. ARB staff aggregated engines into five horsepower ranges: 50-174, 175-749, 750-1,206, 1,207-2,000, and greater than 2,000. Estimated costs for end-user retrofit were based on data from after-market technology providers and OEM costs were provided by EMA members. For each specified horsepower range, the percent increase in cost for a gen-set with after-treatment compared to a new Tier 2 or Tier 3 gen-set without after-treatment was determined for the average size horsepower engine within each horsepower range.

To collect information on the costs for a new Tier 2 or Tier 3 gen-set and the costs associated with gen-sets that would meet each scenario that relied on OEM supplied engines, ARB staff worked with EMA to survey the OEMs. The survey asked for the current average costs for a Tier 2 or Tier 3 gen-set which are currently being sold. ARB

asked manufacturers to estimate the future cost as a percent increase over a Tier 2 or Tier 3 gen-set of an OEM supplied DPF on a Tier 2 or Tier 3 engine, a Tier 4i engine (with DPF), and a Tier 4 gen-set (with DPF & SCR). The cost was the total cost to the end user without the cost of installation. This survey was sent to EMA to distribute to its members. ARB received responses from four manufacturers: Caterpillar, Inc., Cummins, Inc., Cummins West, and MTU Detroit Diesel.<sup>3</sup> To protect the confidentiality of the data provided by each OEM, the data provided was combined and the average used for the cost estimates and presented in this appendix. The estimated costs were the cost for emergency standby gen-sets only and included any costs the OEMs would incur for research, design, assembly line setups, after-treatment technologies, tooling, inventory storage, engine markup, and other considerations. It is important to note that, while EMA members provided estimates of their costs to produce the OEM supplied engines, they also stated that it is not economically viable for them to maintain a California-only platform for these engines and that these engines will not be available "off-the-shelf" from the OEMs.

For the end-user DPF retrofit scenarios, ARB staff relied on DPF retrofit cost data collected during the development of the ATCM. At that time, as outlined in the staff report developed in support of the ATCM, the estimated cost to retrofit a stationary diesel engine with a DPF was \$38 per hp which includes capital and installation costs. (ARB, 2003) ARB staff conducted additional outreach to current DPF vendors to verify that this cost estimate is still applicable. ARB staff contacted manufactures of DPFs currently verified through ARB's verification procedure and found that the cost ranges from \$25 to \$55 for both active and passive systems with an average cost of \$39 per horsepower.<sup>4</sup> Based on this, ARB staff believes the estimate of \$38 per horsepower is still a reasonable cost estimate for a DPF retrofit. To determine the retrofit costs for a SCR system, staff contacted four SCR manufacturers and solicited SCR cost data. Based on the responses received, the capital costs for SCR systems ranged from \$50 to \$150 with an average cost of \$80 per hp. This does not include the cost of installation which, according to the SCR manufacturers, could increase costs by 25 percent to over 100 percent. (Miratech, 2010)

The various cost assumptions and considerations for the different scenarios are summarized below.

# Scenario 1: End User Aftermarket Retrofit of a Tier 2 or Tier 3 Gen-Set with a DPF

In this scenario, it is assumed that the end user purchases an "off-the-shelf Tier 2 or Tier 3 gen-set that meets a 0.15 g/bhp-hr PM standard and installs a DPF purchased from an aftermarket supplier. As discussed above, the estimated costs to retrofit an gen-set with an aftermarket DPF were \$38 per hp. This estimate reflects the costs to

<sup>&</sup>lt;sup>3</sup> Clarke also provided cost information; however, it was excluded due to the fact that they provide direct drive fire pumps instead of generator sets. The data would not be compatible.

<sup>&</sup>lt;sup>4</sup> Miratech, Johnson Matthey, and Rypos provided estimated costs for DPFs for multiple horsepower ranges. The estimated costs were aggregated to protect confidentiality.

purchase the DPF and install it on the gen-set. As shown in Table B-4, the estimated percent cost increase for this scenario relative the costs for a new Tier 2 or Tier 3 genset without after-treatment is between 15 percent and 26 percent.

# Scenario 2: End User Aftermarket Retrofit of a Tier 2 or Tier 3 Gen-Set with a DPF and SCR

This scenario assumes the end user purchases an 'off-the-shelf' Tier 2 or Tier 3 gen-set that meets a 0.15 g/bhp-hr PM standard and installs both a DPF and a SCR. ARB staff relied on the estimated costs of \$38 per hp noted previously to retrofit an gen-set with a DPF and added to that cost, the cost to also retrofit with a SCR. As discussed above, the SCR retrofit costs were estimated to be \$80 per horsepower. This estimate included only the capital cost because the manufacturers indicated that the installation costs are site-specific exercise and it is difficult to estimate an average cost. As shown in Table B-4, the estimated percent cost increase for this scenario relative the costs for a new Tier 2 or Tier 3 gen-set without after-treatment is between 46 percent and 82 percent.

#### Scenario 3: OEM Supplied New Tier 4 Interim Gen-Set

Under this scenario, it is assumed that the OEMs will develop and maintain a Tier 4i platform for emergency standby gen-sets. The Tier 4i standards, for most horsepower ranges, require a DPF to meet stringent PM limits and additional engine modifications to meet lower NOx limits. To meet the lower NOx limits, engine manufacturers indicated that exhaust gas recirculation (EGR) would be required; SCR would probably be required for gen-sets greater than 1207 hp. For this scenario, ARB staff relied on the OEM data provided on the estimated percent increase in costs relative to a new Tier 2 or Tier 3 gen-set without aftermarket controls. These estimates are provided in Table B-5 below and range from 55 percent to 105 percent. As noted above, the final OEM costs reflected the cost to the end user and included research, design, assembly line setups, tooling, inventory storage, engine markup, add-on control devices, and other considerations.

#### Scenario 4: OEM Supplied New Tier 2 or Tier 3 Gen-Set with DPF

In this scenario, we assumed that the OEM would provide a Tier 2 or Tier 3 gen-set with OEM supplied DPF after-treatment. As shown in Table B-5, the estimated percent cost increase for this scenario relative the costs for a new Tier 2 or Tier 3 gen-set without after-treatment is between 30 percent and 65 percent, about double the costs of those in Scenario 1 where the end user would retrofit a DPF to an existing gen-set.

#### Scenario 5: OEM Supplied New Tier 4 Gen-Set (with DPF and SCR)

This scenario assumes that the OEMs would develop and maintain a Tier 4f emergency standby diesel gen-set platform for the California market. The costs for this scenario were based on the data provided by the OEMS. As shown in Table B-5, the estimated percent cost increase for this scenario relative the costs for a new Tier 2 or Tier 3 genset without after-treatment is between 65 percent and 125 percent.

#### Estimated Increase in Gen-Set Costs for the Five Scenarios

Table B-4 provides a summary of the estimated cost increase associated with the Scenarios 1 and 2 that entailed the end user retrofitting a new Tier 2 or Tier 3 gen-set with a DPF or with both a DPF and SCR. For each scenario, the costs are presented as a percentage increase and as the increase in actual dollar amount, relative to a new Tier 2 or Tier 3 gen-set. As can be seen in Table B-4, the costs for an end user to retrofit an emergency standby gen-set with a DPF range from \$4,000 to \$100,000 per gen-set depending on the horsepower. The cost for an end user retrofit with DPF and SCR ranges from \$13,000 to \$310,000 per gen-sets.

HP Range	Cost of NewTier 2/3 Gen-Set (\$)	Aftermarket DPF Regulatory Scenario		Aftermarket Regulatory	SCR + DPF Scenario
		% Increase	\$ Increase	% Increase	\$ Increase
50-174	\$29,000	15%	\$4,000	46%	\$13,000
175-749	\$67,000	26%	\$18,000	81%	\$55,000
750-1206	\$141,000	26%	\$37,000	82%	\$115,000
1207-2000	\$309,000	20%	\$61,000	61%	\$189,000
>2000	\$523,000	19%	\$100,000	59%	\$310,000

#### Table B-4: End-User Retrofit Scenarios: Cost Increases for Emergency Standby Generator Sets

The cost increases associated with Scenarios 3, 4, and 5 that relied on OEM provided after-treatment based engines and technologies are provided in Table II-2. The OEM costs for Tier 4i and Tier 4f gen-sets reflect the addition of DPF and/or SCR after-treatment devices and any costs the OEMs would incur for research, design, assembly line setups, tooling, inventory storage, engine markup, and other considerations. For Tier 4i, a DPF will be required to meet the PM standards on all engines greater than 75 hp. For engines greater than 1207 hp, SCR systems will also likely be required to meet the Tier 4i NOx standard. For the Tier 4f engines, both DPF and SCR systems will be required on all engines greater than 75 hp.

HP Range	Cost of Tier 2/3 Gen- Set (\$)	Tier 4i Regulatory Scenario (DPF)*		OEM Tier 2/3 Scenario (DPF)		Tier 4f Regulatory Scenario (DPF/SCR)	
		% Increase	\$ Increase	% Increase	\$ Increase	% Increase	\$ Increase
50-174	\$29,000	55%	\$16,000	65%	\$19,000	95%	\$28,000
175-749	\$67,000	105%	\$71,000	55%	\$36,000	125%	\$85,000
750-1206	\$141,000	100%	\$136,000	40%	\$57,000	110%	\$156,000
1,207-1,999	\$309,000	75%	\$227,000	30%	\$96,000	80%	\$248,000
>2,000	\$523,000	60%	\$303,000	30%	\$141,000	65%	\$329,000

#### Table B-5: OEM Provided Average Cost Increases for Emergency Standby Generator Sets

\* For > 1,207hp, both SCR and DPF required.

As can be seen in Table B-5, the cost increase for an OEM supplied DPF equipped gen-sets ranges from \$16,000 to \$19,000 for less than 175 hp gen-sets and about \$100,000 for a gen-set in the 1,207 to 1,999 hp range. The costs for OEM gen-sets with DPF and SCR are estimated to be more than 2 times the cost of DPF only gen-sets. Comparing the estimated cost increases between the end-user scenarios and the OEM scenarios, it can be seen that it will be less costly for the end user to retrofit an existing Tier 2 or 3 gen-set than for the OEMs to supply the gen-set. This cost differential helps to support the OEMs contention that it is not economically viable for them to develop and maintain a "California only" emergency standby gen-set platform with after-treatment controls.

Table B-6 below provides a summary of the estimated average cost per hp for each scenario. As is shown, on a per horsepower basis, the costs for an end user to retrofit an existing gen-set is less in most all cases than the potential costs if the gen-set with after-treatment were provided by the OEM. One reason for this cost differential is that the cost data from the OEM included research, design and manufacturing cost associated with producing a CA only product.

HP Range	Tier 4 Interim	OEM Tier 2/3 with DPF	Tier 4 Final	Aftermarket DPF <sup>1</sup>	Aftermarket DPF & SCR
50-174	\$143	\$170	\$250		
175-749	\$154	\$78	\$184		
750-1,206	\$139	\$58	\$160	\$38	\$118
1,207-2,000	\$142	\$60	\$155		
>2,000	\$115	\$54	\$125		

### Table B-6: Average Cost per Horsepower for Each Scenario Investigated

<sup>1</sup>Includes installation costs

#### C. Cost-Effectiveness

ARB staff determined the cost-effectiveness associated with the two scenarios that entailed the end user retrofitting an existing Tier 2 or 3 engine to meet the Tier 4 standards. Because the OEMs have stated they will not provide Tier 4 emergency standby engines for the California market, in the event the ATCM is not amended, the only reasonable compliance pathway for operators would be to retrofit a new Tier 2 or 3 engines with a DPF and SCR to meet the Tier 4 Offroad Standards. In each case, the cost-effectiveness was estimated on a per engine basis by evaluating the emissions and costs impacts for the average size engine within each horsepower range. To determine the cost-effectiveness, ARB staff calculated the difference in PM and NOx emissions between the new Tier 2 or Tier 3 gen-set and the gen-set described for each scenario. For Scenario 1, which relies on DPF after-treatment technology, the entire cost was applied to PM reductions. For Scenario 2, which has both NOx and PM reductions due to the application of DPF and SCR technologies, the costs were apportioned to the estimated emission reductions based on the contribution of the technology cost to the total costs. For example, the cost of the SCR is about 2/3 of the total costs for an engine with both a DPF and SCR. Using this relationship, for an engine equipped with both a DPF and SCR, 2/3 of the cost was attributed to the NOx reductions and 1/3 of the cost to the PM reductions. Table B-7 provides a summary of the costs and cost-effectiveness for each scenario.

Regulatory	gulatory			HP Range					
Scenario			50-174	175-749	750-1206	1207-1999	>2000		
	Average Horsepow	er:	112	462	978	1604	2630		
	Cost Increase Due to Controls	PM	\$4,300	\$17,600	\$37,200	\$60,900	\$99,900		
Scenario 1:		NOx	N/A	N/A	N/A	N/A	N/A		
DPF Retrofit of Tier 2/3 engine	Emission Reductions (Ibs)	PM	8	33	70	115	189		
		NOx	N/A	N/A	N/A	N/A	N/A		
	Cost Effectiveness (\$/lb)	PM	\$540	\$530	\$530	\$530	\$530		
		NOx	N/A	N/A	N/A	N/A	N/A		
Scenario 2: DPF/SCR Retrofit of Tier 2/3 engine	Cost Increase Due to Controls	PM	\$4,400	\$18,200	\$38,500	\$63,100	\$103,400		
		NOx	\$8,800	\$36,300	\$76,900	\$126,100	\$206,900		
	Emission Reductions (Ibs)	PM	8	33	70	115	189		
		NOx	100	413	1456	2280	3740		
	Cost	PM	\$550	\$550	\$550	\$550	\$550		
	Effectiveness (\$/lb)	NOx	\$90	\$90	\$54	\$56	\$56		

# Table B-7: Cost-Effectiveness Associated with the Application of DPF and SCR on Emergency Standby Engines

Assumptions: Emergency standby engine operates 31 hours per year at 30 percent load; 22 hours for maintenance and testing, 7 for emergency hours, and 2 for DRP. DPF costs \$38/hp and SCR costs \$80/hp. Scenario 2 attributes one-third of the cost to PM reductions and two-thirds to NOx reductions. SCR and DPF have 25 year life. For the SCR, it was assumed that for half of the maintenance and testing hours of operation and for all emergency hours (20 hours) the SCR was operating at full efficiency and the NOx emission rate was consistent with the Tier 4 emission standards. For one half of the maintenance and testing operation (11 hours) it was assumed the SCR was not at the correct operating temperature and the NOx levels reflected Tier 2 or Tier 3 NOx emission levels. This assumption is based on the 15 minute warm up time for typical SCR systems. Note, cost estimates are different than those in Table B-4 due to rounding

To provide perspective on these estimates, ARB staff compared the cost-effectiveness for an engine in the 175-749 hp range (see second column under "HP Range" "175-1206" heading in Table B-7) to the cost-effectiveness of regulations or programs currently being implemented by the ARB to reduce PM and NOx emissions. According to an earlier ARB survey, about 40% of all emergency standby engines are within the 175 to 749 hp range. (ARB, 2003). Table B-8 presents a comparison of the PM cost-effectiveness and Table B-9, the NOx cost-effectiveness. As can be seen, the incremental cost-effectiveness associated with the transition from Tier 2 or 3 emission standards to either the Tier 4i or Tier 4f for emergency standby engines is higher than any of the other regulations adopted by the Board. This is primarily due to the low number of hours that emergency standby engine typically operate.

Regulation or Airborne Toxic Control Measure	PM Cost Effectiveness (\$/lb)		
Stationary ATCM Incremental Cost-Effectiveness Tier 2/3 to Tier 4 for New Emergency Standby Engines	\$530		
In-Use Off-road Diesel Vehicle Rule <sup>2</sup>	\$40		
Solid Waste Collection Vehicle Rule	\$32		
Cargo Handling ATCM	\$21		
Ship Main/Aux/Boiler Proposal (2008)	\$16		
Ship Auxiliary Engine Regulation (2005)	\$13		
Public Fleets Rule	\$160		

#### Table B-8: PM Cost-Effectiveness Comparison<sup>1</sup>

Chart taken from Fuel Sulfur and Other Operational Requirements for Ocean-Going Vessels Within California Waters and 24 Nautical Miles of the California Baseline (ARB, 2008)

<sup>2</sup> Attributes all regulation costs associated with diesel emission controls to PM and splits other regulation costs equally between PM and NOx.

#### Table B-9: NOx Cost-Effectiveness Comparison

Regulation or Airborne Toxic Control Measure	NOx Cost Effectiveness (\$/lb)			
Stationary ATCM Incremental Cost-Effectiveness	\$90			
Tier 2/3 to Tier 4 for New Emergency Standby Engines				
Carl Moyer Limit (2008 guidelines)	\$8			
Cargo Handling Equipment Rule	\$1			
In-use Off-Road Diesel Vehicle Regulation	\$2			
Commercial Harbor Craft Rule	\$1			
Portable Engine ATCM	\$2			
Public Fleet Rule	\$11			

#### Load Specific Cost-Effectiveness Calculations

Diesel engines typically have varying emissions rates that are dependent on many variables including the engine load and application. For the analysis of the emissions impacts associated with application of a DPF on a Tier 2 or 3 engine, ARB staff assumed that the PM emission rate of the engine would be equivalent to the 0.15 g/bhp-hr PM emissions standard for Tier 2 or 3 engines greater than 175 hp. This emissions rate is also the publically available emissions rate that is published on the certification executive orders and what manufacturers provide to ARB when demonstrating certification for an engine.

During the development of the proposed amendments, it was commented that when evaluating the cost-effectiveness of applying DPF after-treatment to an emergency standby engine, it is not appropriate to use the Tier 2 or 3 PM emissions limit for a particular horsepower. Rather, it was recommended that ARB staff use the emissions rate that reflects the specific load that the engine is operating. As noted above, ARB

staff relied on the 0.15 g/bhp-hr PM emissions limit for a certified Tier 2 or 3 engine and assumed that is the emissions rate at a 30% load. As a check on this estimation, ARB staff collected available emissions test data at various test loads for 44 different engines. Table B-10 shows the emission rates and the reported values at each load. Using the average emission rates for the 10% and 25% load points, ARB staff calculated the PM cost-effectiveness for a 600 hp engine using the same assumptions for annual hours of operation and DPF life as was used above to generate the values presented in Table B-7. For comparison purposes, ARB staff also recalculated the cost-effectiveness with a 0.15 g/bhp-hr PM emission rate and assumed a 10% and 25% load to provide a more unbiased comparison.

No.	MY	Power	10% load	25% load	50% load	75% load	100% load
1	2007	50	0.25	0.21	0.16	0.16	0.25
2	2010	100	0.25	0.21	0.20	0.19	0.17
3	2007	147	0.27	0.15	0.12	0.09	0.07
4	2010	150	0.19	0.16	0.09	0.08	0.07
5	2010	250	0.51	0.43	0.20	0.05	0.04
6	2010	298	0.87	0.40	0.22	0.04	0.04
7	1985	300	0.68	0.43	0.30	0.20	0.19
8	1999	300	0.17	0.07	0.09	0.08	0.07
9	1991	300	0.41	0.21	0.10	0.09	0.18
10	1986	300	1.25	0.32	0.07	0.07	0.10
11	2010	310	0.29	0.23	0.10	0.05	0.03
12	2000	350	0.96	0.26	0.18	0.17	0.15
13	1999	350	0.36	0.16	0.08	0.07	0.06
14	1991	350	0.77	0.48	0.36	0.18	0.11
15	2000	350	0.74	0.26	0.26	0.23	0.20
16	2000	350	0.73	0.28	0.24	0.24	0.18
17	2000	350	0.74	0.24	0.22	0.20	0.16
18	2005	350	0.17	0.15	0.08	0.07	0.07
19	2010	351	0.12	0.12	0.04	0.04	0.06
20	1990	360	0.68	0.37	0.34	0.28	0.25
21	2005	400	0.16	0.13	0.08	0.07	0.07
22	1990	450	1.31	0.62	0.38	0.40	0.65
23	2005	450	0.13	0.11	0.07	0.07	0.04
24	2005	500	0.13	0.11	0.07	0.07	0.07
25	2010	511	0.24	0.54	0.10	0.12	0.09
26	1998	545	0.57	0.26	0.17	0.20	0.28
27	1998	545	0.70	0.30	0.20	0.23	0.35
28	2010	600	0.32	0.27	0.11	0.07	0.05
29	2010	750	0.30	0.25	0.23	0.19	0.16
30	2010	800	0.30	0.25	0.23	0.19	0.16
31	2010	1000	0.30	0.25	0.20	0.16	0.15
32	2002	1000	0.86	0.36	0.19	0.10	0.07
33	2010	1250	0.51	0.43	0.12	0.09	0.05
34	2000	1500	0.90	0.39	0.23	0.14	0.09
35	2010	1500	0.49	0.42	0.08	0.08	0.05
36	2010	1750	0.33	0.28	0.19	0.08	0.04
37	2010	2000	0.32	0.27	0.16	0.04	0.05
38	2000	2000	0.98	0.34	0.18	0.09	0.07
39	2010	Varies	0.60	0.35	0.15	0.11	0.06
40	2010	Varies	0.28	0.32	0.24	0.06	0.04
41	2010	Varies	0.32	0.17	0.09	0.03	0.05
AVERAGES	g/KW-hr	611 KW	0.50	0.28	0.17	0.13	0.12
	g/BHP-hr	819 HP	0.37	0.21	0.13	0.09	0.09

Table B-10: Diesel Generator Engine Emissions Test Data at Different Load Points<sup>5</sup>

<sup>&</sup>lt;sup>5</sup> Engine emission data provided by Caterpillar, Inc. (Caterpillar, 2010), Cummins, Inc. (Cummins, 2010), John Deere Power Systems (John Deere, 2010), MTU Detroit Diesel (Detroit Diesel, 2010), and "Emissions of regulated pollutants from in-use diesel back-up generators." (U.C. Riverside, 2006)
Using the data in Table B-10, ARB staff calculated the PM cost-effectiveness for a typical 600 hp engine assuming the engine emitted at the average PM emissions rate for the 10% load (0.37 g/bhp-hr) and for the 25% load (0.21 g/bhp-hr). The cost-effectiveness was calculated according to the following equations:

(1) Total PM Reductions = (HP x L) x (EF<sub>PM</sub> - (EF<sub>PM</sub> x .85)) x (1lb/454g) x LF x H

#### Where

HP = horsepower of an emergency standby engine (600 hp)

- L = operational load of engine (10% and 25%)
- EF = emission rate of diesel PM at the specified load (g/bhp-hr)
- LF = expected DPF life (25 years)
- H = annual hours of operation (31 hrs)

(2) Total Cost Effectiveness = (HP x C) / (Total PM Reductions)

Where

HP = horsepower of an emergency standby engine (600 hp)

C = cost of DPF (\$38 per hp)

#### Table B-11: Comparison of PM Cost-Effectiveness Calculated with Load Specific PM Emission Rates to Cost-Effectiveness Calculated Using the PM Emission Standard

Load	HP	PM Emission Rate g/bhp-hr	PM Emission Rate with DPF g/bhp-hr	Total PM Reduced Over 25 Years (lbs)	Total DPF Cost	Cost Effectiveness (\$/Ib)
10%		0.37	0.05	32		\$710
25%		0.21	0.03	46	1 [	\$495
10%	600	0.15	0.01	14	\$22,800	\$1,630
25%		0.15	0.01	36	] [	\$630
30%	_	0.15	0.01	43		\$530

Table B-11 provides a summary of the cost-effectiveness values. The first two rows present the cost effectiveness calculated using the equation above and the average PM emissions rates at 10% and 25% load presented in Table B-10. The last three rows provide the cost-effectiveness values at 10%, 25%, and 30% loads that were calculated using the approach ARB staff used to evaluate the cost-effectiveness of DPF after-treatment on emergency standby engines *i.e.* assume the engine has the same PM emission rate equivalent to 0.15 g/bhp-hr at all loads. As can be seen, at the 25% load, using the load specific values reduces the cost-effectiveness by about 20% as compared to the cost-effectiveness calculated assuming the engine emits at the 0.15 g/bhp-hr emission rate. The difference is more significant at a 10% load, with cost-

effectiveness calculated using the load-specific values being about 60 percent lower than that calculated using the 0.15 g/bhp-hr PM emission rate. However, in each case, it is clear that the cost effectiveness is still prohibitively high compared to previous regulations as can be seen in Table B-8.

#### D. Direct Drive Fire Pumps

The analysis above focused on emergency standby generator sets. The same costs estimates and conclusions regarding cost-effectiveness also apply to emergency directdrive fire pump engines. However, as discussed below, there are also other factors concerning the application of SCR and DPF on emergency standby direct drive fire pumps. Due to the substantial cost and time to develop Tier 4 engines specifically for fire pump applications, and the relatively small market for these engines in California, (about 100 new engines per year), suppliers have indicated that it may not be economically viable for them to offer new fire pump engines in California if the Tier 4 standards are implemented. (Clarke, 2010a)(Clarke, 2010b)

Emergency standby fire pump engines are unique in that they must be certified to the National Fire Protection Association (NFPA) requirements and certified by an independent produce safety organization. Engine manufacturers and fire pump system suppliers work together to develop and certify these engines to NFPA requirements, a process that can take many months or years. Having an added SCR or DPF device on the fire pump engine would likely complicate and lengthen this process.

On the engine manufacturer side, achieving certification typically involves changes to the software that controls the engine. For example, the engine may be programmed to deactivate engine protection features during a fire (such as stopping the engine when it is operating outside of normal parameters), while activating these features during normal maintenance and testing runs. Electronically-controlled engines may also be supplied with two engine control units to provide redundancy in case one fails. Fire pump engines may also be designed without a radiator, instead utilizing the cooling water they are designed to pump. In addition to the development time with the engine manufacturer, the fire pump supplier must certify the engine to the requirements of NFPA 20. Standard for the Installation of Stationary Pumps for Fire Protection. Third party certification companies such as Underwriters Laboratories (an independent product safety certification organization) and FM Global (an insurance company) approve (or "list") products to the NFPA 20 requirements. These organizations certify each component in fire protection systems, including the engine, fire pump, pump control unit, coupling between the engine and pump. For example, the engines used in fire pumps must be certified by the company to ensure that the engine power is at least 10 percent greater than the maximum power required by the pump under any conditions of pump load (among other requirements). Fire pump system suppliers typically seek separate certifications for both FM Global and UL. FM Global certification may be needed for manufacturing sites, while UL may be needed for other applications. Since the supplier wants their fire pump systems to be acceptable in all possible applications, certification to both FM Global and UL is typical.

#### E. Findings

Based on the analysis of the feasibility, costs, and cost-effectiveness associated with the application of DPF and SCR after-treatment devices on emergency standby engines, ARB staff has the following findings.

- Applications of DPFs on emergency standby engines are technically feasible and there are currently about 300 emergency standby engines in California that have DPFs installed.
- There is very limited application of SCR on emergency standby engines. ARB staff is aware of a few applications on larger emergency standby engines in California. However, ARB staff believes that while the current generation of SCR systems may be technically feasible, there are significant economic and operational constraints to the routine use of SCR on emergency standby engines. This is because the majority of operating hours for emergency standby engines occur during short 15 to 30 minute maintenance and testing checks are at low engine loads. In most cases, the temperature needed for the SCR catalyst to function will not be reached during this operation and the SCR will not provide the expected NOx reductions.
- Tier 4 engines that rely on after-treatment technology for emergency standby applications will not be available from the original equipment manufacturers. Representatives from the EMA have indicated that it will not be economically viable for engine manufacturers to develop and maintain a Tier 4 emergency standby engine platform for California. Because of this, staff has concluded that Tier 4 engines for emergency standby applications will not be available "off-the-shelf." Rather, each owner or operator will need to purchase a new Tier 2 or Tier 3 engines and then work with suppliers to retrofit the engine with a DPF and/or SCR to meet the Tier 4 emission standards for all pollutants.
- It is not cost-effective to routinely apply DPF or SCR after-treatment technologies on emergency standby engines. The costs of SCR and DPF after-treatment technology are very high and given the low number of hours that a typical emergency standby engine operates, about 31 hours per year, the cost-effectiveness is significantly higher than other ARB diesel engine regulations.

Based on the analysis, and those of U.S. EPA (EPA, 2006), ARB staff believes it is appropriate to more closely align the ATCM emissions standards for new emergency standby engines with those in the NSPS that do not require after-treatment based emission standards. However, ARB staff believes it is also important to continue provide the districts with the ability to impose more stringent conditions on a site-specific basis where the additional controls are warranted.

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EPA-453/R-94-065

# ALTERNATIVE CONTROL TECHNIQUES DOCUMENT --NO<sub>x</sub> EMISSIONS FROM IRON AND STEEL MILLS

Emission Standards Division



U.S. ENVIRONMENTAL PROTECTION AGENCY Office of Air and Radiation Office of Air Quality Planning and Standards Research Triangle Park, North Carolina 27711 September 1994 · · · ·

#### ALTERNATIVE CONTROL TECHNIQUES DOCUMENTS

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#### BAY AREA AIR QUALITY MANAGEMENT DISTRICT Best Available Control Technology (BACT) Guideline

Source Category

4 2

	D. J. C. C. C. C. L.	Revision:	1 Date and
Source:	products	Document #-	161.5.1
Class:	<50 lb/day Emissions (uncontrolled)	Date:	12/16/03

#### Determination

POLLUTANT	BACT 1. Technologically Feasible/ Cost Effective 2. Achieved in Practice	TYPICAL TECHNOLOGY
POC	<ol> <li>Coating w/ VOC content and transfer efficiency complying w/ Reg. 8, Rule 19, and emissions controlled to overall capture/ destruction efficiency ≥90%<sup>a,c</sup></li> <li>Complying w/ Reg. 8, Rule 19<sup>a</sup></li> </ol>	<ol> <li>Collection System Vented to Carbon Adsorber or Afterburner<sup>a,c</sup></li> <li>Low VOC Coatings<sup>a</sup></li> </ol>
NOx	1. n/a 2. n/a	1. n/a 2. n/a
$SO_2$	1. n/a 2. n/a	1. n/a 2. n/a
СО	1. n/a 2. n/a	1. n/a 2. n/a
PM <sub>i0</sub>	1. n/d 2. n/s	1. n/d 2. Dry Filters or Waterwash, Properly Maintained <sup>4</sup>
NPOC	1. Coating w/ solvent content and transfer efficiency complying w/ Reg. 8, Rule 19, and emissions controlled to overall capture/ destruction efficiency $\geq 90\%^{a,c}$ 2. Complying w/ Reg. 8, Rule 19 <sup>a</sup>	<ol> <li>Collection System Vented to Carbon Adsorber<sup>a.c</sup></li> <li>Low Solvent Coatings<sup>a</sup></li> </ol>

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a. BAAQMD c. Generally considered to be cost-effective if uncontrolled emissions  $\geq$  50 lb/day

www.baagmd.gov/permits/permitting-manuals/bact-+bact-workbook

## BAY AREA AIR QUALITY MANAGEMENT DISTRICT Best Available Control Technology (BACT) Guideline

#### Source Category

Source:	Solid Material Handling (Conveying, Size Reduction, Classification) - Dry	Revision:	1
Class	All	Date:	10/18/91

#### Determination

POLLUTANT	BACT 1. Technologically Feasible/ Cost Effective 2. Achieved in Practice	TYPICAL TECHNOLOGY
POC	1. n/a 2. n/a	1. n/a 2. n/a
NOx	1. n/a 2. n/a	1. n/a 2. n/a
SO <sub>2</sub>	1. n/a 2. n/a	1. n/a 2. n/a
CO	1. n/a 2. n/a	1. n/a 2. n/a
PM <sub>10</sub>	1. $n/d$ 2. Enclosure of Size reduction and classification equipment, conveyors, and associated material transfer points and vent to baghouse(s0 w/ <0.01 gr/dscf <sup>a,T</sup>	1. n/d 2. BAAQMD Approved Design and Operation <sup>a</sup>
NPOC	1. n/a 2. n/a	1. n/a 2. n/a

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T, TBACT	

# Section I: AQMD BACT Determinations

#### Application No.: 323709

## Equipment Category - Bulk Solid Material Storage and Handling - Coke

1.	GENERAL INFORMATION			DATE:	5/16/200	)2	
Α.	MANUFACTURER: Custom Made						<u></u>
Β.	TYPE: Water slurry transfer with hydrobins	C.	MODEL:				
D.	STYLE:						
E.	APPLICABLE AQMD REGULATION XI RULES: 1158						
F.	COST: \$ (2000) SOURCE OF COS	T DA	TA:				
G.	OPERATING SCHEDULE: 24 HRS/DAY		7 <sup>D/</sup>	AYS/WK	· · · · · · · · · · · · · · · · · · ·	52 <sup>w</sup>	/KS/YR
2.	EQUIPMENT INFORMATION			APP. NO.	32370	9	
Α.	FUNCTION: The system transfers coke from re	fine	ery delay	ed cok	ing units	by wate	er slurry to
	three elevated hydrobins. Trucks are loaded	d be	eneath ea	ach hyd	robin by	gravity	feed.
В.	SIZE/DIMENSION/CAPACITY: Each bin: 40' D x 54' H	[, 7	00 tons c	capacity	r		
C.	BLOWERS:	D.	TOTAL FL	OW RATE:	5	scfm	
Ε.	MATERIAL STORED/PROCESSED/HANDLED: Petroleum co	oke					
F.	THROUGHPUT/PROCESS RATE/USAGE RATE: 650,000 tor	ıs p	er year (	Max.)			
3.	COMPANY INFORMATION			APP. NO.	32370	9	
A.	NAME: Ultramar. Inc.					B. SI	C CODE: 2911
C.	ADDRESS: 2402 E. Anaheim St.						
	CITY: Wilmington		STATE: C	CA	ZI	P: 9074	44
D.	CONTACT PERSON: David Price			E. PHO	ONE NO.: 5	62-491	-6797
4.	PERMIT INFORMATION			APP. NO.	32370	9	
Α.	AGENCY: SCAOMD	В.	APPLICAT	ION TYPE:	new cor	structio	on
C.	AGENCY CONTACT PERSON: Norman Ng	L		D. PHO	DNE NO.: 9	09-396	-2460
E.	PERMIT TO CONSTRUCT/OPERATE INFORMATION: P/C N	0.:	323709		ISSUAN	ICE DATE:	7/24/1997
	CHECK IF NO P/C P/O N	0.:			ISSUAN	ICE DATE:	
F.	START-UP DATE: November 1998						
5.	EMISSION INFORMATION			APP. NO	: 32370	9	
A	PERMIT			L	52510	/	
A1.	PERMIT LIMIT: Throughput limited to no more t	har	1 650 00	tons r	er vear	Mainta	in moisture
	rinoughput minicu to no more t	ch	down of	surface	under h	vdrohin	s Wash

down all departing trucks.

website South Coast AQNID www.aqmd.gov/home/permits/bact/guidelines/i---scognd-lear-bacz

5.	EMISSION INFORMATION	APP. NO.:	323709	
A2.	BACT/LAER DETERMINATION: Compliance with R	ule 1158 (10-20-00) an	d use of water	slurry
	transfer and hydrobin storage.	,		
A3.	BASIS OF THE BACT DETERMINATION: Offered by app	plicant		
В.	CONTROL TECHNOLOGY			
B1.	MANUFACTURER/SUPPLIER:			
B2.	ТҮРЕ:			
B3	DESCRIPTION: No. 11 an annual tachnolog	w is required		
	NO add-on control technolog	y is required.	ISSUANCE DATE:	
B4.	F	 P/O NO.:	ISSUANCE DATE:	
		FLOW RATE:		
ВЭ.		BLOWER HP		
B6.				
B7.	PRIMARY POLLUTANTS: Particulate Matter			
B8.	SECONDARY POLLUTANTS:			
B9.	SPACE REQUIREMENT:			
B10.	LIMITATIONS:			B11. UNUSED
B12.	OPERATING HISTORY: System has performed v	well since startup (11/98	3)	
B13.	UNUSED	B14. UNUSED		
C.	CONTROL EQUIPMENT COSTS			
C1.	CAPITAL COST: CHECK IF INSTALL	ATION COST IS INCLUDED IN CAPITA	AL COST	
	EQUIPMENT: \$ INSTALLATION: \$ (2)	000) SOURCE OF COST DATA	:	
C2.	ANNUAL OPERATING COST: \$ (2000)	SOURCE OF COST DATA		
D.	DEMONSTRATION OF COMPLIANCE			
D1.	STAFF PERMFORMING FIELD EVALUATION:			
	ENGINEER'S NAME: Marty Kay / Alfonso Bae	Z	INSPECTOR'S	S NAME:
	DATE:	5/2/2002		
D2.	COMPLIANCE DEMONSTRATION: Recordkeeping a	nd periodic inspections		
D3.	VARIANCE: NO. OF VARIANCES:	DATES:		
	CAUSES:			
D4.	VIOLATION: NO. OF VIOLATIONS:	DATES:		
	CAUSES: None related to coke storage/har	ndling		
D5.	MAINTENANCE REQUIREMENTS:			D6. UNUSED
D7.	SOURCE TEST/PERFORMANCE DATA RESULTS AND ANALYS	IS:		
	DATE OF SOURCE TEST:	CAPTURE EFFICIENCY:		
	DESTRUCTION EFFICIENCY:	OVERALL EFFICEINCY:		
	SOURCE TEST/PERFORMANCE DATA:			
	OPERATING CONDITIONS:			
	TEST METHODS:			

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<b>b. COMMENTS</b> 323709
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This system replaced a coke barn, coke piles, a front-end loader and associated belt conveyors, etc. and is estimated to reduce coke handling-related particulate emissions by approximately 200 lb/day and reduce the refinery's electric power requirements.

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Thought this may apply to their furnace Application No : 2707

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#### **Equipment Category** – Metal Heating Furnace

1.	GENERAL INFORMATION			DATE: 4/15/200	3
Α.	MANUFACTURER: Thorpe Industrial Furnace				
В.	TYPE:	C.	MODEL:		
D.	STYLE:				
E.	APPLICABLE AQMD RULES: 2012				
F.	COST: \$ (NA) SOURCE OF	COST DA	TA:		
G.	OPERATING SCHEDULE: 24 HRS/DAY		5 D.	AYS/WK	50 WKS/YR
2.	EQUIPMENT INFORMATION			APP. NO.: 379746	5
Α.	FUNCTION: RECLAIM device No. D1: rece	eives n	nolten a	luminum from m	elting furnace and
	maintains it in liquid form during alloy a	dditio	n and ni	trogen gassing.	Nitrogen gassing
	mixes and purifies the aluminum alloy pi	roduct	•		
В.	8.8 MMBtu/hr	C.	MAXIMUN	120	tpd (typical)
D.	BURNER INFORMATION: NO.: 2	YPE: L	.ow-NO	X	
Ε.	PRIMARY FUEL: Natural Gas	F.	OTHER F	UEL: None	
G.	OPERATING CONDITIONS: Batch operation. Batc	ch size	is appro	oximately 40 tons	s. Typically, three
bat	ches per day.			-	
2	COMPANY INFORMATION			APP NO: 07074	
				3/9/40	
<u> </u>	International Extrusion Corp.				B. 310 CODL. 3354
0.	ADDRESS: 1000 Meridian Ave.		STATE	7.1	
	Alhambra				91803
<i>D</i> .	Bob Olivas			E. PHONE NO 62	26-576-2424
4.	PERMIT INFORMATION			APP. NO.: 379746	5
Α.	AGENCY: SCAOMD	В.	APPLICA	TION TYPE: modifica	ation
C.	AGENCY CONTACT PERSON: Manny Quizon			D. PHONE NO.: 90	09-396-2639
E.	PERMIT TO CONSTRUCT/OPERATE INFORMATION: P/	/C NO.:	379736	ISSUANC	CE DATE: 1/22/2001
	CHECK IF NO P/C P/	/O NO.:	379736	ISSUANC	CE DATE: 2/15/2002
F.	START-UP DATE: 3/29/2001	100 B			
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5.	EMISSION INFORMATION			APP. NO.: 379746	5
Α.	PERMIT				
A1.	PERMIT LIMIT: NOx not to exceed 40 ppmvd	@3%0	D2 (REC	CLAIM Concentr	ration Limit)
1 4 2					

BACT/LAER DETERMINATION: 40 ppmvd@3%O2 (low-NOx burner)

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5.	EMISSION INFORMATION		APP. NO.: 379746		
A3.	BASIS OF THE BACT/LAER DETERMINATION: Achieved	l in Practice			
В.	CONTROL TECHNOLOGY				
B1.	MANUFACTURER/SUPPLIER: Bloom Engineerin	g Co.	·····		
B2.	TYPE: Low-NOx Burner	<b>~</b>			
B3.	DESCRIPTION: Model 1500-LXX, 4.4 MM	Btu/hr			
B4.	CONTROL EQUIPMENT PERMIT APPLICATION DATA:	P/C NO.:	ISSUANCE DATE:		
		P/O NO.:	ISSUANCE DATE:		
B5.	WASTE AIR FLOW TO CONTROL EQUIPMENT:	F	LOW RATE:		
	ACTUAL CONTAMINANT LOADING:	В	LOWER HP:		
B6.	WARRANTY: NOx guaranteed not to excee	d .044 lb/MMBt	u (35 ppmvd@3%O2)		
B7.	PRIMARY POLLUTANTS: NOX, CO, VOC, PM				
B8.	SECONDARY POLLUTANTS:				
B9.	SPACE REQUIREMENT:				
B10.	LIMITATIONS:			B11.	UNUSED
B12.	OPERATING HISTORY:				
B13.	UNUSED	B14. UNUSED			
C.	CONTROL EQUIPMENT COSTS				
C1.	CAPITAL COST: CHECK IF INSTALL	LATION COST IS INCLUDE	D IN EQUIPMENT COST		
	EQUIPMENT: \$ INSTALLATION: \$	$(NA)^{\text{SOURCE OF}}$	COST DATA:		
C2.	ANNUAL OPERATING COST: \$ (NA)	SOURCE OF	COST DATA:		
D.	DEMONSTRATION OF COMPLIANCE				
D1.	STAFF PERMFORMING FIELD EVALUATION:				
	ENGINEER'S NAME: INSPI	ECTOR'S NAME:	DATE:		
D2.	COMPLIANCE DEMONSTRATION:				
D3.	VARIANCE: NO. OF VARIANCES: None	DATES:			
	CAUSES:				
D4.	VIOLATION: NO. OF VIOLATIONS: None	DATES:			
	CAUSES:				
D5.	MAINTENANCE REQUIREMENTS:			D6.	UNUSED

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5. EMISSION INFORM	ATION		APP. NO	<sup></sup> 379746
D7. SOURCE TEST/PERFORMANCE DATA R	ESULTS AND ANA	LYSIS:		
DATE OF SOURCE TEST: 9/52001	l	CAPTUR	E EFFICIENCY	r. •
DESTRUCTION EFFICIENCY:		OVERALI	EFFICIENCY	:
SOURCE TEST/PERFORMANCE DATA:				
Temp	eratures, F		ppmvd@	03%O2
Furnace % Load Roof	Exhaust	O2, % (dry)	NOx	СО
D1 (Holding) 30 1340	659	11.5	33.0	58
100 1360	667	5.4	25.1	165
OPERATING CONDITIONS: Test di	urations wer	e 40 minutes at	low fire	and 20 minutes at high fire.
TEST METHODS: AQMD Method 100.1. Test was approved by AQMD Monitoring & Source				
Test Engineering group.				

#### 6. COMMENTS

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APP. NO.: 379746

This is a RECLAIM facility. The facility requested a permit modification to apply a RECLAIM concentration limit of 40 ppmvd (corrected to 3% O2) to this furnace. This low-NOx burner is considered achieved in practice. Although this burner is capable of meeting a NOx limit of 40 ppm in this furnace when operated on natural gas, NOx emissions may be different in other furnaces with other burner/furnace configurations, operating temperatures or other operating conditions. It is suggested the the NOx emission guarantee or 50 ppm, the BACT Part D guideline, be used as a starting point in permitting a new or modified furnace, i.e., in the Permit to Construct, and that the final NOx limit in the Permit to Operate be determined after source testing is completed. Source testing should include the highest-NOx operating mode

#### Best Available Control Technology (BACT) Guideline 8.4.1\*

Last Update: 10/20/1992

#### Dry Material Storage and Conveying Operation, 100 tons/day

Pollutant	Achieved in Practice or	Technologically	Alternate Basic
	contained in the SIP	Feasible	Equipment
PM10	Storage, augers, elevators, conveyors all enclosed and vented to a fabric filter baghouse		

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in s a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

\*This is a Summary Page for this Class of Source

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webs site www.valleyair.org/busind/pto/bact/chapter & pdf

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#### Best Available Control Technology (BACT) Guideline 8.4.2\*

Last Update: 9/29/1992

#### Wet Material Storage and Conveying Operation, 200 tons/day

Pollutant	Achieved in Practice or	Technologically	Alternate Basic
	contained in the SIP	Feasible	Equipment
PM10	Enclosed storage with sufficient moisture so visible emissions are less than 5% opacity from any single emission point		

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in s a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

\*This is a Summary Page for this Class of Source

#### Best Available Control Technology (BACT) Guideline 8.4.3\*

Last Update: 4/2/2012

#### Dry Material Handling Operation - Mixing, Blending, Milling, or Storage

Pollutant	Achieved in Practice or	Technologically	Alternate Basic
	contained in the SIP	Feasible	Equipment
PM10	Mixer, augers, elevators, conveyors all enclosed and vented to a fabric filter baghouse, or equivalent (99% or greater control efficiency)		

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in s a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

\*This is a Summary Page for this Class of Source

#### Best Available Control Technology (BACT) Guideline 8.3.10\*

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Last Update: 6/19/2000

#### **Cooling Tower - Induced Draft, Evaporative Cooling**

Pollutant	Achieved in Practice or	Technologically	Alternate Basic
	contained in the SIP	Feasible	Equipment
PM10		Cellular Type Drift Eliminator	

BACT is the most stringent control technique for the emissions unit and class of source. Control techniques that are not achieved in practice or contained in s a state implementation plan must be cost effective as well as feasible. Economic analysis to demonstrate cost effectiveness is required for all determinations that are not achieved in practice or contained in an EPA approved State Implementation Plan.

\*This is a Summary Page for this Class of Source

EPA/452/B-02-001

# EPA AIR POLLUTION CONTROL COST MANUAL

Sixth Edition

EPA/452/B-02-001

January 2002

web site https://www3.epa.gov/ ttncatc1/dir1/c\_allct pdf

United States Environmental Protection Agency Office of Air Quality Planning and Standards Research Triangle Park, North Carolina 27711 This sixth edition of the EPA Air Pollution Control Cost Manual was prepared by the Air Quality Strategies and Standards Division of the Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. Mention of trade names or commercial products is not intended to constitute endorsement or recommendation for use. Copies of this report are available through the OAQPS Clean Air Technology Center (MD-15), U.S. Environmental Protection Agency, Research Triangle Park NC 27711, or from the National Technical Information Service, 5285 Port Royal Road, Springfield VA 22161, (phone: 1-800-553-6847.)

Questions and comments should be addressed to the principal editor, Daniel C. Mussatti, OAQPS, phone 919-541-0032.

#### EPA Air Pollution Control Cost Manual (Sixth Edition) Section/Chapter Title Introduction Section 1 Chapter 1 Background Chapter 2 Cost Estimation: Concepts and Methodology Section 2 **Generic Equipment and Devices** Hoods, Ductwork, and Stacks Chapter 1 Chapter 2 Fans, Pumps, and Motors <sup>2</sup> Permanent Total Enclosures<sup>2</sup> Chapter 3 Chapter 4 Monitors<sup>1</sup> Section 3 VOC Controls **VOC Recapture Controls** Section 3.1 Chapter 1 Carbon Adsorbers Refrigerated Condensers Chapter 2 **VOC Destruction Controls** Section 3.2 Chapter 1 Flares Chapter 2 Incinerators NO<sub>x</sub> Controls Section 4 NO Combustion Controls Section 4.1 Fuel Switching Chapter 1 Low NOx Burners and other Combustion Controls 2 Chapter 2 Chapter 3 Steam/Water Injection Chapter 4 Natural Gas Reburn Section 4.2 NO Post-Combustion Selective Non-Catalytic Reduction Chapter 1 Selective Catalytic Reduction Chapter 2 Non-Selective Catalytic Reduction<sup>2</sup> Chapter 3 Section 5 SO, and Acid Gas Controls Pre-Combustion Controls Section 5.1 Fuel Substitution Chapter 1 Section 5.2 **Post-Combustion Controls** Wet Scrubbers for Acid Gas Chapter 1 Wet and Dry Scrubbers for SO,<sup>2</sup> Chapter 2 **Particulate Matter Controls** Section 6 Baghouses and Filters Wet Scrubbers for PM<sup>2</sup> Chapter 1 Chapter 2 Electrostatic Precipitators Chapter 3 Inertial Impactors Chapter 4 Section 7 Mercury Controls<sup>1</sup> <sup>1</sup> New Chapter Planned Chapter

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#### BACT Clearinghouse (Searchable)

INSTRUCTIONS: To filter, enter a search term in "Search Description" and press return, or select a "Main Category" and/or "Sub Category"

Search Description

Main Category

Sub Category

Description

- 1.1.1 Boiler: < or = 20.0 MMBtu/hr, Natural Gas or Propane Fired \*RESCINDED\* (10/26/2009)
- 1.1.2 Boiler: > 20.0 MMBtu/hr, Natural gas fired, base-loaded or with small load swings, \*RESCINDED\* (10/26/2009)
- 1.1.3 Boiler > 20.0 MMBtu/hr, Natural gas fired, with highly variable loads or high turndown ratios, \*RESCINDED\* (10/26/2009)
- 1.1.4 Digester Gas Fired Boiler \*RESCINDED\* (10/26/2009)
- 1.1.5 Boiler-Dual Fuel for Facilities Requiring Liquid Backup Fuel \*RESCINDED\* (10/26/2009)
- 1.1.6 Boiler Fired with a High-Ammonia Fuel \*RESCINDED\* (10/26/2009)
- 1.1.7 Limited Use Boiler Natural Gas Fired, < 9 Billion Btu/yr \*RESCINDED\* (10/26/2009)
- 1.1.8 Biomass-fired Boiler Grate Systems \*RESCINDED\* (10/26/2009)
- 1.2.1 Oiffield Steam Generator (> or = 20 MMBtu/hr) (3/24/2014)
- 1.2.2 Steam Generator >20.0 MMBtu/Hr Vertically Oriented w/Counterflow Heat Transfer \*RESCINDED\* (10/26/2009)
- 1.2.3 Oilfield Steam Generator/TEOR Gas Incinerator \*\* RESCINDED part of 5/04 update to guideline 1.2.1\*\* (5/1/2004)
- 1.3.1 Fluidized-Bed Combustor => 272 MMBtu/hr, Cogeneration Operation, Fired with Delayed Petroleum Coke (DPC) (8/27/2005)
- 1.3.2 Fluidized Bubbling Bed Combustor (biomass-fired) \*RESCINDED\* (3/12/2012)
- 1.4.1 Waste Gas Flare 15.3 MMBtu/hr, Serving a Tank Vapor Control System \*RESCINDED\* (11/7/2016)
- 1.4.2 Waste Gas Flare Incinerating Produced Gas \*RESCINDED\* (11/7/2016)
- 1.4.3 Landfill Gas Vapor Collection System \*RESCINDED\* (11/7/2016)
- 1.4.4 Digester Gas-Fired Flare \*RESCINDED\* (11/7/2016)
- 1.4.5 Oilfield Waste Gas Incinerator \*RESCINDED\* (11/7/2016)

San Joaquin Valley AQNID

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this is a searchable BACT cleaninghous

I can not print the list

I didn't see anything that seemed applicable to Nucor or P&G, but you can shim the list on the web site if you want

https://www3.epa.gov/ttncatc1/cica/atech\_e.html#444

web rite

https://www3.epa.gov/ttncatc1/cica/atech\_e.html#444 Last updated on 9/30/2016



Technology Transfer Network

Unsre-Mexiconder chere rational Gentereoraty Air Pollutionachnology Center CICA Technical Resources (CICA)

# **Technical Resources**

This section includes documents, software tools, models and listings of available material. These resources either provide information on air quality, or are tools to assess air quality along the U.S.-Mexico border and/or any other area, especially Spanish speaking countries.



For additional information on products and projects funded by CICA, see <u>CICA Project Abstracts</u>

You will need Adobe Reader to view some of the files on this page. See EPA's PDF page to learn more.

#### Technical Resources

#### Categories

- Air Pollution Technology Fact Sheets
- CATC Technical Bulletins
- EPA Air Pollution Control Cost Manual
- Air Quality Models
- Emissions Modeling: El Paso-Juarez
- Emissions Inventories: Mexico (Western Governors Assoc. Publications)
- Emissions Factors & Transport Studies
- Ambient Air Monitoring Information
- Other Publications

Air Pollution Technology Fact Sheets		
Sub-categories	Resources	
Baghouses (Fabric Filters)	<ul> <li>Mechanical Shaker-Cleaned Type with &amp; without Sonic Horn Enhancement (33kb; 7-15-03)</li> <li>Pulse-Jet Cleaned Type (33 kb; 7-15-03)</li> <li>Reverse-Air/Reverse-Jet Cleaned Type with &amp; without Sonic Horn Enhancement (36 kb; 7-15-03)</li> </ul>	
Cyclones	Cyclone Fact Sheet (31 kb; 7-15-03)	
Electrostatic Precipitators	<ul> <li>Dry Electrostatic Precipitator - Wire-Pipe Type (29 kb; 7-15-03)</li> <li>Dry Electrostatic Precipitator - Wire-Plate Type (33 kb; 7-15-03)</li> <li>Wet Electrostatic Precipitator - Wire-Pipe Type (28 kb; 7-15-03)</li> <li>Wet Electrostatic Precipitator - Wire-Plate Type</li> </ul>	

Elutriators	<ul> <li>Elutriator Fact Sheet (24 kb; 7-15-03)</li> </ul>
Filters (Extended Media)	<ul> <li>Cartridge Collector with Pulse-Jet Cleaning (45 kb; 7-15-03)</li> <li>High Efficiency Particle Air Filter &amp; Ultra Low Penetration Air Filter (37 kb; 7-15-03)</li> </ul>
Flares	• Flare Fact Sheet (29 kb; 7-15-03)
Incinerators	<ul> <li><u>Catalytic Incinerator (32 kb; 7-15-03)</u></li> <li><u>Recuperative Type Incinerator (30 kb; 7-15-03)</u></li> <li><u>Regenerative Type Incinerator (25 kb; 7-15-03)</u></li> <li><u>Thermal Incinerator (30 kb; 7-15-03)</u></li> </ul>
Permanent Total Enclosures	<ul> <li>Permanent Total Enclosure Fact Sheet (22 kb; 7-15-03)</li> </ul>
Scrubbers	<ul> <li>Condensation Scrubber (21 kb; 7-15-03)</li> <li>Fiber-Bed Scrubber (21 kb; 7-15-03)</li> <li>Flue Gas Desulfurization - Wet, Spray Dry, and Dry Scrubbers (34 kb; 7-15-03)</li> <li>Impingement-Plate/Tray-Tower Scrubber (30 kb; 7-15-03)</li> <li>Mechanically-Aided Scrubber (22 kb; 7-15-03)</li> <li>Orifice Scrubber (23 kb; 7-15-03)</li> <li>Packed-Bed/Packed-Tower Wet Scrubber (32 kb; 7-15-03)</li> <li>Spray-Chamber/Spray-Tower Wet Scrubber (33 kb, 7-15-03)</li> <li>Venturi Scrubber (25 kb; 7-15-03)</li> </ul>
Selective Catalytic Reduction	<ul> <li>Selective Catalytic Reduction (28 kb; 7-15-03)</li> </ul>
Selective Non-catalytic Reduction	<ul> <li><u>Selective Non-Catalytic Reduction (32 kb;</u> <u>7-15-03)</u></li> </ul>
Separators	<ul> <li>Mechanically-Aided Separators (21 kb; 7-15-03)</li> <li>Momentum Separators (24 kb; 7-15-03)</li> </ul>
Settling Chambers	<ul> <li>Settling Chamber Fact Sheet (28 kb; 7-15-03)</li> </ul>

(32 kb; /-15-03	
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CATC Technical Bulletins			
Sub-categories	Resources		
Choosing and Adsorption System for VOC: Carbon, Zeolite of Polymers?	<ul> <li><u>Choosing an Adsorption System</u>, EPA 456/F- 99-004 (269 kb; 6-10-99)</li> </ul>		
Nitrogen Oxides (NOx), Why and How They are Controlled	<ul> <li><u>Nitrogen Oxides (NOx), EPA-456/F-99-006R</u> (306, kb; 6-14-00)</li> </ul>		

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Refrigerated Condensers for Control of Organic Air Emissions	<ul> <li><u>Refrigerated Condensers, EPA-456/R-01-004</u> (250 kb; 1-07-02)</li> </ul>
Ultraviolet and Electron Beam (UV/EB) Cured Coatings, Inks and Adhesives	<ul> <li><u>Ultraviolet and Electron Beam, EPA-456/K-</u> 01-001 (720 kb; 9-06-01)</li> </ul>
Using Bioreactors to Control Air Pollution	<ul> <li><u>Using Bioreactors, EPA-456/R-03-003 (470 kb;</u> <u>10-15-03)</u></li> </ul>
Zeolite: A Versatile Air Pollutant Adsorber	• Zeolite, EPA-456/F-98-004 (161 kb; 8-12-98)
Other CATC Program & Products	<u>Clean Air Technology Center (CATC)</u>

EPA Air Pollution Control Cost Manual (EPA 452/B-02-001)		
Sub-categories	Resources	
READ ME file and Table of Contents	<ul> <li><u>READ ME first file (16 kb; 4-26-02)</u></li> <li><u>Table of Contents (26 kb; 4-26-02)</u></li> </ul>	
Entire Document (All Chapters Currently Available)	• Entire Document; All Chapters Currently Available (2.5 Mb; 4-26-02)	
Section 1 - Introduction	<ul> <li><u>Chapter 1 - Background (42 kb; 4-26-02)</u></li> <li><u>Chapter 2 - Cost Estimation: Concepts and</u> <u>Methodology (183 kb; 4-26-02)</u></li> </ul>	
Section 2 - Generic Equipment and Devices	<ul> <li>Chapter 1 - Hoods, Ductwork, and Stacks (184 kb; 4-26-02)</li> <li>Chapter 4 - Monitors (137 kb; 4-26-02)</li> </ul>	
Section 3 - VOC Controls	<ul> <li>Section 3.1 - VOC Recapture Controls, Chapter 1 - Carbon Absorbers (138 kb; 4-26-02)</li> <li>Section 3.1 - VOC Recapture Controls, Chapter 2 - Refrigerated Condensers (133 kb; 4-26-02)</li> <li>Section 3.2 - VOC Destruction Controls, Chapter 1 - Flares (136 kb; 4-26-02)</li> <li>Section 3.2 - VOC Destruction Controls, Chapter 2 - Incinerators (194 kb; 4-26-02)</li> </ul>	
Section 4 - NOx Controls	<ul> <li>Section 4.2 - NOx Post-Control, Chapter 1 - Selective Non-Catalytic Reduction (187 kb; 4-26-02)</li> <li>Section 4.2 - NOx Post-Control, Chapter 2 - Selective Catalytic Reduction (244 kb; 4-26-02)</li> </ul>	
Section 5 - SO2 and Acid Gas Controls	<ul> <li>Section 5.2 - Post-Combustion Controls, Chapter 1 - Wet Scrubbers for Acid Gas (319 kb; 4-26-02)</li> </ul>	
Section 6 - Particulate Matter Controls	<ul> <li><u>Chapter 1 - Baghouses and Filters (277 kb;</u> <u>4-26-02)</u></li> <li><u>Chapter 2 - Wet Scrubbers for Particulate</u> <u>Matter (828 kb; 9-10-03)</u></li> </ul>	

	<ul> <li><u>Chapter 3 - Electrostatic Precipitators (599 kb;</u> <u>4-26-02)</u></li> </ul>	
Vatavuk Air Pollution Control Cost Indexes (VAPCCI) and COST-AIR Air Pollution Control Cost Spreadsheets (Second Edition) are no longer supported by EPA. See the VAPCCI- CICA text file for more information.	• <u>READ ME file - (.txt Format; 2 kb; 5-5-05)</u>	
•		
Δ	ir Quality Models	
Sub-categories	Resources	
Industrial Source Complex 3 (ISC3) (Spanish Version) (revised 10/2000)	<ul> <li><u>READ ME first file (3 kb)</u></li> <li><u>Model Change Bulletins in Spanish (.txt Format, 8 kb)</u></li> <li><u>User's Guide in Spanish (901 kb)</u></li> <li><u>Addendum in Spanish (68 kb)</u></li> <li><u>ISC3 Model (.zip Format, 605 kb)</u></li> </ul>	
Mobile5-Mexico Emission Factor Model (Spanish Version) (revised 10/2000)	<ul> <li>READ ME first file (.html Format, 3 kb)</li> <li>User's Guide (2 kB)</li> <li>Mobile5 Model (.zip Format, 307 kb)</li> </ul>	
PCRAMMET meteorological data preprocessor (Spanish Version) (revised 10/2000)	<ul> <li><u>READ ME first file (2 kb)</u></li> <li><u>Model Change Bulletins in Spanish (.txt Format, 2 kb)</u></li> <li><u>User's Guide in Spanish (180 kb)</u></li> <li><u>PCRAMMET Model (.zip Format, 510 kb)</u></li> </ul>	
SCREEN3 Model (Spanish Version) (12-17-2000)	<ul> <li>READ ME first file (2 kb)</li> <li>Model Change Bulletins in Spanish (.txt Format, 3 kb)</li> <li>User's Guide in Spanish (95 kb)</li> <li>SCREEN3 Model (307 kb)</li> </ul>	
U.S. EPA Models	<ul> <li><u>Support Center for Regulatory Air Models</u> (SCRAM)</li> </ul>	
Emissions Modeling: El Paso Juarez		
Sub-categories	Resources	
READ ME file for El Paso-Juarez Emissions Modeling Studies	• READ ME first file (6 kb; 5-14-01)	

Phase I Tasks - Organizing and Editing of Data Bases

- Editing of External Station Survey Database (655 kb; 5-14-01)
  Editing of Household Survey Database (1.1 Mb;
- <u>5-14-01</u>)
   <u>Editing of Workplace Special Survey Database</u> (499 kb; 5-14-01)
- <u>On Board Transit Count Database (170 kb;</u> 5-14-01)

Phase II Tasks - Data Organizing	<ul> <li>Organize Roadway and Transit Data into</li></ul>
and Network Development	Transportation Networks (1.7 Mb; 5-14-01)
Phase III Tasks - Preparation/Testing of Models	<ul> <li>Improvements to Mode Split Model Application (119 kb; 5-14-01)</li> <li>Improvements to the On-Road Mobile Source Emissions Modeling (577 kb; 5-14-01)</li> <li>Mode Split Model Application (161 kb; 5-14-01)</li> <li>On-Road Mobile Source Emissions Modeling (306 kb; 5-14-01)</li> <li>Traffic Assignment Application (487 kb; 5-14-01)</li> <li>Trip Distribution Model Application (305 kb; 5-14-01)</li> <li>Trip Generation Model Application (111 kb; 5-14-01)</li> </ul>

Emissions Inventories: Mexico (Western Governors Assoc. Publications)		
Sub-categories	Resources	
Mexico Emissions Inventory Program Background/Overview	<ul> <li><u>Background Overview in READ ME first file (3</u> kb; 3-6-01)</li> </ul>	
Mexico Emission Inventory Program: Methods, Plans and Lessons Learned	<ul> <li>Methods, Plans and Lessons Learned - Component List in READ ME first file (4 kb; 3-6-01)</li> </ul>	
Methods Evaluation and Proposal	<ul> <li>Methods Evaluation and Proposal (1.02 Mb; 3-6-01)</li> </ul>	
Implementation Plan Version 2.0	<ul> <li>Implementation Plan Version 2.0 (2.24 Mb; 3-6-01)</li> </ul>	
Lessons Learned for Application in Mexicali	<ul> <li>Lessons Learned from Application in Mexicali (96 kb; 3-6-01)</li> </ul>	
Advanced Training Workbook	<ul> <li>Advanced Training Workbook README first file (4 kb; 3-6-01)</li> <li>Advanced Training Workbook Workbook (864 kb; 3-6-01)</li> </ul>	
READ ME file for Volume II- VIII	<ul> <li><u>READ ME first file for Volumes II-VIII (6 kb;</u> <u>3-6-01)</u></li> </ul>	
Volume II - Emissions Inventory Fundamentals	<ul> <li>Volume II - Emissions Inventory Fundamentals (1.02 Mb; 3-6-01)</li> </ul>	
Volume III - Basic Emissions Estimating Techniques	<ul> <li><u>Volume III - Basic Emissions Estimating</u> <u>Techniques (1.04 Mb; 3-6-01)</u></li> </ul>	
Volume IV - Point Source Inventory Development	<ul> <li><u>Volume IV - Point Source Inventory</u> <u>Development (1.11 Mb; 3-6-01)</u></li> </ul>	

Volume V - Area Source Inventory	<ul> <li><u>Volume V - Area Source Inventory Development</u></li></ul>
Development	(719 kb; 3-6-01)
Volume VI - Motor Vehicle Inventory	<ul> <li><u>Volume VI - Motor Vehicle Inventory</u></li></ul>
Development	<u>Development (1.07 Mb; 3-6-01)</u>
Volume VIII - Modeling Inventory	<ul> <li><u>Volume VIII - Modeling Inventory Development</u></li></ul>
Development	(3.16 Mb; 3-6-01)

Emissions Factors & Transport Studies		
Sub-categories	Resources	
Air Emissions for Scrap Tire Combustion	<ul> <li>Emissions from Scrap Tire Combustion, EPA-600/R-97-115 (655 kb; 1-16-98)</li> </ul>	
Emission Estimation Techniques for Unique Source Categories in Mexicali, Mexico	Unique Source Categories in Mexicali, Mexico; EPA-456/R-99-002 (157kb; 7-7-99)	
Emissions Prevention and Control Techniques for Automobile Body Shops, Ciudad Juarez, MX	<ul> <li><u>Automobile Body Shops in Ciudad Juarez,</u> <u>Mexico; EPA-456/R-01-004 (187 kb; 9-2-99)</u></li> </ul>	
Emissions from Street Vendor Cooking Devices (Charcoal Grilling)	• Emissions from Street Vendor Cooking Devices; EPA-600/R-99-048 (3.6 Mb; 6-2-99)	
Imperial Valley/Mexicali/Cross Border PM 10 Transport Study	<ul> <li>PM10 Transport Study READ ME first file (11-21-96) (.txt Format, 2 kb)</li> <li>PM10 Transport Study Microsoft Word &amp; Excel 5.1 files (.zip Format, 1.25 Mb, 11-21-96)</li> </ul>	
U.S. EPA Emission Inventroy & Factors Information	<u>Clearinghouse for Inventories and Emission</u> <u>Factors (CHIEF)</u>	

Ambient Air Monitoring Information		
Sub-categories	Resources	
Ambient Monitoring Plan for Piedras Negras and Ciudad Acuna, Coahuila, Mexico	<ul> <li><u>Piedras Negras and Ciudad Acuna Monitoring</u> <u>Plan, EPA-456/R-98-001 (1.55 Mb; 1-12-98)</u></li> </ul>	
Tijuana QA/AC Monitoring Manual	<ul> <li><u>READ ME first file (11-21-96) (.txt format, 2 kb)</u></li> <li><u>Monitoring Manual (Wordperfect files)</u> (11-21-96) (.zip format, 188 kb)</li> <li><u>Spreadsheet Forms (Quattro Pro) (11-21-96)</u> (.zip format, 227 kb)</li> </ul>	
U.S. EPA Ambient Air Monitoring Information	<u>Ambient Monitoring Technology Information</u> Center (AMTIC)	

Other Publications			
Sub-categories		Resources	
CICA Information Brochure		<u>CICA Information Brochure (24kb; 4-21-98)</u>	
Stationary Source Control Techniques for Fine Particulate Matter (PM) EPA-452/R-97-001		<ul> <li><u>PM Techniques; Contains 7 sections, 2</u> appendices and an abstract (983 kb; 12-10-01)</li> </ul>	
Technical Basis for Appendices to Annex IV of the La Paz Agreement		<ul> <li>Technical Basis Document (1.7 Mb; 7-19-00)</li> <li>Technical Basis Document - Appendix (3.7 Mb; 7-19-00)</li> </ul>	

United States Environmental Protection Agency Air Office of Air Quality Planning and Standards Research Triangle Park, NC 27711 EPA 456/F-99-006R November 1999



web site https://www3.epa.gov/ttncate1/dir1/

if any of the contents are of use to you.

froxdoc.pdf

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## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

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FINAL

RBLC ID: IN-0156 Corporate/Company: STEEL DYNAMICS, INC. -STRUCTURAL AND RAIL DIVISION Facility Name: STEEL DYNAMICS, INC. - STRUCTURAL AND RAIL DIVISION Process: COOLING TOWER: ROLLING MILL (CONTACT) ID#15A

Primary Fuel:		Pollutant Inform	ation - List o	f Pollut	ants Help
Throughput: Process Code:	8000.00 GAL/MIN 99.009	Pollutant	Primary Emission Limit	Basis	Verified
		<u>Particulate matter, filterable (FPM)</u>	0.0010 % DRIFT RATE	BACT- PSD	NO
		<u>Particulate matter,</u> filterable < 10 μ <u>(FPM10)</u>	0.0010 % DRIFT RATE	BACT- PSD	NO

**Process Notes:** 



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

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RBLC ID: LA-0317 Corporate/Company: METHANEX USA, LLC Facility Name: METHANEX - GEISMAR METHANOL PLANT Process: cooling towers (I-CT-621, II-CT-621)

		Pollutant Infor	mation - Lis	t of Poll	utants Help
Primary Fuel: Throughput: Process Code:	66000.00 gpm (each) 99.009	Pollutant	Primary Emission Limit	Basis	Verified
		<u>Particulate</u> matter, total < 10 µ (TPM10)	0.0010 %	BACT- PSD	UNKNOWN
		<u>Particulate</u> <u>matter, total &lt;</u> 2.5 μ (TPM2.5)	0.0010 %	BACT- PSD	UNKNOWN

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**Process Notes:** 



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

	Help
	FINAL
<b>RBLC ID:</b> LA-0239	
Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC	
Facility Name: NUCOR STEEL LOUISIANA	
Process: COK-213 - Coke Battery 2 FGD Waste Loading	1999 - 199

Primary Fuel: Throughput:	59319.00 t/yr	Pollutant Inform	nation - List o	of Pollut	ants Help
Process Code:	99.190	Pollutant	Primary Emission Limit	Basis	Verified
		<u>Particulate</u> <u>matter, filterable</u> (FPM)	0.0200 LB/H	BACT- PSD	YES

Process Notes: FGD dust from the coke plant and the sinter plant will be shipped to landfill, primarily by truck.

These are al particulate BACT from a Necos facility



### **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below.
RBLC Home New Search Search Results Facility Information Process List Process Information

	Help
	FINAL
<b>RBLC ID:</b> LA-0239	
Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC	
Facility Name: NUCOR STEEL LOUISIANA	
Process: DOC-102 - Dock 2 Loading/Unloading Gantry Crane	
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Primary Fuel: Throughput:	Pollutant Information - Li		Pollutant Information - List of Pollutants Help		utants Help
Process Code:	99.190	Pollutant	Primary Emission Limit	Basis	Verified
		<u>Particulate</u> matter, filterable (FPM)	0.4400 LB/H	BACT- PSD	UNKNOWN

**Process Notes:** Raw materials will be received by barge, rail or truck. These materials will be transferred from the barges by a continuous barge unloader and transported by conveyor belt to their individual storage piles. Finished product or other byproduct material will be loaded onto the barges using the same conveyor system.



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

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FINAL

RBLC ID: LA-0239 Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC Facility Name: NUCOR STEEL LOUISIANA Process: PIL-106 - Sinter Storage Piles

Primary Fuel: Throughput:	661.00 T/H	Pollutant Inform	nation - List o	f Pollut	ants Help
Process Code:	99.190	Pollutant	Primary Emission Limit	Basis	Verified
		<u>Particulate</u> matter, filterable (FPM)	1.1500 LB/H	BACT- PSD	NO

**Process Notes:** The sintering process converts fine-sized raw materials, including iron ore, coke breeze, limestone, mill scale, and flue dust, into an agglomerated product called sinter. The feed materials are sized and mixed to prepare a physically uniform feed to the sinter strand. this material is stroded in a storage pile.



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

Help
FINAL

RBLC ID: LA-0239 Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC Facility Name: NUCOR STEEL LOUISIANA Process: PIL-108 - Mill Scale Storage Piles

Primary Fuel: Throughput:	661.00 T/H	Pollutant Inform	nation - List o	f Pollut	ants Help
Process Code: 99.190	99.190	Pollutant	Primary Emission Limit	Basis	Verified
		<u>Particulate</u> matter, filterable (FPM)	0.6500 LB/H	BACT- PSD	NO

**Process Notes:** Mill scale will be received by barge, rail or truck. This material will be transferred from the barges by a continuous barge unloader and transported by conveyor belt to its individual storage pile. On an as-needed basis, this material will be reclaimed onto conveyor belts and transported to the Sinter Plant.



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

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**FINAL** 

RBLC ID: LA-0239 Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC Facility Name: NUCOR STEEL LOUISIANA Process: PIL-102 - Iron Ore Pellet Storage Piles

Primary Fuel: Throughput:	: 5512.00 tons per hour	Pollutant Inform	nation - List o	f Pollut	ants Help
Process Code:	99.190	Pollutant	Primary Emission Limit	Basis	Verified
		<u>Particulate</u> <u>matter, filterable</u> <u>(FPM)</u>	5.6100 LB/H	BACT- PSD	NO

**Process Notes:** Iron ore pellets will be received at the river dock by ocean-going ship or barge. The material will be transferred from the ship or barge by a clamshell unloader mounted to a gantry crane. The clamshell will discharge to a hopper, and then to a conveyor belt which transports the iron ore to storage piles. The iron ore is then loaded onto a conveyor belt by a reclaimer for transport to the Stock House



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess information

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RBLC ID: LA-0239 Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC Facility Name: NUCOR STEEL LOUISIANA Process: PIL-105 - Granulated Slag Storage Piles

Primary Fuel: Throughput:	661.00 T/H	Pollutant Inform	nation - List o	of Pollut	Help Verified		
Process Code: 99.190	Pollutant	Primary Emission Limit	Basis	Verified			
		<u>Particulate</u> matter, filterable (FPM)	1.5600 LB/H	BACT- PSD	NO		

**Process Notes:** Granulated slag and slag aggregate from the slag granulation area are combined and stored in piles for shipment to customers, by barge



### **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

Help
FINAL

Contract.

RBLC ID: LA-0239 Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC Facility Name: NUCOR STEEL LOUISIANA Process: PIL-101 - Coal Storage Piles

Primary Fuel: Throughput:	5512.00 T/h	Pollutant Inform	nation - List o	f Pollut	ants Help Verified				
<b>Process Code:</b> 99.190	Pollutant	Primary Emission Limit	Basis	Verified					
		<u>Particulate</u> <u>matter, filterable</u> <u>(FPM)</u>	1.4800 LB/H	BACT- PSD	NO				

**Process Notes:** Coal barges will be unloaded by a continuous unloader at the receiving dock on the Mississippi River, and material will then be loaded onto conveyor belts leading to the coal storage pile area. A reclaimer will be used to remove coal from the storage piles onto conveyors leading to the coke ovens or Pulverized Coal Injection (PCI) Mill areas, as needed.



### **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

Help	
FINA	L

RBLC ID: LA-0239 Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC Facility Name: NUCOR STEEL LOUISIANA Process: PIL-104 - Pig Iron Storage Piles

Primary Fuel: Throughput:	1102.00 t/h	Pollutant Inform	nation - List o	f Pollut	tants Help				
<b>Process Code:</b> 99.190	Pollutant	Primary Emission Limit	Basis	Verified					
		Particulate matter, filterable (FPM)	0.2700 LB/H	BACT- PSD	NO				

**Process Notes:** Pig iron produced at the facility is stored on-site in outdoor storage piles. The iron is loaded onto trucks or rail cars and transported to the Mississippi River dock for shipment to customers by ship or barge.



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

	Help
	FINAL
<b>RBLC ID:</b> LA-0239	
Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC	
Facility Name: NUCOR STEEL LOUISIANA	
Process: COK-113 - Coke Battery 1 FGD Waste Loading	

Primary Fuel: Throughput:	59319.00 t/yr	Pollutant Inform	nation - List o	f Pollut	Help Verified			
Process Code:	99.190	Pollutant	Primary Emission Limit	Basis	Verified			
		Particulate matter, filterable (FPM)	0.0200 LB/H	BACT- PSD	YES			

Process Notes: FGD dust from the coke plant and the sinter plant will be shipped to landfill, primarily by truck.



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

Help.	
FIN	AL

RBLC ID: LA-0239 Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC Facility Name: NUCOR STEEL LOUISIANA Process: TRN-101 - Wagon Tipper

Primary Fuel: Throughput:	2204662.00 t/yr 99.190	Pollutant Infor	Pollutant Information - List of Pollutants Help			
Process Code:		Pollutant	Primary Emission Limit	Basis	Verified	
		<u>Particulate</u> <u>matter,</u> filterable (FPM)	0.0100 LB/H	BACT- PSD	UNKNOWN	

Process Notes: Rail car unloading station for coal and mill scale



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

	Help
	FINAL
<b>RBLC ID:</b> LA-0239	A CONTRACTOR AND A
Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC	
Facility Name: NUCOR STEEL LOUISIANA	
Process: DST-101-Blast Furnace 1 Topgas Dust Catcher	

Primary Fuel: Throughput: Process Code:	0 99.190	Pollutant Information - List of Pollutants			
		Pollutant	Primary Emission Limit	Basis	Verified
		<u>Particulate</u> matter, filterable (FPM)	0.0100 LB/H	BACT- PSD	UNKNOWN

Process Notes: Conveyor system



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

Help

**FINAL** 

RBLC ID: LA-0239 Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC Facility Name: NUCOR STEEL LOUISIANA Process: PIL-103 - Flux Storage Piles

Primary Fuel: Throughput:	1323.00 T/H	Pollutant Inform	Pollutant Information - List of Pollutants				
Process Code:	99.190	Pollutant	Primary Emission Limit	Basis	Verified		
		<u>Particulate</u> <u>matter, filterable</u> <u>(FPM)</u>	1.9800 LB/H	BACT- PSD	NO		

**Process Notes:** Miscellaneous materials such as limestone, dolomite, and electric arc furnace (EAF) slag will be received by barge. These materials will be transferred from the barges by a continuous barge unloader and transported by conveyor belt to their individual storage piles. On an as-needed basis, these materials will be reclaimed onto conveyor belts and transported to the process areas which require them. Limestone, Dolomite and EAF slag will be sent to the Stock House for consumption in the blast furnaces



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

	Help
	FINAL
<b>RBLC ID:</b> LA-0239	
Corporate/Company: CONSOLIDATED ENVIRONMENTAL MANAGEMENT INC	
Facility Name: NUCOR STEEL LOUISIANA	
Process: PIL-107 - Coke Breeze Storage Piles	
	2017/01/2017/01/2017/01/2017/01/2017/01/2017/01/2017/01/2017/01/2017/01/2017/2017

Primary Fuel: Throughput:	661.00 t/h 99.190	Pollutant Information - List of Pollutants				
Process Code:		Pollutant	Primary Emission Limit	Basis	Verified	
		<u>Particulate</u> matter, filterable (FPM)	0.5100 LB/H	BACT- PSD	NO	

**Process Notes:** Coke fines from the coke handling areas, of the coke ovens and the stock houses is stored in a silo for shipment to customers, primarily by barge.



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

Help	
FIN	AL

RBLC ID: OH-0350 Corporate/Company: REPUBLIC STEEL Facility Name: REPUBLIC STEEL Process: Flux and Carbon storage material handling

		Pollutant Information - List of Pollutants Help			
Primary Fuel: Throughput:	0	Pollutant	Primary Emission Limit	Basis	Verified
FIGUESS COLC.	55.130	<u>Particulate</u> <u>matter, total &lt; 10</u> <u>µ (TPM10)</u>	2.4000 LB/H	N/A	UNKNOWN
		<u>Particulate</u> <u>matter, total &lt;</u> 2.5 μ (TPM2.5)	0.3700 LB/H	N/A	UNKNOWN
		Visible Emissions (VE)	20.0000 % OPACITY	N/A	UNKNOWN

Process Notes: Electric Arc Furnace flux agent and charge carbon storage and material handling operations, loading/unloading of storage bins, truck loading/unloading



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

Help
FINAL

RBLC ID: PA-0255 Corporate/Company: ELLWOOD QUALITY STEELS COMPANY Facility Name: ELLWOOD QUALITY STEELS COMPANY Process: ELECTRIC ARC FURNACE

		Pollutant Information - List of Pollutants			
Drimory Eucly	NC	Pollutant	Primary Emission Limit	Basis	Verified
Throughput:	30.00 MCF/H	<u>Carbon</u> Monoxide	450.0000 T/YR	BACT- PSD	UNKNOWN
Process Code:	12.310	<u>Nitrogen Oxides</u> (NOx)	28.5000 T/YR	Other Case- by-Case	UNKNOWN
		Particulate matter, filterable < 10 μ (FPM10)	0.1500 LB/T	BACT- PSD	UNKNOWN
		<u>Sulfur Oxides</u> (SOx)	0.4500 LB/H	BACT- PSD	UNKNOWN
		Volatile Organic Compounds (VOC)	0.3000 LB/T	BACT- PSD	UNKNOWN

**Process Notes:** 

#### **TCEQ Mechanical Sources**

#### Current Best Available Control Technology (BACT) Guidelines

Iron and Steel Industry

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NUCOR Telas Commission of Environmental Quality

Source Type	Pollutant	Minimum Acceptable Control	Details
Scrap Handling	Particulate Matter (PM)	70% reduction	Typically achieved when transfer to charge bucket conducted indoors or partial enclosure is enclosed, i.e. three sides
Raw Material Conveying and Storage	РМ	99% reduction, outlet grain loading ≤ 0.01 gr/dscf, 5% opacity at stack	Typically achieved when dry powdery materials are conveyed by pneumatic or enclosed system and stored in silos with emissions exhausted to a fabric filter
Electric Arc Furnaces (NSPS AA and Aa)	РМ	Emission capture system meets ACGIH design; canopy hood capture of at least 95%; direct evacuation or fourth hole capture efficiency of at least 99%; an outlet grain loading $\leq$ 0.0032 gr/dscf front half PM catch; and $\leq$ 0.0052 gr/dscf for total PM catch; 3% opacity at stack; 6% building opacity	Typically achieved by charging and tapping emissions captured by canopy hood and exhausted to a fabric filter, and melting and refining emissions captured using direct evacuation or fourth hole and exhausted to a fabric filter
	NOx	0.43 lbs NO <sub>x</sub> /ton steel melted, good combustion and engineering practices	Typically achieved by minimizing air infiltration, and maintaining furnace draft during melting and refining operations
	со	Good combustion and engineering practices	Typically achieved by maintaining proper air gap/air inlet to exhaust gas stream

TCEQ-Mechanical Sources (Revised 01/13) This information is maintained by the Mechanical/Agricultural/Construction NSR Section and is subject to change.

Page 1 of 3

Source Type	Pollutant	Minimum Acceptable Control	Details
Electric Arc Furnaces (NSPS AA and Aa) (continued)	SO <sub>2</sub>	0.24 lbs SO <sub>2</sub> /ton steel	
	VOC	0.35 lbs VOC/ton steel	Typically achieved with melted scrap management program
Metallurgy Furnace	РМ	98% reduction, outlet grain loading ≤ 0.0052 gr/dscf if EAF filter, and ≤ 0.01 gr/dscf if not EAF filter, 6% building opacity	Typically achieved by capture hood exhausted to a fabric filter
	Products of Combustion (POC)	Pipeline quality sweet natural gas firing and good combustion practices	
Casting	РМ	Outlet grain loading of ≤ 0.0052 if EAF fabric filter, ≤ 0.01 gr/dscf if not EAF filter	Typically achieved by hood capture and exhaust to a fabric filter; and no roof vents above the casting deck area
Ladles/Tundish/Preheat/Dryer/Operations	POC	0.1 lb NO <sub>x</sub> /MMBtu	Typically achieved with natural gas/LPG fuel
Ladles/Tundish Prep Area	РМ	99% reduction, outlet grain loading ≤ 0.01 gr/dscf, unless routed to EAF filter, 5% opacity on stack	
Billet Reheat Furnace	POC	0.1 lb NO <sub>x</sub> /MMBtu, good combustion practices, 3% opacity at stack	Typically achieved with natural gas/LPG fuel, low NO <sub>x</sub> burners
Rolling Mill	РМ	70% reduction	Typically achieved when operation is conducted inside a building, and water sprays used for mill scale cooling and collection

TCEQ-Mechanical Sources (Revised 01/13) This information is maintained by the Mechanical/Agricultural/Construction NSR Section and is subject to change.

Page 2 of 3

Source Type	Pollutant	Minimum Acceptable Control	Details
Mill Scale Processing	РМ	70% reduction, outlet grain loading ≤ 0.01 gr/dscf	Typically achieved by minimizing handling steps, and using water sprays at transfer points, dump pits, stockpiles, and conveyors
Core Sand Handling	РМ	100% capture, an outlet grain loading ≤ 0.01 gr/dscf	Typically achieved by receiving, conveying, and storing in a closed system exhausted to a fabric filter
Green Sand Handling	РМ	90% reduction, an outlet grain loading ≤ 0.01 gr/dscf	Typically achieved by minimizing handling, storing indoors using a bin or partial enclosure, i.e. three- sided enclosure, and using moisture as appropriate
Sand Reclamation	РМ	50% reduction	Typically achieved by enclosure/within building
Mold Shakeout	РМ	100% capture, an outlet grain loading ≤ 0.01 gr/dscf	Typically achieved by conducting stackout indoors, capturing emissions and exhausting to a fabric filter, and transferring reclaimed sand using covered or enclosed conveyor system
Plant Roads	РМ	Main plant roads, and high traffic areas and parking areas to be paved and cleaned as necessary; low traffic roads, slag storage, and processing areas to be watered and/or treated with dust suppressant as necessary	

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TCEQ-Mechanical Sources (Revised 01/13) This information is maintained by the Mechanical/Agricultural/Construction NSR Section and is subject to change.

Page 3 of 3

#### **TCEQ Chemical Sources**

#### Current Best Available Control Technology (BACT) Guidelines

Storage Tanks

This information is maintained by the Chemical NSR Section and is subject to change. Last update 06/2015.

Year	Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
2015	Atmospheric Storage Tanks	Tank capacity < 25 Mgal or TVP < 0.50 psia	Fixed roof with submerged fill. White or aluminum uninsulated exterior surfaces exposed to the sun.	
		Tank Capacity ≥ 25 Mgal	Internal floating roof (IFR). White or aluminum uninsulated exterior surfaces exposed to the sun.	Alternative 1: Primary seal: mechanical or liquid mounted
	and 0.50 psia < 11.0 psia	and 0.50 psia < TVP		Alternative 2: Primary seal: vapor mounted and Secondary seal: rim mounted
		< 11.0 psia		Drain dry design (new tanks only)
			External floating roof (EFR). White or aluminum uninsulated exterior surfaces exposed to the sun.	Primary seal: mechanical or liquid mounted, and Secondary seal: rim mounted
			Slotted guide pole fittings must have gasketed cover, and at least 2 of the following – wiper, float, or sleeve.	Drain dry design (new tanks only)
			Vent to control	Appropriate control device efficiency
		Tank Capacity ≥ 25 Mgal and TVP ≥ 11.0 psia	Vent to control	Appropriate control device efficiency

Page 1 of 1

#### **TCEQ Combustion Sources Current Best Available Control Technology (BACT) Requirements**

#### Turbines

BACT changed **04/12**. Electric Generating Units may be authorized by Standard Permit (*if no Prevention of Significant Deterioration (PSD) or Nonattainment (NA)* permitting is required). The Standard Permit limits are listed below:

Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
Electric Generating Units Greater than 10MW	NOx	0.14 lb/MW-hr (over 300 hr/yr) 0.38 lb/MW-hr (under300 hr/yr)	
Electric Generating Units Less than 10MW	NOx	1.90 lb/MW-hr	Fuel $\geq$ 75% volume landfill, digester, stranded oilfield, or renewable gas
East Texas	NOx	0.47 lb/MW-hr (over 300 hr/yr) 1.65 lb/MW-hr (under 300 hr/yr)	Units installed before 1/1/2005
	NOx	0.14 lb/MW-hr (over 300 hr/yr) 0.47 lb/MW-hr (under 300 hr/yr) 0.47 lb/MW-hr (if ≤ 250 kW only)	Units installed on or after 1/1/2005
Electric Generating Units	NOx	3.11 lb/MW-hr (over 300 hr/yr)	
Less than 10MW West Texas		21 lb/MW-hr (under 300 hr/yr)	
Electric Generating Units	SO <sub>2</sub>	10 grains S per 100 dscf – natural gas 30 grains S per 100 dscf – landfill, digester, stranded oilfield, renewable	Gaseous fuel
		0.05 wt % sulfur	Liquid fuel

TCEQ-Combustion Sources (Revised 07/12) This information is maintained by the Comb on/Coatings New Source Review (NSR) Section and is subject to change.

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# TCEQ Combustion Sources Current Best Available Control Technology (BACT) Requirements

#### Turbines

Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
Gas-Fired	NOx	5.0 - 9.0 ppmvd at 15% O2	Dry Low NOx burner, water, or steam, SCR
Turbine	со	9 – 25 ppmvd at 15% O2	Detailed BACT Analysis may be needed if > 9 ppmvd CO proposed
Simple Cycle (Reduced operation units such as peakers may have higher NO <sub>x</sub> , CO, and/or VOC limits and will require a case-by-case analysis.)	voc	2 ppmvd at 15% O₂	
	NH <sub>3</sub>	7 – 10 ppmvd at 15% O2	

Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
Gas-Fired	NOx	2.0 ppmvd at 15% O <sub>2</sub> , 24-hr average	Dry Low NOx burner, water, or steam, SCR
Turbine	CO	2 – 4 ppmvd at 15% O <sub>2</sub>	Detailed BACT Analysis needed if > 4 ppmvd CO proposed
Combined Cycle	VOC	2 ppmvd at 15% O2	
	NH <sub>3</sub>	7 - 10 ppmvd at 15% O2	

Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
Gas-Fired	NOx	2.0 ppmvd at 15% O <sub>2</sub> , 24-hr average	Dry Low NO <sub>x</sub> burner, water, or steam, SCR
Turbine	со	2 – 4 ppmvd at 15% O <sub>2</sub>	Detailed BACT Analysis needed if > 4 ppmvd CO proposed
Combined Cycle with Duct Burner	VOC	4 ppmvd at 15% O₂	
	NH <sub>3</sub>	7 – 10 ppmvd at 15% O2	

TCEQ-Combustion Sources (Revised 07/12) This information is maintained by the Combustion/Coatings New Source Review (NSR) Section and is subject to change.

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#### TCEQ COMBUSTION SOURCES CURRENT BEST AVAILABLE CONTROL TECHNOLOGY (BACT) GUIDELINES

INTERNAL COMBUSTION ENGINES This information is maintained by the Combustion/Coatings Section and is subject to change. Last update 3/2010

	Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
	Gas Fired	NOx (<500 hp)	1.0 g/bhp-hr	catalytic converter for rich burn
	Internal Combustion	NOx (>=500 hp)	0.5 g/bhp-hr	no liquid fuel except for back-up (limited hours)
	Engines	со	3.0 g/bhp-hr	Electric Generating Units May Be Authorized By Standard Permit
	(ICE) Spark Ignited	VOC	1.0 g/bhp-hr	
	Liquid Fired ICE Compression Ignited		Usually Authorized By PBR	Alternative (Low Emission) Fuels Only
	Electric Generating Unit Greater than 10MW	NOx (>300 hrs) NOx (<=300 hrs)	0.14 lb/MW-hr (over 300 hr/yr) 0.38 lb/MW-hr (under 300 hr/yr)	May Be Authorized By Standard Permit
	Electric Generating Unit Less than 10MW East Texas	NOx	1.90 lb/MW-hr	May Be Authorized By Standard Permit Only Units Firing Landfill Gas, Oil Field Gas, or Digester Gas With Less Than 30 Grains Sulfur per 100 dscf
		NOx (>300 hrs) NOx (<=300 hrs)	0.47 lb/MW-hr 1.65 lb/MW-hr	May Be Authorized By Standard Permit Units Installed before 1/1/2005
		NOx (>300 hrs and >250 kw) NOx (<=300 hrs or <250 kw)	0.14 lb/MW-hr 0.47 lb/MW-hr	May Be Authorized By Standard Permit Units Installed On or After 1/1/2005
	Electric Generating Unit Less than 10MW West Texas	NOx (>300 hrs) NOx (<=300 hrs)	3.11 lb/MW-hr 21 lb/MW-hr	May Be Authorized By Standard Permit
	Electric Generating Unit	SO2	Gaseous Fuel: 10 grains Sulfur per 100 dscf	
			0.05 wt % Sultur	

### TCEQ COMBUSTION SOURCES CURRENT BEST AVAILABLE CONTROL TECHNOLOGY (BACT) GUIDELINES

#### BOILERS

This information is maintained by the Combustion/Coatings Section and is subject to change. Last update 04/2009

Year	Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
2006	Boiler	NOx	0.01 lb/MMBtu when firing 75% - 100% natural gas	plant fuel gas may contain up to 75% natural gas
	>40 MMBtu/hr		0.015 lb/MMBtu when firing plant fuel gas	plant fuel gas specifics: <50% H2; >920 Btu/dscf
		CO	50 ppmvd at 3% O2	fuel oil firing less than 760 hr/yr
		PM	Less than 5% opacity	
		NH3	10 ppmvd at 3% O2	7

#### TCEQ Chemical Sources Current Best Available Control Technology (BACT) Requirements

#### **Process Furnaces and Heaters**

Year	Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
2011	Process Furnaces and Heaters	NOx	Burners with the best $NO_x$ performance given the burner configuration and gaseous fuel used. Case-by-case review necessary if $NO_x > 0.01$ lb/MMBtu. Cost data must be submitted for SCR if firing rate is > 300 MMBtu/hr and burner $NO_x$ is > 0.01 lb/MMBtu. CEMS required for 100 MMBtu/hr.	Performance is an annual average.
		СО	50 ppmv corrected to 3% O <sub>2</sub>	

TCEQ - This information is maintained by the Chemical NSR Section and is subject to change. (Last Revision Date 08/01/2011)

#### TCEQ Chemical Sources Current Best Available Control Technology (BACT) Requirements

#### **Cooling Towers**

Year	Source Type	Pollutant	Minimum Acceptable Control	Control Efficiency or Details
2011	Cooling Towers	VOC	Non-contact design Monthly monitoring of VOC in water per Appendix P or approved equivalent – assume all VOC stripped out Repair identified leaks as soon as possible, but before next scheduled shutdown, or shutdown triggered by 0.08 ppmw cooling water VOC concentration	
		Particulate	Drift eliminators Drift < 0.001%	

TCEQ - This information is maintained by the Chemical NSR Section and is subject to change. (Last Revision Date 08/01/2011)

#### **TCEQ Mechanical Sources Current Best Available Control Technology (BACT) Guidelines**

This may be a duplicate of one & already gave you.

**Iron and Steel Industry** 

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Source Type	Pollutant	Minimum Acceptable Control	Details
Scrap Handling	Particulate Matter (PM)	70% reduction	Typically achieved when transfer to charge bucket conducted indoors or partial enclosure is enclosed, i.e. three sides
Raw Material Conveying and Storage	РМ	99% reduction, outlet grain loading ≤ 0.01 gr/dscf, 5% opacity at stack	Typically achieved when dry powdery materials are conveyed by pneumatic or enclosed system and stored in silos with emissions exhausted to a fabric filter
Electric Arc Furnaces (NSPS AA and Aa)	РМ	Emission capture system meets ACGIH design; canopy hood capture of at least 95%; direct evacuation or fourth hole capture efficiency of at least 99%; an outlet grain loading $\leq$ 0.0032 gr/dscf front half PM catch; and $\leq$ 0.0052 gr/dscf for total PM catch; 3% opacity at stack; 6% building opacity	Typically achieved by charging and tapping emissions captured by canopy hood and exhausted to a fabric filter, and melting and refining emissions captured using direct evacuation or fourth hole and exhausted to a fabric filter
	NOx	0.43 lbs NO <sub>x</sub> /ton steel melted, good combustion and engineering practices	Typically achieved by minimizing air infiltration, and maintaining furnace draft during melting and refining operations
	со	Good combustion and engineering practices	Typically achieved by maintaining proper air gap/air inlet to exhaust gas stream

TCEQ-Mechanical Sources (Revised 01/13) This information is maintained by the Mechanical/Agricultural/Construction NSR Section and is subject to change.

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Source Type	Pollutant	Minimum Acceptable Control	Details
Electric Arc Furnaces (NSPS AA and Aa) (continued)	SO <sub>2</sub>	0.24 lbs SO <sub>2</sub> /ton steel	
	VOC	0.35 lbs VOC/ton steel	Typically achieved with melted scrap management program
Metallurgy Furnace	РМ	98% reduction, outlet grain loading ≤ 0.0052 gr/dscf if EAF filter, and ≤ 0.01 gr/dscf if not EAF filter, 6% building opacity	Typically achieved by capture hood exhausted to a fabric filter
	Products of Combustion (POC)	Pipeline quality sweet natural gas firing and good combustion practices	
Casting	РМ	Outlet grain loading of $\leq$ 0.0052 if EAF fabric filter, $\leq$ 0.01 gr/dscf if not EAF filter	Typically achieved by hood capture and exhaust to a fabric filter; and no roof vents above the casting deck area
Ladles/Tundish/Preheat/Dryer/Operations	POC	0.1 lb NO <sub>x</sub> /MMBtu	Typically achieved with natural gas/LPG fuel
Ladles/Tundish Prep Area	РМ	99% reduction, outlet grain loading ≤ 0.01 gr/dscf, unless routed to EAF filter, 5% opacity on stack	
Billet Reheat Furnace	POC	0.1 lb NO <sub>x</sub> /MMBtu, good combustion practices, 3% opacity at stack	Typically achieved with natural gas/LPG fuel, low NO <sub>x</sub> burners
Rolling Mill	РМ	70% reduction	Typically achieved when operation is conducted inside a building, and water sprays used for mill scale cooling and collection

TCEQ-Mechanical Sources (Revised 01/13) This information is maintained by the Mechanical/Agricultural/Construction NSR Section and is subject to change.

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Source Type	Pollutant	Minimum Acceptable Control	Details
Mill Scale Processing	PM	70% reduction, outlet grain loading ≤ 0.01 gr/dscf	Typically achieved by minimizing handling steps, and using water sprays at transfer points, dump pits, stockpiles, and conveyors
Core Sand Handling	РМ	100% capture, an outlet grain loading ≤ 0.01 gr/dscf	Typically achieved by receiving, conveying, and storing in a closed system exhausted to a fabric filter
Green Sand Handling	РМ	90% reduction, an outlet grain loading ≤ 0.01 gr/dscf	Typically achieved by minimizing handling, storing indoors using a bin or partial enclosure, i.e. three- sided enclosure, and using moisture as appropriate
Sand Reclamation	РМ	50% reduction	Typically achieved by enclosure/within building
Mold Shakeout	РМ	100% capture, an outlet grain loading ≤ 0.01 gr/dscf	Typically achieved by conducting stackout indoors, capturing emissions and exhausting to a fabric filter, and transferring reclaimed sand using covered or enclosed conveyor system
Plant Roads	РМ	Main plant roads, and high traffic areas and parking areas to be paved and cleaned as necessary; low traffic roads, slag storage, and processing areas to be watered and/or treated with dust suppressant as necessary	

TCEQ-Mechanical Sources (Revised 01/13) This information is maintained by the Mechanical/Agricultural/Construction NSR Section and is subject to change.

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## Section II: Non-AQMD LAER/BACT Determinations Application No.: CO-258

## **Equipment Category – Steel Rolling Mill**

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H	TYPE		MODEL			
D.		C.	MODEL		·	
D.	STYLE:					
E.	APPLICABLE AQMD REGULATION XI RULES: None					
F.	COST: \$ (2000) SOURCE O	F COST DA	TA:			
G.	OPERATING SCHEDULE: 24 HRS/DAY		7 0	AYS/WK	52 WKS/YF	२
2.	EQUIPMENT INFORMATION			APP. NO.:	CO-258	
A.	FUNCTION: Cold rolling mill and 80-inch flat stock (mostly in coil form).	hot stri	p mill r	olling stand	d. Used to produc	e steel
В.	SIZE/DIMENSION/CAPACITY:					
C.	BLOWERS:	D.	TOTAL F	LOW RATE:	scfm	
E.	MATERIAL STORED/PROCESSED/HANDLED:				50111	
F.	THROUGHPUT/PROCESS RATE/USAGE RATE:	×	·	·		
3.	COMPANY INFORMATION			APP. NO.:	CO-258	
Α.	NAME: USX				B. SIC COD	DE:
C.	ADDRESS:					
	CITY: West Mifflin		STATE:	PA	ZIP:	
D.	CONTACT PERSON: Tom O'Toole			E. PHONE	<sup>NO.:</sup> 412-675-738	80
4.	PERMIT INFORMATION			APP. NO.:	CO-258	
	AGENCY: Allegheny County Health Dept.	. В.	APPLICA	TION TYPE: ch	nange of condition	ns
Α.					NO: IIA == 0 011	8
А. С.	AGENCY CONTACT PERSON: Timothy Novack			D. PHONE	412-578-811	
А. С. Е.	AGENCY CONTACT PERSON: Timothy Novack	P/C NO.:		D. PHONE	ISSUANCE DATE:	
A. C. E.	AGENCY CONTACT PERSON: Timothy Novack PERMIT TO CONSTRUCT/OPERATE INFORMATION: CHECK IF NO P/C	P/C NO.: P/O NO.:	CO-258	B. PHONE	NO.:         412-578-811           ISSUANCE DATE:         ISSUANCE DATE:           ISSUANCE DATE:         12/	/30/96
A. C. E. F.	AGENCY CONTACT PERSON: Timothy Novack PERMIT TO CONSTRUCT/OPERATE INFORMATION: CHECK IF NO P/C START-UP DATE:	P/C NO.: P/O NO.:	CO-258	D. PHONE	ISSUANCE DATE: ISSUANCE DATE: ISSUANCE DATE: 12/	/30/96
A. C. E. F.	AGENCY CONTACT PERSON: Timothy Novack PERMIT TO CONSTRUCT/OPERATE INFORMATION: CHECK IF NO P/C START-UP DATE: EMISSION INFORMATION	P/C NO.: P/O NO.:	CO-258	APP. NO.:	NO         412-578-811           ISSUANCE DATE:         ISSUANCE DATE:           ISSUANCE DATE:         12/           CO-258         ISSUANCE DATE:	/30/96
A. C. E. F. <b>5.</b>	AGENCY CONTACT PERSON: Timothy Novack PERMIT TO CONSTRUCT/OPERATE INFORMATION: CHECK IF NO P/C START-UP DATE: EMISSION INFORMATION PERMIT	P/C NO.: P/O NO.:	CO-258	APP. NO.:	NO.: 412-578-811 ISSUANCE DATE: ISSUANCE DATE: 12/ CO-258	/30/96
A. C. E. F. <b>5.</b> A1.	AGENCY CONTACT PERSON: Timothy Novack PERMIT TO CONSTRUCT/OPERATE INFORMATION: CHECK IF NO P/C START-UP DATE: EMISSION INFORMATION PERMIT PERMIT Lubricating oils used on colo	P/C NO.: P/O NO.: 1 rolling	CO-258	APP. NO.: (	ISSUANCE DATE: ISSUANCE DATE: 12/ CO-258	/30/96 d to be
A. C. E. F. <b>5.</b> A.	AGENCY CONTACT PERSON: Timothy Novack PERMIT TO CONSTRUCT/OPERATE INFORMATION: CHECK IF NO P/C START-UP DATE: EMISSION INFORMATION PERMIT PERMIT PERMIT LIMIT: Lubricating oils used on colo oil-water emulsions containing less that	Р/С NO.: Р/О NO.:           1 rolling           2% V(	CO-258 g mill an OC and	APP. NO.: ( and hot strip 4% VOC,	Alternative of the second seco	/30/96 d to be
A. C. E. F. <b>5.</b> A1.	AGENCY CONTACT PERSON: Timothy Novack PERMIT TO CONSTRUCT/OPERATE INFORMATION: CHECK IF NO P/C START-UP DATE: EMISSION INFORMATION PERMIT PERMIT PERMIT LIMIT: Lubricating oils used on colo oil-water emulsions containing less that	Р/С NO.: Р/О NO.:           1 rolling           2% V(	CO-258 g mill an OC and	APP. NO.: ( and hot strip 4% VOC,	Alternative of the second seco	/30/96 d to be

Other equipment form date 8/17/2000

5.	EMISSION INFORMATION	APP. NO.: CO-258
A3.	BASIS OF THE BACT DETERMINATION: The permit condition	ns listed above in 5.A.A1 are included in a
	recent Pennsylvania SIP revision (Federal Reg	ister, August 21, 2001, Vol. 66, No. 162.
	pp43788-43795) and thus automatically qualif	v as BACT. SCAOMD has no rules or BACT
	listings governing VOC content of lubricants u	used in steel rolling mills.
В.	CONTROL TECHNOLOGY	
B1.	MANUFACTURER/SUPPLIER:	
B2.	TYPE: Low-VOC lubricants	
B3.	DESCRIPTION: Oil-water emulsions	
B4.	CONTROL EQUIPMENT PERMIT APPLICATION DATA: P/C NO.:	ISSUANCE DATE:
	P/O NO.:	ISSUANCE DATE:
B5.	WASTE AIR FLOW TO CONTROL EQUIPMENT:	FLOW RATE:
	ACTUAL CONTAMINANT LOADING:	BLOWER HP:
B6.	WARRANTY:	
B7.	PRIMARY POLLUTANTS: VOC	
B8.	SECONDARY POLLUTANTS:	
B9.	SPACE REQUIREMENT:	
B10.	LIMITATIONS:	B11. UNUSED
B12.	OPERATING HISTORY:	
B13.	UNUSED B14	. UNUSED
C.	CONTROL EQUIPMENT COSTS	
C1.	CAPITAL COST: CHECK IF INSTALLATION CO	ST IS INCLUDED IN CAPITAL COST
	EQUIPMENT: \$ INSTALLATION: \$ (200	0) SOURCE OF COST DATA:
C2.	ANNUAL OPERATING COST: \$ (2000)	SOURCE OF COST DATA:
D.	DEMONSTRATION OF COMPLIANCE	
D1.	STAFF PERMFORMING FIELD EVALUATION:	
	ENGINEER'S NAME: INSPECTOR'S N	AME: DATE:
D2.	COMPLIANCE DEMONSTRATION:	
D3.	VARIANCE: NO. OF VARIANCES:	DATES:
	CAUSES:	
D4.	VIOLATION: NO. OF VIOLATIONS:	DATES:
	CAUSES:	
D5.	MAINTENANCE REQUIREMENTS:	D6. UNUSED
D7.	SOURCE TEST/PERFORMANCE DATA RESULTS AND ANALYSIS:	
	DATE OF SOURCE TEST:	CAPTURE EFFICIENCY:
	DESTRUCTION EFFICIENCY:	OVERALL EFFICEINCY:
	SOURCE TEST/PERFORMANCE DATA:	
	OPERATING CONDITIONS:	
	TEST METHODS:	

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6. COMMENTS	APP. NO.:	CO-258

In steel rolling, a lubricant is a normal part of the process. The lubricant is sprayed onto the work piece and drips down into a catch pan, from which it is recirculated to the sprayers. Discussions with a leading supplier of oils used in steel rolling indicate that % oil in water ranges from <1 to 6 in cold rolling and from 0.4 to 0.8 in hot strip rolling and that max. VOC in the neat oils used to make up cold rolling oils is 56%. This information indicates that the 2% and 4% VOC limits in this permit should be technically feasible for most cold rolling operations and for all hot strip rolling operations.

document is 113 papes so if you want details based on the table of contents, look at the web site

https://epd.georgia.gov/air/sites/epd.georgia.gov.air/ files/related\_files/document/0750024pd.pdf

## Prevention of Significant Air Quality Deterioration Review

## **Preliminary Determination**

November 2010

Facility Name: Osceola Steel Company City: Adel County: Cook AIRS Number: 04-13-075-00034 Application Number: 19537 Date Application Received: March 16, 2010

Review Conducted by: State of Georgia - Department of Natural Resources Environmental Protection Division - Air Protection Branch Stationary Source Permitting Program

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Preliminary Determination Nucor Steel Decatur, LLC 712-0037

#### Introduction

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On November 13, 2015, Nucor Steel Decatur, LLC submitted an air permit application for the facility located at 4301 lverson Boulevard, Trinity, Alabama. Additional information was received on December 3, 2015, December 22, 2015, and January 11, 2016. The facility has proposed to deepen the hearth on each of the existing Electric Arc Furnaces (EAFs) and add natural gas burners equaling 11.61 MMBtu/hr to the existing 106.87 MMBtu/hr Galvanizing Line.

#### Process Description

Nucor Steel Decatur owns and operates a scrap steel mill. The mill produces steel coils primarily from steel scrap and scrap substitutes using the Electric Arc Furnace (EAF) process. In general, raw materials, including: various grades of scrap steel, direct reduced iron (DRI), hot briquetted iron (HBI), pig iron, iron carbide, lime, dolomitic lime, pebble lime, carbon (coal and coke), alloy materials, dropout chamber contents, slag conditioners, pour-back heats, and roll grinding scarf are brought to the facility by barge, rail, or truck, or produced internally. Scrap and scrap substitutes, alloys, carbon, fluxes, and other materials are charged to two EAFs and melted by application of electric current through the mixture. Molten metal is tapped to ladles and is transferred to one of the three ladle metallurgical furnaces (LMFs), where the metallurgy and temperature of the steel is adjusted. From the LMFs, the molten metal is transferred to one of two continuous casters, which cast continuous slabs of steel.

After casting, the slabs proceed through one of two roller hearth furnaces and then to the rolling mill, where they are rolled to the desired dimensions and coiled. Steel coils may then be further processed in the cold rolling mill to meet customer order specification. The coils may first be cleaned with hydrochloric acid in the pickle line. Cleaned steel can then be reduced in thickness in the cold reversing mill/temper milled. Some coils may then be galvanized in the galvanizing line. Some material may be annealed in the annealing furnaces. Steel may pass through none, one, or any combination of these processes. The deepening of the hearth could potentially increase the melting capacity 140 tons per day (\$1,100 tons per year). The maximum steel production rate for the facility is 440 tons per hour (tph), and the maximum annual steel production for the facility is 3,200,000 tons per year.

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Document is 447 peage so only sinted summary

website www.adem.state.al.us/ newsEvents/notices/jan16/ pdfs/Inucor.pdf

PSD The proposed modification would qualify as a major source modification since the emissions of PM, PM10, PM2.5, SO2, NOx, CO, and VOC would be increased more than the significant emissions rated listed in ADEM Admin. Code R. 335-3-14-.04(1)(w). The proposed major modification would be subject to ADEM Admin. Code R. 335-3-14-.04 which was adopted pursuant to the federal requirements for prevention of significant deterioration (PSD).

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PSD regulations were designed to limit pollutant concentration increases in areas that are cleaner than the National Ambient Air Quality Standards (NAAQS). The regulations establish increments that set ceilings on the amount of increased ambient pollutant concentrations that will be allowed in a PSD area. Sources subject to P5D regulations must comply with specific pre-construction review requirements.

A major source or major modification under a PSD review must be constructed with Best Available Control Technology (BACT). Additionally, the effects on soils, vegetation, visibility, and ambient air quality must be addressed for each applicable pollutant. If the net air emissions increase of any applicable pollutant is less than its significance emission rate, PSD does not apply for that pollutant.

The following table shows the PSD significant emissions increase threshold values and emission increases as specified in the application submitted:

Pollutant	PSD Significant Emission Rate (TPY)	Proposed Emission Rate Increase (TPY)	Significant Source	
Particulate Matter (PM)	25	66.99	YES	
Particulate Matter {< 10 μm) (PM <sub>10</sub> )	15	66.99	YES	
Particulate Matter {< 2.5 µm} (PM <sub>2.5</sub> )	10	66.99	YES	
Sulfur Dioxide (SO <sub>2</sub> )	40	173.6	YES	
Nitrogen Oxides (NO <sub>x</sub> )	40	316.6	YES	
Carbon Monoxide (CO)	100	2,304.3	YES	

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Pollutant	PSD Significant Emission Rate (TPY)	Proposed Emission Rate Increase (TPY)	Significant Source
Volatile Organic Compounds (VOCs)	40	97.88	YES
Lead (Pb)	0.6	0.44	NO
Greenhouse Gases (CO <sub>2</sub> e)	75,000	67,589	NO

#### BACT

The Clean Air Act prescribes several technology-based limitations affecting new or modified air pollution sources. Among these limitations is BACT. New or modified major sources must be constructed with BACT, which is determined on a case-by-case basis, and addresses the energy, environmental, economic, and other costs associated with each alternative technology, and the benefit of reduced emissions that technology would bring.

#### Electric Arc Furnaces

The existing EAFs operate in a batch mode whereby the scrap steel and scrap substitutes are charged, melted, and tapped. During normal operation, cold scrap metal and scrap substitutes, carbon, and fluxing agents are charged into the EAF shell, powered by a high-powered transformer. A larger electrical potential is applied to the carbon electrodes. The combination of the heat for the arcing process and gas jets melts the scrap and scrap substitutes into molten steel. As the scrap begins to melt, the temperature of the exhaust gas from the EAF increases appreciably. As melting progresses, oxygen lancing and carbon injection are performed and alloy injection may occur; thus, the temperature of the exhaust gas stream can approach 3,000°F, which is approximately the temperature of molten steel. Batch cycles typically vary from 40 to 50 minutes, but may run shorter or longer depending on operation conditions.

The capture system for the exhaust gases from the EAFs is a direct evacuation control (DEC) and an overhead roof exhaust system consisting of a canopy hood. The DEC duct locally evacuates the exhaust gases directly from the furnace to the main duct system, which is then directed to the EAF baghouses. The roof exhaust system evacuates fugitive fumes from the closed roof plenums located over the EAFs and directs them through the main duct system to the EAF baghouses.

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The dust collection equipment for the EAFs consists of two baghouses. Each baghouse has a design volume flow rate of 1,500,000 acfm and 1,100,000 dscfm. 1

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#### PM/PM10/PM2.5

Particulate emissions from the EAFs will be captured by the DEC and roof exhaust system and ultimately exhausted through a baghouse. The maximum flow rate through each baghouse is estimated at approximately 1,100,000 dscfm. The NSP5 and NESHAP emission standard for particulate matter emissions from an EAF are both 0.0052 grains/dscf. Fabric filtration in baghouses is the predominant control device for EAFs. A baghouse is the most effective control device for particulate matter emissions from EAFs. A review of the RBLC database revealed that generally EAFs have been permitted at 0.0018 gr/dscf (filterable) and generally 0.0052 gr/dscf (filterable and condensable).

Nucor Steel Decatur proposes the use of fabric filtration and emissions rate of 0.0018 gr/dscf (43.22 lbs/hr) for filterable PM and 0.0052 gr/dscf (124 lbs/hr) for filterable and condensable PM for BACT.

A review of the RACT/BACT/LAER Clearinghouse revealed that the proposed control design would provide PM/PM<sub>14</sub>/PM<sub>25</sub> control that is at least as stringent as most of the other BACT determinations for similar sources. Therefore, the proposed control design listed above is considered BACT for PM/PM<sub>14</sub>/PM<sub>25</sub> emissions from the electric arc furnaces.

#### SO<sub>2</sub>

The sources of SO<sub>2</sub> emissions from the EAFs are attributable to the sulfur content of the raw materials charged in the EAFs and to the materials which are used in the foamy slag process. A review of the BACT emission limits for EAF steel mills shows a range of 0.2 to 0.7 lb/ton.

Nucor Steel Decatur examined the following technologies potentially applicable to the electric arc furnaces: lower-sulfur charge substitution and flue gas desulfurization (FGD) options including: wet scrubbing, spray dryer absorption (SDA), and dry sorbent injection (DSI). Nucor Steel Decatur determined that the flue gas desulfurization options would be technically infeasible because of the large gas flow and the large amplitude temperature variations of the exhaust gases from the EAFs.

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Nucor Steel Decatur proposes the use of good operating practices, the use of low sulfur injection carbon (less than or equal to 2% sulfur), and an emissions rate of 0.35 lb/ton of steel produced (127.9 lbs/hr) for BACT.

A review of the RACT/BACT/LAER Clearinghouse revealed that the proposed control design would provide SO<sub>2</sub> control that is at least as stringent as most of the other BACT determinations for similar sources. Therefore, the proposed control design listed above is considered BACT for SO<sub>2</sub> emissions from the electric arc furnaces.

### NOx

NO<sub>x</sub> is formed from the chemical reaction between nitrogen and oxygen at high temperatures. NO<sub>x</sub> formation occurs by different mechanisms. In the case of an EAF, NO<sub>x</sub> predominantly forms from thermal dissociation and subsequent reaction of nitrogen and oxygen molecules in the combustion air. This mechanism of NO<sub>x</sub> formation is referred to as thermal NO<sub>x</sub>. The other mechanisms of NO<sub>x</sub> formation such as fuel NO<sub>x</sub> and prompt NO<sub>x</sub>, are thought to have lesser contributions to NO<sub>x</sub> emissions from EAFs. Review of the RBLC database shows limited established for EAFs ranging from 0.13 lb/ton to 1.0 lb/ton, with most facilities higher than 0.35 lb/ton.

Nucor Steel Decatur examined the following technologies potentially applicable to the electric arc furnaces: combustion controls, selective catalytic reduction (SCR), non-selective catalytic reduction (NSCR), SCONOx catalytic oxidation/absorption, shell DeNOx system (modified SCR), and selective non-catalytic reduction (SNCR) options including: £000n's Thermal DeNOx, Nalco Fuel Tech's NOxOUT, and low temperature oxidation (LTO). Nucor Steel Decatur determined that low excess air would be technically infeasible because EAFs do not operate with combustion air feeds and the combustion process in not modulated with the near-atmospheric furnace conditions. Over fire air is geared primarily for fuel NOx reduction as it created incomplete combustion conditions. Such conditions can result in inefficient scrap melting, therefore Nucor Steel Decatur determined over fire air to be technically infeasible. Burners out of service and load reduction options incorporate a reduction in furnace load, thereby, potentially reducing NOx formation. These options are fundamentally inconsistent with the design criterion for an EAF, therefore Nucor Steel Decatur determined that burner out of service and load reduction would be technically infeasible. The reduced combustion air temperature option is limited to equipment with combustion air preheaters which are not applicable

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to EAFs, therefore Nucor Steel Decatur determined that reduced combustion air temperature would be technically infeasible. Nucor Steel Decatur determined that flue gas recirculation would be technically infeasible because the recirculation of the flue gas would create cool spots in the EAF, and create undesirable particulate matter in the EAF as additional natural gas fired burners would need to be installed to account of the loss of the even distribution of heat. Nucor Steel Decatur determined selective catalytic reduction (SCR) to be economically infeasible because the cost per ton of NO<sub>x</sub> removed by the SCR would be \$32,253. Nucor Steel Decatur determined non-selective catalytic reduction (NSCR), SCONO<sub>x</sub> catalytic oxidation/absorption, shell DeNO<sub>x</sub> system (modified SCR), and selective non-catalytic reduction (SNCR) options to be technically infeasible because these options require relatively stable air flow and specific temperature ranges which the air flow from the EAFs don't meet. ,

Nucor Steel Decatur proposes the use of oxy-fuel fired burners and an emission rate of 0.42 lb/ton of steel produced (153.4 lbs/hr) for BACT.

A review of the RACT/BACT/LAER Clearinghouse revealed that the proposed control design would provide NO<sub>X</sub> control that is at least as stringent as most of the other BACT determinations for similar sources. Therefore, the proposed control design listed above is considered BACT for NO<sub>X</sub> emissions from the electric arc furnaces.

#### со

CO will be emitted as a byproduct of incomplete combustion from the following potential sources – charged and injection carbon, scrap steel, scrap substitutes, electrodes, natural gas, and "foaming slag" operating practice. EAFs generate CO as a result of oxidation of carbon introduced into the furnace charge to refine the steel and as a result of the sublimation/oxidation of the carbon electrode. A review of the RBLC database revealed that other steel mills have an emission limit ranging from about 1.93 – 6.0 lbs/ton of steel produced.

Nucor Steel Decatur examined the following technologies potentially applicable to the electric arc furnaces: flaring of CO emissions, CO oxidation catalysts, post-combustion reaction chamber, catalytic incineration, oxygen injection, and direct evacuation control (DEC). Flaring of emissions for CO destruction would cost an estimated \$12,627 per ton of CO removed. Therefore, Nucor Steel Decatur

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determined the use of a flare to be economically infeasible. Nucor Steel Decatur determined that the use of a CO oxidation catalyst would be technically infeasible based on the temperature requirements for a CO catalyst would not be met by the EAFs exhaust streams. Nucor Steel Decatur determined that a post-combustion reaction chamber and catalytic incineration would be economically infeasible based the estimated \$15,646 cost per ton of CO removed. Nucor Steel Decatur determined that oxygen injection would be technically infeasible based cyclic operating schedule of the EAFs and the inconsistent temperature profile.

Nucor Steel Decatur proposes the use of the existing DEC to capture the emissions and an emissions rate of 2.3 lb/ton of steel produced (840.2 lbs/hr) for BACT.

A review of the RACT/BACT/LAER Clearinghouse revealed that the proposed control design would provide CO control that is at least as stringent as most of the other BACT determinations for similar sources. Therefore, the proposed control design listed above is considered BACT for CO emissions from the electric arc furnaces.

### voc

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VOC emissions from the EAFs will be intermittent and limited to the brief period during EAF charging when organic compounds such as oil or paint present in the scrap are volatized.

Nucor Steel Decatur examined the following technologies potentially applicable to the electric arc furnaces: catalytic or thermal oxidation, degreasing of scrap metal prior to charging in the EAF, and a scrap management program. Nucor Steel Decatur determined that catalytic oxidation would be technically infeasible based on the temperature requirements for catalyst oxidation would not be met by the EAFs exhaust streams. Thermal oxidation was considered economically infeasible based on the estimated \$276,806 cost per ton of VOC removed. Nucor Steel Decatur estimated the cost per ton of VOC removed by degreasing to be \$256,231, therefore, degreasing was considered economically infeasible.

Nucor Steel Decatur proposes the use of a scrap management program and an emission rate of 0.13 lb/ton of steel produced (47.5 lbs/hr) for BACT.

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A review of the RACT/BACT/LAER Clearinghouse revealed that the proposed control design would provide VOC control that is at least as stringent as most of the other BACT determinations for similar sources. Therefore, the proposed control design listed above is considered BACT for VOC emissions from the electric arc furnace.

### Natural Gas Burners (Galvanizing Line)

Nucor Steel Decatur proposes to install natural gas-fired burners in the galvanizing furnace. The total burners to be added will have a maximum heat input rate of 11.61 MMBtu/hr which would bring the maximum heat input rate for the whole galvanizing furnace to 106.87 MMBtu/hr.

### PM/PM10/PM2.5

Particulate matter emission from the galvanizing line burners primarily result from carryover of noncombustible tract constituents in the fuel. Typically, particulates are hard to detect with natural gas firing due to the low ash content. Due to the relatively small emissions (0.39 TPY) from natural gas combustion, the application of add-on controls is considered impractical, as no control technologies for particulate abatement have been successfully implemented for similar furnace emissions.

Nucor Steel Decatur proposes the use of natural gas combustion with good combustion practices per manufacturer's guidance and an emission rate of 0.0076 lb/MMBtu for BACT.

A review of the RACT/BACT/LAER Clearinghouse revealed that the proposed control design would provide  $PM/PM_{10}/PM_{2.5}$  control that is at least as stringent as most of the other BACT determinations for similar sources. Therefore, the proposed control design listed above is considered BACT for  $PM/PM_{10}/PM_{2.5}$  emissions from the new burners.

#### SO2

SO<sub>2</sub> emissions from the galvanizing burners would primarily result from a combustion by-product of the fuel. Due to the relatively small emissions (0.39 TPY) from natural gas combustion, the application of add-on controls is considered impractical, as no technologies for SO<sub>2</sub> control have been successfully implemented for similar furnace emissions.

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Nucor Steel Decatur proposes the use of natural gas combustion with good combustion practices per manufacturer's guidance and an emission rate of 0.0006 lb/MMBtu for BACT.

A review of the RACT/BACT/LAER Clearinghouse revealed that the proposed control design would provide SO<sub>2</sub> control that is at least as stringent as most of the other BACT determinations for similar sources. Therefore, the proposed control design listed above is considered BACT for SO<sub>2</sub> emissions from the new burners.

### NOx

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NO<sub>2</sub> emissions from the galvanizing burners would primarily result from a combustion by-product of the fuel. The galvanizing line is presently controlled using Selective Catalytic Reduction (SCR), which is considered the most effective technically feasible option for controlling NO<sub>4</sub> from galvanizing furnaces.

Nucor Steel Decatur proposes the use of SCR and an emissions rate of 6.6 lb/hr and 0.067 lb/MMBtu for BACT.

A review of the RACT/BACT/LAER Clearinghouse revealed that the proposed control design would provide NO<sub>X</sub> control that is at least as stringent as most of the other BACT determinations for similar sources. Therefore, the proposed control design listed above is considered BACT for NO<sub>X</sub> emissions from the new burners.

#### со

CO emissions from the galvanizing burners would primarily result from a combustion by-product of the fuel. Due to the relatively small emissions (4.27 TPY) from natural gas combustion, the application of add-on controls is considered impractical, as no technologies for CO control have been successfully implemented for similar furnace emissions.

Nucor Steel Decatur proposes the use of natural gas combustion with good combustion practices per manufacturer's guidance and an emission rate of 0.084 lb/MMBtu for BACT.

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A review of the RACT/BACT/LAER Clearinghouse revealed that the proposed control design would provide CO control that is at least as stringent as most of the other BACT determinations for similar sources. Therefore, the proposed control design listed above is considered BACT for CO emissions from the new burners.

### voc

VOC emissions from the galvanizing burners would primarily result from a combustion by-product of the fuel. Due to the relatively small emissions (0.28 TPY) from natural gas combustion, the application of add-on controls is considered impractical, as no technologies for VOC control have been successfully implemented for similar furnace emissions.

Nucor Steel Decatur proposes the use of natural gas combustion with good combustion practices per manufacturer's guidance and an emission rate of 0.0055 lb/MMBtu for BACT.

A review of the RACT/BACT/LAER Clearinghouse revealed that the proposed control design would provide VOC control that is at least as stringent as most of the other BACT determinations for similar sources. Therefore, the proposed control design listed above is considered BACT for VOC emissions from the new burners.

### Air Quality Analysis

An applicant for a PSD permit is required to conduct an air quality analysis of the ambient impacts associated with the construction and operation of the proposed new sources or modification. The main purpose of the air quality analysis is to demonstrate that new emissions from a proposed major stationary source or major modification will not cause or contribute to a violation of any applicable National Ambient Air Quality Standards (NAAQS) or PSD increment. Ambient impacts of non-criteria pollutants must also be evaluated. Generally the analysis will include (1) an assessment of existing air quality, which may include ambient monitoring data and air quality dispersion modeling results, and (2) predictions, using dispersion modeling, of ambient concentrations that will result from the applicant's proposed project and future growth associated with the project.

National Ambient Air Quality Standards (NAAQS)

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The NAAQS are maximum concentration "ceilings" measured in terms of the total concentration of a pollutant in the atmosphere. The following table presents the applicable standards for the pollutants under PSD review:

Pollutant/Averaging Time	Primers Standard	Secondary Standard
Particulate Matter (< 10 µm) (PM <sub>10</sub> )		
PM <sub>10</sub> , 24-hour	150 µg/m <sup>3</sup>	150 µg/m <sup>3</sup>
Particulate Matter (< 2.5 µm) (PM <sub>2.5</sub> )		
PM2.5, Annual	12 µg/m <sup>3</sup>	15 μg/m <sup>3</sup>
PM2.5, 24-hour	35 μg/m <sup>3</sup>	35 μg/m³
Sulfur Dioxide (SO <sub>2</sub> )		
SO <sub>2</sub> , 1-hour	75 ppb	-
SO <sub>2</sub> , 3-hour	****	0.5 ppm
Nitrogen Dioxide (NO <sub>2</sub> )		
NO <sub>2</sub> , Annuał	53 ppb	53 ppb
NO <sub>2</sub> , 1-hour	100 ppb	_
Carbon Monoxide (CO)		
CO, 1-hour	35 ppm	
CO, 8-hour	9 ppm	

A complete review of the air quality analysis can be found in Attachment 1. As can be seen from the review, all of the predicted pollutant concentrations are less than the NAAQS and the NAAQS for each pollutant are not expected to be exceeded.

The PSD requirements provide for a system of area classifications which affords an opportunity to identify local land use goals. There are three area classifications. Each classification differs in terms of the amount of growth it would permit before significant air quality deterioration would be deemed to occur. Class I areas have the smallest increments and thus allow only a small degree of air quality deterioration. Class II areas can accommodate normal well-managed industrial growth. Class III areas have the largest increments and thereby provide for larger amount of development than either Class I or Class II areas. Presently, there are no Class III areas in the country. The table below shows the pollutants and associated Class 1 and II PSD increments.

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Pollutant	Averaging Period	Class Live/m <sup>2</sup>	Class It (us/m*)	
PM	Annual	5	19	
PM	24-hour	10	37	
PM10	Annual	4	17	
PM10	24-hour	8	30	
PM2.5	Annual	1	5	
PM2.5	24-hour	2	9	
SO <sub>2</sub>	Annual	2	20	
SO <sub>2</sub>	24-hour	5	91	
SO <sub>2</sub>	3-hour	25	512	
NO <sub>2</sub>	Annual	2.5	25	

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## The following is a brief synopsis of each class area and how it relates to this project:

## Class | Areas:

Class I Areas have the smallest increments and thus allow only a small degree of air quality deterioration. Air Permit applications forms submitted document that the closest Class I Area, the Sipsey Wilderness, is within 100 km from the facility. In addition to the Class I increment analysis; modeling was performed to address the impacts on regional haze and other air quality values. Again, Attachment 1 provides a review of the Class I Area analysis. The predicted impacts on regional haze and other air quality values at the Sipsey Wilderness Area are below the levels recommended by the Federal Land Manager (FLM).

## Class II Areas:

Class II areas can accommodate normal well-managed industrial growth Constellium Alloys and E13 plants are located in a Class II Area. Attachment No. 1 provides a review of the PSD Class II increment analysis. As can be seen from the review, there are no predicted violations of the Class II increment for any averaging period.

## Class III Areas:

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Class III areas have the largest increments and thereby provide for larger amount of development than either Class I or Class II areas. Presently, there are no Class III areas in the state of Alabama. Therefore, no Class III area analysis was performed for this project.

### Additional Impact Analysis

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All PSD permit applicants must prepare an additional impact analysis, for each pollutant subject to regulation, which would be emitted by the proposed new source or modification. This analysis assesses the impacts of air, ground, and water pollution on soils, vegetation, and visibility caused by an increase in emissions and from associated growth. The additional impact analysis generally has three parts:

- (a) Growth
- (b) Soils and Vegetation
- (c) Visibility Impairment

#### Growth

Since the mill is an existing source, Nucor Steel Decatur's proposed construction changes will be minimal and anticipated growth in the area will also be minimal. Commercial growth is anticipated to occur at a gradual rate in the future.

### Soils and Vegetation

As the impacts from the proposed modification will be less than all NAAQS, which are intended to protect human health and are more stringent than standards intended to protect soil or vegetation, the project is not expected to have a significant impact on the surrounding soil. Modeled impacts of annual NO<sub>2</sub> are less than the SIL. In summary, the project is not expected to result in significant impact on soil, vegetation, or wildlife in the area surrounding the facility.

#### Visibility Impairment

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As part of the NSPS for electric arc furnaces, Nucor Steel Decatur is required to meet opacity limits. Opacity limits are also imposed on other sources at the mill. These limits reduce the events of visible plumes, thus visibility impacts in the immediate vicinity of the mill should be negligible. There were no airports or scenic vistas located near the receptors that exceed the pollutant-specific SILs; thus, no visibility analyses were required.

### Analysis of Non-Criteria Pollutants/Air Toxics Review

- 13 -

An air toxics analysis was performed for the air toxics emitted from units associated with the proposed project that have emissions increases of greater than 0.1 lb/hr. A complete review of the air toxics analysis can be found in Attachment No. 1. Results indicated that all air toxics were predicted to have a maximum annual concentration lower than their respective TLV/40 and TLV/420. Therefore, no further modeling was required. • • •

### Compliance Assurance Monitoring (CAM)

The existing EAFs and galvanizing line are subject to CAM, and therefore the CAM plans will be followed by the modified units.

#### <u>NSPS</u>

The existing EAFs, baghouses, and dust handling systems are subject to New Source Performance Standards (NSPS) 40 CFR Part 60, Subpart AAa – Standards of Performance for Steel Plants: Electric Arc Furnaces and Argon – Oxygen Decarburization Vessels Constructed After August 7, 1983. Subpart AAa specifically regulates particulate matter emissions to 0.0052 grains/dscf and 3 percent opacity at the control device, 6 percent opacity from the shop due solely to the operations of the electric arc furnace, and 10 percent opacity from the dust handling system. The rule also requires the installation of a continuous opacity monitoring system (COMs) on each baghouse controlling an EAF. BACT limits are at least as stringent as the NSPS, 40 CFR Part 60, Subpart AAa.

#### NESHAP/MACT

The existing EAFs are subject to National Emission Standards for Hazardous Air Pollutants (NESHAP) 40 CFR Part 63 Subpart YYYYY – National Emission Standards for Hazardous Air Pollutants for Area Sources: Electric Arc Furnace Steelmaking Facilities. The modification to the EAF is not considered reconstruction based on the definition found in 563.2, therefore the facility is still considered an existing source. Subpart YYYYY specially regulates scrap management plans and particulate matter emissions to 0.0052 grains/dscf and 6 percent opacity from the shop due solely to the operations of the electric arc furnace. BACT limits are at least as stringent as the NESHAP, 40 CFR Part 63, Subpart YYYYY.

## Recommendation

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. . . .

Based on the above analysis, I recommend that, upon receiving permitting fees and pending the completion of the appropriate public comment period, the following Air Permits be issued with the attached provisos (See Attachment 2):

712-0037-X001 Two (2) Electric Arc Furnaces with Two (2) Meltshop Baghouses 712-0037-X016 106.87 MMBtu/hr Galvanizing Line with Selective Catalytic Reduction

Ryan Cowart Industrial Minerals Section Energy Branch Air Division

January 22, 2016 Date

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# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

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FIN	IAL

RBLC ID: AL-0275 Corporate/Company: NUCOR STEEL TUSCALOOSA, INC. Facility Name: NUCOR STEEL TUSCALOOSA, INC. Process: Electric Arc Furnace

		Pollutant Information - List of Pollutants Help				
Primary Fuel: Throughput:	0 <b>Pollutant</b> 81.210 <u>Particulate matternation filterable (FPM)</u>	Poliutant	Primary Emission Limit	Basis	Verified	
Process Code:		<u>Particulate matter,</u> <u>filterable (FPM)</u>	0.0018 GR	BACT- PSD	NO	
		<u>Particulate matter,</u> <u>filterable &lt; 10 μ</u> (FPM10)	0.0052 GR	BACT- PSD	NO	
		<u>Particulate matter</u> , filterable < 2.5 μ (FPM2.5)	0.0049 GR.	BACT- PSD	NO	

not sure how applicable all these are, but this is all these BACT at various sites



# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

Help	
FIN	AL

RBLC ID: AL-0301 Corporate/Company: NUCOR STEEL TUSCALOOSA, INC. Facility Name: NUCOR STEEL TUSCALOOSA, INC. Process: ELECTRIC ARC FURNACE BAGHOUSE # 2

					Help
Primary Fuel: Throughput: Process Code:	600000.00 LB/H 81.210	Pollutant	Primary Emission Limit	Basis	Verified
	011110	Particulate matter, filterable (FPM)	0.0018 GR/DSCF	BACT- PSD	NO
		<u>Particulate matter,</u> total < <u>10 μ</u> (TPM10)	0.0052 GR/DSCF	BACT- PSD	NO
		<u>Particulate matter,</u> total < 2.5 μ <u>(TPM2.5)</u>	0.0049 GR/DSCF	BACT- PSD	NO

Pollutant Information - List of Pollutants

Process Notes: ADDITIONAL BAGHOUSE TO CONTROL EXISTING EAF



# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

Help DRAFT

RBLC ID: TX-0651 Corporate/Company: NUCOR CORPORATION Facility Name: STEEL MILL Process: ELECTRIC ARC FURNACE

		Pollutant Inform	nation - List	of Pollu	Itants Help
		Pollutant	Primary Emission Limit	Basis	Verified
		Carbon Monoxide	2.2700 LB/T OF STEEL	BACT- PSD	UNKNOWN
		<u>Lead (Pb) / Lead</u> Compounds	0.0032 GR/DSCF	MACT	UNKNOWN
		<u>Nitrogen Oxides</u> (NOx)	0.9000 LB/TON OF STEEL	BACT- PSD	UNKNOWN
Primary Fuel: Throughput: Process Code:	electricity 316.00 TPH 81.210	Particulate matter, filterable < 10 μ (FPM10)	0.0032 GR/DSCF	MACT	UNKNOWN
		Particulate matter, filterable < 2.5 μ (FPM2.5)	0.0032 GR/DSCF	MACT	UNKNOWN
		<u>Particulate</u> <u>matter, total</u> (TPM)	0.0032 GR/DSCF	MACT	UNKNOWN
		<u>Particulate</u> matter, total < 10 µ (TPM10)	0.0052 GR/DSCF	MACT	UNKNOWN
		<u>Particulate</u> <u>matter, total &lt;</u> 2.5 μ (TPM2.5)	0.0052 GR/DSCF	MACT	UNKNOWN
		<u>Sulfur Dioxide</u> (SO2)	1.7600 LB/TON OF STEEL	BACT- PSD	UNKNOWN
		Volatile Organic Compounds (VOC)	0.4300 LB/TON OF STEEL	BACT- PSD	UNKNOWN

Process Notes: 1,500,000 TPY



# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

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RBLC ID: IN-0140 Corporate/Company: NUCOR STEEL Facility Name: NUCOR STEEL Process: MELTSHOP

		Pollutant Information - List of Pollutants Help			
Primary Fuel:		Pollutant	Primary Emission Limit	Basis	Verified
Throughput: Process Code:	502.00 T/H 81.210	<u>Fluorides,</u> <u>Total</u>	5.0200 LB/H	OTHER CASE-BY- CASE	UNKNOWN
		<u>Lead (Pb) /</u> Lead Compounds	0.2400 LB/H	OTHER CASE-BY- CASE	UNKNOWN
		Mercury	0.0800 LB/H	OTHER CASE-BY- CASE	UNKNOWN
		<u>Sulfur Dioxide</u> (SO2)	0.3300 LB/T OF STEEL	OTHER CASE-BY- CASE	UNKNOWN

Process Notes: CONSITS OF: ELECTRIC ARC FURNACES 1 & 2, TWO CONTINUOUS CASTERS, DESULFURIZATION STATION, LADLE DRYER, LADLE PREHEATER, ONE ARGON OXYGEN DECARURIZATION VESSEL, ONE LMF EU-13C, 2 LMFS (EU13A & EU13B) 81.290 81.220 81.230



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

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**FINAL** 

RBLC ID: MI-0417 Corporate/Company: GERDAU MACSTEEL, INC. Facility Name: GERDAU MACSTEEL, INC. Process: FG-MELTSHOP (Melt Shop)

Electric with Oxy-fuel	Pollutant	Primary Emission Limit	Basis	Verified
Throughput: 130.00 T/H	<u>Carbon Dioxide</u> Equivalent (CO2e)	320.0000 LB/T	BACT- PSD	NO
Process Code: 81.210	Carbon Monoxide	2.0000 LB/T	BACT- PSD	NO
	<u>Nitrogen Oxides</u> (NOx)	0.2000 LB/T	BACT- PSD	NO
	<u>Particulate matter,</u> <u>total &lt; 2.5 μ</u> (TPM2.5)	0.1000 LB/T	BACT- PSD	NO
	<u>Sulfur Dioxide</u> (SO2)	0.2000 LB/T	BACT- PSD	NO
	<u>Visible Emissions</u> (VE)	3.0000 %	BACT- PSD	NO

**Process Notes:** Melt shop which includes an electric arc furnace (EUEAF), a ladle metallurgy station (EULMF), and two (2) vacuum degassers (twin tank) (EUVTD). Two Process Codes associated are 81.210 (entered above) and 81.220. The throughput is 130 tons of liquid steel per hour The steel is melted in an electric arc furnace using an electric arc along with natural gas fired oxy-fueled burners, which increase the steel melting rate. The molten steel is tapped from the vessel and is covered and transferred to the ladle metallurgy station. After ladle metallurgy is complete the ladle is covered and transferred to the vacuum degassing station.

# Pollutant Information - List of Pollutants



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

Help		
FI	NAL	_

RBLC ID: IN-0196 Corporate/Company: NUCOR STEEL Facility Name: NUCOR STEEL Process: SNUB FURNACE

		Pollutant Information - List of Pollu			Help		
		Pollutant	Primary Emission Limit	Basis	Verified		
		Carbon Monoxide	84.0000 LB/MMCF	BACT- PSD	NO		
Primary Fuel: Throughput:	NATURAL GAS 502.00 T/H	<u>Nitrogen Oxides</u> (NOx)	100.0000 LB/MMCF NAT GAS	BACT- PSD	NO		
Process Code:	81.220	Particulate matter, filterable (FPM)	1.9000 LB/MMCF NAT GAS	BACT- PSD	NO		
		<u>Particulate matter,</u> filterable < 2.5 μ (FPM2.5)	7.6000 LB/MMCF NAT GAS	BACT- PSD	NO		
		<u>Particulate matter,</u> total < 10 μ (TPM10)	7.6000 LB/MMCF NAT GAS	BACT- PSD	NO		
		<u>Sulfur Dioxide</u> (SO2)	0.6000 LB/MMCF NAT GAS	BACT- PSD	NO		
		<u>Volatile Organic</u> Compounds (VOC)	5.5000 LB/MMCF NAT GAS	BACT- PSD	NO		

Process Notes: SNUB FURNACE - 6 MMBTU/HR



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. **RBLC Home** New Search Search Results **Facility Information** Process List Process Information

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**RBLC ID:** OH-0316 Corporate/Company: V & M STAR Facility Name: V & M STAR Process: LADLE REFINING STATION

		Pollutant Information - List of Pollutants Help			
		Pollutant	Primary Emission Limit	Basis	Verified
		<u>Carbon</u> Monoxide	536.0000 LB/H	BACT- PSD	NO
Primary Fuel: Throughput: 134.00 T/H Process Code: 81.220	<u>Lead (Pb) / Lead</u> Compounds	0.2400 LB/H	Other Case- by-Case	NO	
	81.220	<u>Nitrogen Oxides</u> (NOx)	53.6000 LB/H	BACT- PSD	NO
		Particulate matter, filterable < 10 μ (FPM10)	14.1000 LB/H	BACT- PSD	UNKNOWN
		<u>Sulfur Dioxide</u> (SO2)	33.5000 LB/H	Other Case- by-Case	NO
		<u>Visible Emissions</u> (VE)	6.0000 %	Other Case- by-Case	NO
		<u>Volatile Organic</u> <u>Compounds</u> <u>(VOC)</u>	24.1000 LB/H	Other Case- by-Case	NO

Process Notes: 134 TONS OF LIQUID STEEL/HOUR AND 830,000 TONS OF LIQUID STEEL/YEAR IS THE MAXIMUM PRODUCTION RATE.



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

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RBLC ID: OK-0128 Corporate/Company: MID AMERICAN STEEL AND WIRE COMPANY Facility Name: MID AMERICAN STEEL ROLLING MILL Process: Ladie Metallurgy Furnace

		Pollutant Inform	nation - List	of Pollı	utants Help
Primary Fuel:		Pollutant	Primary Emission Limit	Basis	Verified
Throughput: Process Code:	0 81.220	Carbon Monoxide	0.1000 LB/T	BACT- PSD	UNKNOWN
		<u>Nitrogen Oxides</u> (NOx)	0.0500 LB/T SCRAP	BACT- PSD	UNKNOWN
		<u>Particulate</u> matter, total < 10 μ (TPM10)	0.0020 GR/DSCF	BACT- PSD	UNKNOWN
		<u>Sulfur Dioxide</u> (SO2)	0.0500 LB/T	BACT- PSD	UNKNOWN
		<u>Volatile Organic</u> <u>Compounds</u> (VOC)	0.0350 LB/T	BACT- PSD	UNKNOWN



## **Process Information - Details**

 For information about the pollutants related to this process, click on the specific pollutant in the list below.

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## We'd welcome you

Pollutant Information - List of Pollutantiank you for visiting ou

Natural gas	Pollutant	Primary Emission Limit	Basis	Ve <b>ltible:</b> for it at the <u>concl</u> No thanks Yes, I'll give
184.00 MMBtu/H 81.230	Carbon Monoxide	15.4600 LB/H	BACT- PSD	UN This survey is conducted by an UN on behalf of the site you are vi
011200	<u>Nitrogen Oxides</u> (NOx)	27.6000 LB/H	BACT- PSD	UNKNOWN
	<u>Particulate</u> matter, total < 2.5 µ (TPM2.5)	0.0075 LB/MMBTU	BACT- PSD	UNKNOWN
	<u>Sulfur Dioxide</u> (SO2)	0.0006 LB/MMBTU	BACT- PSD	UNKNOWN
	<u>Volatile Organic</u> <u>Compounds</u> <u>(VOC)</u>	0.0054 LB/MMBTU	BACT- PSD	UNKNOWN
	Natural gas 184.00 MMBtu/H 81.230	Natural gas 184.00 MMBtu/H 81.230 Carbon Monoxide Nitrogen Oxides (NOx) Particulate matter, total < 2.5 µ (TPM2.5) Sulfur Dioxide (SO2) Volatile Organic Compounds (VOC)	Natural gasPollutantPrimary Emission Limit184.00 MMBtu/HCarbon Monoxide15.4600 LB/H81.230Nitrogen Oxides (NOX)27.6000 LB/HNitrogen Oxides (NOX)27.6000 LB/HParticulate matter, total < 2.5 µ (TPM2.5)0.0075 LB/MMBTUSulfur Dioxide (SO2)0.0006 LB/MBTUVolatile Organic (VOC)0.0054 LB/MBTU	Natural gasPollutantPrimary Emission LimitBasis184.00 MMBtu/HCarbon Monoxide15.4600 LB/HBACT- PSD81.230Nitrogen Oxides (NOX)27.6000 LB/HBACT- PSDNitrogen Oxides (NOX)27.6000 LB/HBACT- PSDParticulate matter, total < 2.5 µ (TPM2.5)0.0075 LB/MMBTUBACT- PSDSulfur Dioxide (SO2)0.0006 LB/MMBTUBACT- PSDVolatile Organic (VOC)0.0054 LB/MMBTUBACT- PSD



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

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	FIN	IAL

RBLC ID: IN-0140 Corporate/Company: NUCOR STEEL Facility Name: NUCOR STEEL Process: STRIP CASTER LIN

		Pollutant Information - List of Pollutants Help			
		Pollutant	Primary Emission Limit	Basis	Verified
Primary Fuel: Throughput:	270.00 T/H	<u>Fluorides, Total</u>	2.7000 LB/H	OTHER CASE- BY-CASE	NO
Process Code:	81.230	<u>Lead (Pb) /</u> <u>Lead</u> Compounds	0.1300 LB/H	OTHER CASE- BY-CASE	NO
		Particulate matter, filterable (FPM)	0.0018 GR/D <b>SC</b> F*	OTHER CASE- BY-CASE	NO
		<u>Particulate</u> matter, filterable (FPM)	0.0052 GR/DSCF*	OTHER CASE- BY-CASE	UNKNOWN
		Particulate matter, filterable < 10 µ (FPM10)	0.0018 GR/DSCF*	OTHER CASE- BY-CASE	UNKNOWN

**Process Notes:** CASTRIP FACILITY CONSISTS OF THE FOLLOWING EQUIPMENT: LADLE METALLURGY STATION, TUNDISH AND CONTINUOUS STRIP CASTER



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

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Heln

RBLC ID: MI-0417 Corporate/Company: GERDAU MACSTEEL, INC. Facility Name: GERDAU MACSTEEL, INC. Process: EUCASTER

Primary Fuel: natural gas in oxy-fuel burners	Pollutant	Primary Emission Limit	Basis	Verified
Throughput: 130.00 Tons liquid steel per hour	<u>Carbon_Dioxide</u> Equivalent (CO2e)	0	BACT- PSD	NO
<b>Process Code:</b> 81.230	<u>Carbon Monoxide</u>	0	BACT- PSD	NO
	<u>Nitrogen Oxides</u> <u>(NOx)</u>	0	BACT- PSD	NO
	<u>Particulate matter,</u> total < 2.5 μ (ΤΡΜ2.5)	0	BACT- PSD	NO
	<u>Sulfur Dioxide</u> (SO2)	0	BACT- PSD	NO

**Pollutant Information - List of Pollutants** 

**Process Notes:** Molten steel produced by the electric arc furnace is delivered to the continuous caster in a ladle via the ladle metallurgy system and twin tank vacuum degasser. The molten steel is gravity fed from the ladle to the tundish. From the tundish, the molten steel flows into the enclosed caster strands. The semi-molten steel is then cut into billets by oxy-fuel cutting torches. The four cutting torches have a combined rated capacity of 4413 cubic feet of natural gas per hour.



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

Help
FINAL

RBLC ID: TX-0705 Corporate/Company: STRUCTURAL METALS INC Facility Name: STEEL MINIMILL FACILITY Process: Casting Operations

		Pollutant Infor	mation - List	of Poll	utants Help
Primary Fuel: Throughput:	Natural Gas 1300000.00 tons/year	Pollutant	Primary Emission Limit	Basis	Verified
Process Code:	81.230	<u>Carbon</u> Monoxide	0	BACT- PSD	UNKNOWN
		<u>Nitrogen Oxides</u> (NOx)	0	BACT- PSD	UNKNOWN
		<u>Sulfur Dioxide</u> (SO2)	0	BACT- PSD	UNKNOWN
		<u>Volatile Organic</u> <u>Compounds</u> (VOC)	0	BACT- PSD	UNKNOWN

Process Notes: Casting Operations - Ladle Preheaters and ladle resin dryers



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

Help
FINAL

RBLC ID: AL-0275 Corporate/Company: NUCOR STEEL TUSCALOOSA, INC. Facility Name: NUCOR STEEL TUSCALOOSA, INC. Process: Propane Fired Emergency Generator

		Pollutant Infor	mation - List	of Pollut	ants Help
Primary Fuel: Throughput: Process Code:	Propane 400.00 kw 81.290	Pollutant	Primary Emission Limit	Basis	Verified
		<u>Carbon</u> Monoxide	7.5000 LB/1000GAL	BACT- PSD	NO
		<u>Nitrogen Oxides</u> (NOx)	13.0000 LB/1000GAL	RACT	NO
		<u>Particulate</u> <u>matter, filterable</u> <u>(FPM)</u>	0.7000 LB/1000GAL	BACT- PSD	NO



# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

Help
FINAL

RBLC ID: AL-0275 Corporate/Company: NUCOR STEEL TUSCALOOSA, INC. Facility Name: NUCOR STEEL TUSCALOOSA, INC. Process: Tempering Furnace

					Help
Primary Fuel: Throughput: Process Code:	Natural Gas 35.00 MMBTU/H 81.290	Pollutant	Primary Emission Limit	Basis	Verified
		Carbon Monoxide	0.0840 LB/MMBTU	BACT- PSD	NO
		<u>Nitrogen Oxides</u> <u>(NOx)</u>	0.0670 LB/MMBTU	BACT- PSD	NO
		Particulate matter, filterable (FPM)	0.0076 LB/MMBTU	BACT- PSD	NO

**Pollutant Information - List of Pollutants** 



# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below.

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RBLC ID: AL-0275 Corporate/Company: NUCOR STEEL TUSCALOOSA, INC. Facility Name: NUCOR STEEL TUSCALOOSA, INC. Process: Diesel Fired Emergency Generator

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Primary Fuel: Throughput: Process Code:	Diesel 800.00 hp 81.290	Pollutant	Primary Emission Limit	Basis	Verified
		Carbon Monoxide	0.0055 LB/HP-H	BACT- PSD	NO
		<u>Nitrogen Oxides</u> <u>(NOx)</u>	0.0150 LB/HP-H	BACT- PSD	NO
		<u>Particulate</u> <u>matter, filterable</u> (EPM)	0.0007 LB/HP-H	BACT- PSD	NO

Pollutant Information - List of Pollutants



# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

	Help
	FINAL
<b>RBLC ID:</b> AL-0275	
Corporate/Company: NUCOR STEEL TUSCALOOSA, INC.	
Facility Name: NUCOR STEEL TUSCALOOSA, INC.	
Process: Vacuum Degasser with flare and cooling towers	

		Pollutant Information - List of Pollutants Help			
Primary Fuel: Throughput: Process Code:	0 81.290	Pollutant	Primary Emission Limit	Basis	Verified
		Carbon Monoxide	0.0750 LB/T	BACT- PSD	NO
		<u>Nitrogen Oxides</u> (NQx)	0.0050 LB/T	BACT- PSD	NO
		Particulate matter, filterable (FPM)	0.0080 GR/DSCF	BACT- PSD	NO



# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

Help

FINAL

RBLC ID: AL-0275 Corporate/Company: NUCOR STEEL TUSCALOOSA, INC. Facility Name: NUCOR STEEL TUSCALOOSA, INC. Process: Austenitizing Furnace

	Pollutant Inform	nation - List	of Polluti	Help
Natural Gas 40.60 MMBTU/H 81.290	Pollutant	Primary Emission Limit	Basis	Verified
	Carbon Monoxide	0.0840	BACT- PSD	NO
	<u>Nitrogen Oxides</u> <u>(NOx)</u>	0.1960 LB/MMBTU	BACT- PSD	NO
	<u>Particulate</u> matter, filterable <u>(FPM)</u>	0.0076 LB/MMBTU	BACT- PSD	NO
	Natural Gas 40.60 MMBTU/H 81.290	Pollutant Inform         Natural Gas         40.60 MMBTU/H         81.290         Carbon Monoxide         Nitrogen Oxides         (NOx)         Particulate         matter, filterable         (FPM)	Natural Gas40.60 MMBTU/H81.290Carbon Monoxide0.0840Nitrogen Oxides(NOx)Particulate matter, filterable (FPM)	Natural Gas40.60 MMBTU/H81.290Carbon Monoxide0.0840Nitrogen Oxides0.1960Nitrogen Oxides0.1960BACT-PSDParticulatematter, filterable(FPM)



# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

Help
FINAL

RBLC ID: AL-0275 Corporate/Company: NUCOR STEEL TUSCALOOSA, INC. Facility Name: NUCOR STEEL TUSCALOOSA, INC. Process: Plate Cutting Beds

					Help
Primary Fuel: Throughput: Process Code:	Natural Gas 0.32 MMBTU/H 81.290	Pollutant	Primary Emission Limit	Basis	Verified
		Carbon Monoxide	0.0840 LB/MMBTU	BACT- PSD	NO
		<u>Nitrogen Oxides</u> (NOx)	0.5600 LB/H	BACT- PSD	NO
		<u>Particulate</u> matter, filterable <u>(FPM)</u>	0.1000 LB/H	BACT- PSD	NO

Pollutant Information - List of Pollutants



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

> Help FINAL

RBLC ID: AL-0301 Corporate/Company: NUCOR STEEL TUSCALOOSA, INC. Facility Name: NUCOR STEEL TUSCALOOSA, INC. Process: AUSTENITIZING FURNACE

NATURAL GAS 40.60 MMBTU/H 81.290	Pollutant Information - List of Pollutants Help				
	Pollutant	Primary Emission Limit	Basis	Verified	
	Carbon Monoxide	0.0840 LB/MMBTU	BACT- PSD	NO	
	<u>Nitrogen Oxides</u> (NOx)	0.1960 LB/MMBTU	BACT- PSD	NO	
	<u>Particulate</u> matter, filterable (FPM)	0.0076 LB/MMBTU	BART	NO	
	NATURAL GAS 40.60 MMBTU/H 81.290	Pollutant Inform NATURAL GAS 40.60 MMBTU/H 81.290 Carbon Monoxide Nitrogen Oxides (NOx) Particulate matter, filterable (FPM)	Pollutant Information - ListNATURAL GAS40.60 MMBTU/H81.290Carbon Monoxide0.0840Carbon Monoxide0.0840Limit0.0840LB/MMBTUNitrogen Oxides(NOx)Particulatematter, filterable(FPM)	Pollutant Information - List of PollutationNATURAL GAS40.60 MMBTU/H81.290Carbon Monoxide0.0840Nitrogen Oxides0.1960Datter, filterable0.0076BART	



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

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FINAL	

RBLC ID: AL-0301 Corporate/Company: NUCOR STEEL TUSCALOOSA, INC. Facility Name: NUCOR STEEL TUSCALOOSA, INC. Process: VACUUM DEGASSER

Primary Fuel: Throughput: Process Code:	600000.00 LB/H 81.290	Pollutant Information - List of Pollutants			
		Pollutant	Primary Emission Limit	Basis	Verified
		Carbon Monoxide	0.0750 LB/T	BACT- PSD	NO
		<u>Nitrogen Oxides</u> <u>(NOx)</u>	0.0050 LB/TON	BACT- PSD	NO
		<u>Particulate</u> matter, filterable (FPM)	0.0080 GR/DSCF	BACT- PSD	NO


# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

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RBLC ID: AL-0301 Corporate/Company: NUCOR STEEL TUSCALOOSA, INC. Facility Name: NUCOR STEEL TUSCALOOSA, INC. Process: PLASMA TORCHES

			Pollutant Information - List of Pollutants Help				
	Primary Fuel: Throughput: Process Code:	NATURAL GAS 0.64 MMBTU/H 81.290	Pollutant	Primary Emission Limit	Basis	Verified	
			<u>Carbon Monoxide</u>	0.0840 LB/MMBTU	BACT- PSD	NO	
			<u>Nitrogen Oxides</u> (NOx)	0.5600 LB/H	BACT- PSD	NO	
			<u>Particulate</u> matter, filterable (FPM)	0.1000 LB/H	BACT- PSD	NO	

Process Notes: TWO TORCHES



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### **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

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RBLC ID: AL-0301 Corporate/Company: NUCOR STEEL TUSCALOOSA, INC. Facility Name: NUCOR STEEL TUSCALOOSA, INC. Process: TEMPERING FURNACE

		Pollutant Inform	nation - List o	f Polluta	ants Help
Primary Fuel: Throughput: Process Code:	NATURAL GAS 35.00 MMBTU/H 81.290	Pollutant	Primary Emission Limit	Basis	Verified
		Carbon Monoxide	0.0840 LB/MMBTU	BACT- PSD	NO
		<u>Nitrogen Oxides</u> <u>(NOx)</u>	0.0670 LB/MMBTU	BACT- PSD	NO
		<u>Particulate</u> matter, filterable (FPM)	0.0076 LB/MMBTU	BACT- PSD	NO



### **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

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RBLC ID: IN-0196 Corporate/Company: NUCOR STEEL Facility Name: NUCOR STEEL Process: TUNDISH NOZZLE PREHEATERS

	Pollutant Information - List of Pollutants			
	Pollutant	Primary Emission Limit	Basis	Verified
	<u>Carbon Monoxide</u>	84.0000 LB/MMCF NAT GAS	BACT- PSD	NO
NATURAL GAS 6.40 MMBTU/H	<u>Nitrogen Oxides</u> (NOx)	100.0000 LB/MMCF NAT GAS	BACT- PSD	NO
81.290	<u>Particulate</u> <u>matter, filterable</u> <u>(FPM)</u>	1.9000 LB/MMCF NATGAS	BACT- PSD	NO
	<u>Particulate</u> matter, total < 10 <u>µ (TPM10)</u>	7.6000 LB/MMCF NAT GAS	BACT- PSD	NO
	Particulate matter, total < 2.5 µ (TPM2.5)	7.6000 LB/MMCF NAT GAS	BACT- PSD	NO
	<u>Sulfur Dioxide</u> (SO2)	0.6000 LB/MMCF NAT GAS	BACT- PSD	NO
	<u>Volatile Organic</u> <u>Compounds (VOC)</u>	5.5000 LB/MMCF NAT GAS	BACT- PSD	NO
	NATURAL GAS 6.40 MMBTU/H 81.290	Pollutant InformPollutantPollutantPollutantCarbon Monoxide6.40 MMBTU/H(NOX)81.290Particulate matter, filterable (FPM) Particulate matter, total < 10 $\mu$ (TPM10) Particulate matter, total < 10 $\mu$ (TPM10) Particulate matter, total < 10 $\mu$ (TPM10) Particulate Matter, total < 10 $\mu$ (SO2)Volatile Organic Compounds (VOC)	Pollutant Information - List ofPollutantPrimary Emission LimitNATURAL GASCarbon Monoxide84.0000 LB/MMCF NAT GAS6.40 MMBTU/HNitrogen Oxides (NOx)100.0000 LB/MMCF NAT GAS81.290Particulate matter, filterable (FPM)1.9000 LB/MMCF NAT GASParticulate matter, total < 10 $\mu$ (TPM10)7.6000 CASParticulate matter, total < 10 $\mu$ (TPM10)7.6000 GASParticulate matter, total < 10 $\mu$ (TPM10)7.6000 GASParticulate matter, total < 10 $\mu$ (TPM2.5)6AS GASSulfur Dioxide (SO2)0.6000 LB/MMCF NAT GASVolatile Organic Compounds (VOC)5.5000 LB/MMCF NAT GAS	Pollutant Information - List of PollutationPollutantPrimary Emission LimitBasisNATURAL GASCarbon Monoxide $84.0000$ LB/MMCF NAT GASBACT- PSDNATURAL GASNitrogen Oxides (NOX) $100.0000$ LB/MMCF NAT GASBACT- PSD81.290Particulate matter, filterable (FPM) $1.9000$ LB/MMCF NAT GASBACT- PSDParticulate matter, total < 10 $\mu$ (TPM10) $7.6000$ GASBACT- PSDParticulate matter, total < 10 $\mu$ (TPM10) $7.6000$ GASBACT- PSDParticulate matter, total < 10 $\mu$ (TPM10) $7.6000$ GASBACT- PSDSulfur Dioxide (SO2) $0.6000$ LB/MMCF NAT GASBACT- PSDVolatile Organic Compounds (VOC) $5.5000$ LB/MMCF NAT GASBACT- PSD



### **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

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<b>RBLC ID:</b> IN-0196	
Corporate/Company: NUCOR STEEL	
Facility Name: NUCOR STEEL	
Process: PICKLE LINE #2	

		Pollutant Information - List of Pollutants Help				
Primary Fuel: Throughput: Process Code:	250.00 T/H 81 290	Pollutant	Primary Emission Limit	Basis	Verified	
FIOLESS COUE.	01.290	<u>Particulate matter,</u> filterable (FPM)	0.0100 GR/DSCF	BACT- PSD	NO	
		<u>Particulate matter,</u> filterable < 10 μ (FPM10)	0.0100 GR/DSCF	BACT- PSD	NO	
		<u>Particulate matter,</u> filterable < 2.5 μ (FPM2.5)	0.0100 GR/DSCF	BACT- PSD	NO	



### **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

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	FINAL
<b>RBLC ID:</b> IN-0196	
Corporate/Company: NUCOR STEEL	
Facility Name: NUCOR STEEL	
Process: HOT STRIP MILL	

Primary Fuel: Throughput:	502.00 T/H	Pollutant Inforr	rmation - List of Pollutants Help			
Process Code:	81.290	Pollutant	Primary Emission Limit	Basis	Verified	
		<u>Volatile Organic</u> Compounds (VOC)	0.0600 LB/T	BACT- PSD	NO	



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

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FINAL

RBLC ID: IN-0196 Corporate/Company: NUCOR STEEL Facility Name: NUCOR STEEL Process: TUNNEL FURNACES 1 AND 2, SHUTTLE FURNACES 1 AND 2

		Pollutant Information - List of Pollutants Help			
		Pollutant	Primary Emission Limit	Basis	Verified
Primary Fuel:		Carbon Monoxide	84.0000 LB/MMCF NAT GAS	BACT- PSD	NO
Throughput: Process Code:	502.00 T/H 81.290	<u>Nitrogen Oxides</u> (NOx)	100.0000 LB/MMCF NAT GAS	BACT- PSD	NO
		<u>Particulate matter,</u> <u>filterable &lt; 10 μ</u> (FPM10)	7.6000 LB/MMCF NAT GAS	BACT- PSD	NO
		Particulate matter, filterable < $2.5 \mu$ (FPM2.5)	7.6000 LB/MMCF NAT GAS	BACT- PSD	NO
		<u>Sulfur Dioxide</u> (SO2)	0.6000 LB/MMCF NAT GAS	BACT- PSD	NO
		<u>Volatile Organic</u> Compounds (VOC)	5.5000 LB/MMCF NAT GAS	BACT- PSD	NO

Process Notes: TUNNEL FURNACES - 50 MMBTU/HR EACH SHUTTLE FURNACES - 13 MMBTU/HR EACH



### **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

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Pollutant Information - List of Pollutants

RBLC ID: IN-0196 Corporate/Company: NUCOR STEEL Facility Name: NUCOR STEEL Process: MELTSHOP

					Help
		Pollutant	Primary Emission Limit	Basis	Verified
Primary Fuel: Throughput: Process Code:		<u>Carbon Dioxide</u> Equivalent (CO2e)	544917.0000 T/YR	BACT- PSD	NO
		Carbon Monoxide	2.0000 LB/T	BACT- PSD	NO
	502.00 T/H	Lead (Pb) / Lead Compounds	0.2400 LB/H	BACT- PSD	NO
	81.290	<u>Nitrogen Oxides</u> (NOx)	0.3500 LB/T	BACT- PSD BACT- PSD BACT- PSD BACT- PSD	NO
		Particulate matter, filterable (FPM)	0.0018 GR/DSCF	BACT- PSD	NO
		<u>Particulate</u> <u>matter, filterable</u> < 10 μ (FPM10)	0.0052 GR/DSCF	BACT- PSD	NO
		$\frac{Particulate}{matter, filterable} < 2.5 \mu (FPM2.5)$	0.0052 GR/DSCF	BACT- PSD	NO
		<u>Sulfur Dioxide</u> (SO2)	0.3300 LB/T	BACT- PSD	NO
		<u>Volatile Organic</u> <u>Compounds</u> (VOC)	0.0900 LB/T	BACT- PSD	NO



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. New Search **RBLC Home** Search Results Facility Information Process List Process Information

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Pollutant Information - List of Pollutants

**RBLC ID:** IN-0196 Corporate/Company: NUCOR STEEL Facility Name: NUCOR STEEL Process: TUNDISH PREHEATERS

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					Help
		Pollutant	Primary Emission Limit	Basis	Verified
		Carbon Monoxide	84.0000 LB/MMCF	BACT- PSD	NO
Primary Fuel: Throughput:	502.00 T/H	<u>Nitrogen Oxides</u> (NOx)	100.0000 LB/MMCF NAT GAS	BACT- PSD	NO
Process Code: 81.290	81.290	<u>Particulate matter,</u> filterable (FPM)	1.9000 LB/MMCF NAT GAS	BACT- PSD	NO
		$\frac{Particulate matter,}{filterable < 10 \mu}$ (FPM10)	7.6000 LB/MMCF NAT GAS	BACT- PSD	NO
		$\frac{Particulate matter,}{filterable < 2.5 \mu}$ (FPM2.5)	7.6000 LB/MMCF NAT GAS	BACT- PSD	NO
		<u>Sulfur Dioxide</u> (SO2)	0.6000 LB/MMCF NAT GAS	BACT- PSD	NO
		Volatile Organic Compounds (VOC)	5.5000 LB/MMCF NAT GAS	BACT- PSD	NO

Process Notes: TUNDISH PREHEATERS - 12 MMBTU/HR EACH



## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

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FIN	AL

RBLC ID: IN-0196 Corporate/Company: NUCOR STEEL Facility Name: NUCOR STEEL Process: CASTRIP

					Help
Primary Fuel: Throughput:	270.00 T/H	Pollutant	Primary Emission Limit	Basis	Verified
Process Code:	81.290	<u>Lead (Pb) / Lead</u> Compounds	0.1300 LB/H	BACT- PSD	NO
		<u>Particulate matter,</u> filterable < 10 μ (FPM10)	0.0052 GR/DSCF	BACT- PSD	NO
		<u>Particulate matter,</u> filterable < 2.5 μ (FPM2.5)	0.0052 GR/DSCF	BACT- PSD	NO
		<u>Particulate matter,</u> total (TPM)	0.0018 GR/DSCF	BACT- PSD	NO

Pollutant Information - List of Pollutants



# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

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RBLC ID: AR-0139 Corporate/Company: NUCOR CORPORATION (NUCOR STEEL, ARKANSAS) Facility Name: NUCOR CORPORATION - NUCOR STEEL, ARKANSAS Process: ANNEALING FURNACE SN-61

Primary Fuel:	NATURAL GAS	Pollutant Ir	nformation - Lis	st of Poll	utants Help
Process Code: 81.2	81.290	Pollutant	Primary Emission Limit	Basis	Verified
		<u>Carbon</u> Monoxide	3.3000 LB/H	BACT- PSD	UNKNOWN
		<u>Sulfur Dioxid</u> (SO2)	<sup>le</sup> 0.1000 LB/H	BACT- PSD	NO

Process Notes: 8 FURNACES



### **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below.

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RBLC ID: AR-0138 Corporate/Company: NUCOR CORPORATION - NUCOR STEEL, ARKANSAS Facility Name: NUCOR CORPORATION - NUCOR STEEL, ARKANSAS Process: VACUUM TANK DEGASSER SN-94

Primary Fuel:	NATURAL GAS	Pollutant Inf	ormation - List	of Poll	utants Help
Process Code:	81.290	Pollutant	Primary Emission Limit	Basis	Verified
		<u>Carbon</u> <u>Monoxide</u>	0.0750 LB/TON	BACT- PSD	UNKNOWN
		<u>Sulfur Dioxide</u> <u>(SO2)</u>	0.0050 LB/TON	BACT- PSD	UNKNOWN



# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list<br/>below.RBLC HomeNew SearchSearch ResultsFacility InformationProcess ListProcess Information

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	FINAL

RBLC ID: OH-0341 Corporate/Company: NUCOR STEEL Facility Name: NUCOR STEEL MARION, INC. Process: Melt Shop Spray Contact Cooling Tower

		Pollutant Info	rmation - Lis	st of Pollu	Itants Help
Primary Fuel: Throughput:	198360.00 GAL/H	Pollutant	Primary Emission Limit	Basis	Verified
Process Code: 81	81.290	<u>Particulate</u> <u>matter, total</u> <u>(TPM)</u>	0.2200 LB/H	BACT- PSD	UNKNOWN
		<u>Particulate</u> matter, total < 2.5 µ (TPM2.5)	0.0400 LB/H	BACT- PSD	UNKNOWN
		<u>Visible</u> Emissions (VE)	10.0000 %	OTHER CASE- BY-CASE	UNKNOWN

**Process Notes:** Cooling Tower with 0.005% drift rate and 198,360 gallons/hour and a maximum TDS content of 2,650 mg/L.



# **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below.					
<b>RBLC Home</b>	New Search	Search Results	Facility Information	Process List	Process Information

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	FINAL
<b>RBLC ID:</b> OH-0341	
Corporate/Company: NUCOR STEEL	
Facility Name: NUCOR STEEL MARION, INC.	
Process: Rolling Mill Contact Cooling Tower	

		Pollutant Info	rmation - Lis	st of Pollu	Itants Help
Primary Fuel: Throughput:	225000.00 GAL/H	Pollutant	Primary Emission Limit	Basis	Verified
Process Code: 81.290	<u>Particulate</u> <u>matter, total</u> <u>(TPM)</u>	0.4600 LB/H	BACT- PSD	UNKNOWN	
		<u>Particulate</u> matter, total < 2.5 μ (TPM2.5)	0.0700 LB/H	BACT- PSD	UNKNOWN
		<u>Visible</u> Emissions (VE)	10.0000 %	OTHER CASE- BY-CASE	UNKNOWN

Process Notes: Cooling Tower with 0.005% drift rate and 225,000 gallons/hour and a maximum TDS content of 2,650 mg/L.

0.4300 T/YR BACT-PSD UNKNOWN

OTHER

CASE

10.0000 %

CASE-BY- UNKNOWN



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## **Process Information - Details**

For information about the pollutants related to this process, click on the specific pollutant in the list below. RBLC Home New Search Search Results Facility Information Process List Process Information

				Help	
				FINAL	
RBLC ID: OH-0341 porate/Company: NUCOR STEEL Facility Name: NUCOR STEEL MARION, INC. Process: Scrap steel storage piles					
	Pollutant I	nformation -	List of Po	llutants Help	
Primary Fuel: Throughput: 722700.00 T/YP		Drimary			
Process Code: 81.290	Pollutant	Emission	Basis	Verified	

Particulate

<u>matter,</u> fugitive

Visible

**Emissions** 

**Process Notes:** Maximum scrap throughput of 722,700 tons per year. Scrap management plan to eliminate or reduce mercury and lead emissions when melted.

(VE)

#### 12.5 Iron And Steel Production

#### 12.5.1 Process Description<sup>1-3</sup>

The production of steel at an integrated iron and steel plant is accomplished using several interrelated processes. The major operations are: (1) coke production, (2) sinter production, (3) iron production, (4) iron preparation, (5) steel production, (6) semifinished product preparation, (7) finished product preparation, (8) heat and electricity supply, and (9) handling and transport of raw, intermediate, and waste materials. The interrelation of these operations is depicted in a general flow diagram of the iron and steel industry in Figure 12.5-1. Coke production is discussed in detail in Section 12.2 of this publication, and more information on the handling and transport of materials is found in Chapter 13.

#### 12.5.1.1 Sinter Production -

The sintering process converts fine-sized raw materials, including iron ore, coke breeze, limestone, mill scale, and flue dust, into an agglomerated product, sinter, of suitable size for charging into the blast furnace. The raw materials are sometimes mixed with water to provide a cohesive matrix, and then placed on a continuous, travelling grate called the sinter strand. A burner hood, at the beginning of the sinter strand ignites the coke in the mixture, after which the combustion is self supporting and it provides sufficient heat, 1300 to 1480°C (2400 to 2700°F), to cause surface melting and agglomeration of the mix. On the underside of the sinter strand is a series of windboxes that draw combusted air down through the material bed into a common duct, leading to a gas cleaning device. The fused sinter is discharged at the end of the sinter strand. The remaining sinter product is cooled in open air or in a circular cooler with water sprays or mechanical fans. The cooled sinter is crushed and screened for a final time, then the fines are recycled, and the product is sent to be charged to the blast furnaces. Generally, 2.3 Mg (2.5 tons) of raw materials, including water and fuel, are required to produce 0.9 Mg (1 ton) of product sinter.

#### 12.5.1.2 Iron Production -

Iron is produced in blast furnaces by the reduction of iron bearing materials with a hot gas. The large, refractory lined furnace is charged through its top with iron as ore, pellets, and/or sinter; flux as limestone, dolomite, and sinter; and coke for fuel. Iron oxides, coke and fluxes react with the blast air to form molten reduced iron, carbon monoxide (CO), and slag. The molten iron and slag collect in the hearth at the base of the furnace. The byproduct gas is collected through offtakes located at the top of the furnace and is recovered for use as fuel.

The production of 1 ton of iron requires 1.4 tons of ore or other iron bearing material; 0.5 to 0.65 tons of coke; 0.25 tons of limestone or dolomite; and 1.8 to 2 tons of air. Byproducts consist of 0.2 to 0.4 tons of slag, and 2.5 to 3.5 tons of blast furnace gas containing up to 100 pounds (lb) of dust.

The molten iron and slag are removed, or cast, from the furnace periodically. The casting process begins with drilling a hole, called the taphole, into the clay-filled iron notch at the base of the hearth. During casting, molten iron flows into runners that lead to transport ladles. Slag also flows into the clay-filled iron notch at the base of the hearth. During casting, molten iron flows into runners that lead to transport ladles. Slag also flows into the clay-filled iron notch at the base of the hearth. During casting, molten iron flows into runners that lead to transport ladles. Slag also flows from the furnace, and is directed through separate runners to a slag pit adjacent to the casthouse, or into slag pots for transport to a remote slag



Figure 12.5-1. General flow diagram for the iron and steel industry.

pit. At the conclusion of the cast, the taphole is replugged with clay. The area around the base of the furnace, including all iron and slag runners, is enclosed by a casthouse. The blast furnace byproduct gas, which is collected from the furnace top, contains CO and particulate. Because of its high CO content, this blast furnace gas has a low heating value, about 2790 to 3350 joules per liter (J/L) (75 to 90 British thermal units per cubic foot [Btu/ft<sup>3</sup>]) and is used as a fuel within the steel plant. Before it can be efficiently oxidized, however, the gas must be cleaned of particulate. Initially, the gases pass through a settling chamber or dry cyclone to remove about 60 percent of the particulate. Next, the gases undergo a 1- or 2-stage cleaning operation. The primary cleaner is normally a wet scrubber, which removes about 90 percent of the remaining particulate. The secondary cleaner is a high-energy wet scrubber (usually a venturi) or an electrostatic precipitator, either of which can remove up to 90 percent of the particulate that eludes the primary cleaner. Together these control devices provide a clean fuel of less than 0.05 grams per cubic meter (g/m<sup>3</sup>) (0.02 grains per cubic foot [g/ft<sup>3</sup>]). A portion of this gas is fired in the blast furnace stoves to preheat the blast air, and the rest is used in other plant operations.

### 12.5.1.3 Iron Preparation Hot Metal Desulfurization -

Sulfur in the molten iron is sometimes reduced before charging into the steelmaking furnace by adding reagents. The reaction forms a floating slag which can be skimmed off. Desulfurization may be performed in the hot metal transfer (torpedo) car at a location between the blast furnace and basic oxygen furnace (BOF), or it may be done in the hot metal transfer (torpedo) ladle at a station inside the BOF shop.

The most common reagents are powdered calcium carbide  $(CaC_2)$  and calcium carbonate  $(CaCO_3)$  or salt-coated magnesium granules. Powdered reagents are injected into the metal through a lance with high-pressure nitrogen. The process duration varies with the injection rate, hot metal chemistry, and desired final sulfur content, and is in the range of 5 to 30 minutes.

### 12.5.1.4 Steelmaking Process — Basic Oxygen Furnaces -

In the basic oxygen process (BOP), molten iron from a blast furnace and iron scrap are refined in a furnace by lancing (or injecting) high-purity oxygen. The input material is typically 70 percent molten metal and 30 percent scrap metal. The oxygen reacts with carbon and other impurities to remove them from the metal. The reactions are exothermic, i. e., no external heat source is necessary to melt the scrap and to raise the temperature of the metal to the desired range for tapping. The large quantities of CO produced by the reactions in the BOF can be controlled by combustion at the mouth of the furnace and then vented to gas cleaning devices, as with open hoods, or combustion can be suppressed at the furnace mouth, as with closed hoods. BOP steelmaking is conducted in large (up to 363 Mg [400 ton] capacity) refractory lined pear shaped furnaces. There are 2 major variations of the process. Conventional BOFs have oxygen process (Q-BOP), oxygen is injected through tuyeres located in the bottom of the furnace. A typical BOF cycle consists of the scrap charge, hot metal charge, oxygen blow (refining) period, testing for temperature and chemical composition of the steel, alloy additions and reblows (if necessary), tapping, and slagging. The full furnace cycle typically ranges from 25 to 45 minutes.

### 12.5.1.5 Steelmaking Process — Electric Arc Furnace -

Electric arc furnaces (EAF) are used to produce carbon and alloy steels. The input material to an EAF is typically 100 percent scrap. Cylindrical, refractory lined EAFs are equipped with carbon electrodes to be raised or lowered through the furnace roof. With electrodes retracted, the furnace roof can be rotated aside to permit the charge of scrap steel by overhead crane. Alloying agents and fluxing materials usually are added through the doors on the side of the furnace. Electric current of the opposite polarity electrodes generates heat between the electrodes and through the scrap. After melting and refining periods, the slag and steel are poured from the furnace by tilting.

The production of steel in an EAF is a batch process. Cycles, or "heats", range from about 1-1/2 to 5 hours to produce carbon steel and from 5 to 10 hours or more to produce alloy steel. Scrap steel is charged to begin a cycle, and alloying agents and slag materials are added for refining. Stages of each cycle normally are charging and melting operations, refining (which usually includes oxygen blowing), and tapping.

#### 12.5.1.6 Steelmaking Process - Open Hearth Furnaces -

The open hearth furnace (OHF) is a shallow, refractory-lined basin in which scrap and molten iron are melted and refined into steel. Scrap is charged to the furnace through doors in the furnace front. Hot metal from the blast furnace is added by pouring from a ladle through a trough positioned in the door. The mixture of scrap and hot metal can vary from all scrap to all hot metal, but a half-and-half mixture is most common. Melting heat is provided by gas burners above and at the side of the furnace. Refining is accomplished by the oxidation of carbon in the metal and the formation of a limestone slag to remove impurities. Most furnaces are equipped with oxygen lances to speed up melting and refining. The steel product is tapped by opening a hole in the base of the furnace with an explosive charge. The open hearth steelmaking process with oxygen lancing normally requires from 4 to 10 hours for each heat.

#### 12.5.1.7 Semifinished Product Preparation -

After the steel has been tapped, the molten metal is teemed (poured) into ingots which are later heated and formed into other shapes, such as blooms, billets, or slabs. The molten steel may bypass this entire process and go directly to a continuous casting operation. Whatever the production technique, the blooms, billets, or slabs undergo a surface preparation step, scarfing, which removes surface defects before shaping or rolling. Scarfing can be performed by a machine applying jets of oxygen to the surface of hot semifinished steel, or by hand (with torches) on cold or slightly heated semifinished steel.

### 12.5.2 Emissions And Controls

### 12.5.2.1 Sinter -

Emissions from sinter plants are generated from raw material handling, windbox exhaust, discharge end (associated sinter crushers and hot screens), cooler, and cold screen. The windbox exhaust is the primary source of particulate emissions, mainly iron oxides, sulfur oxides, carbonaceous compounds, aliphatic hydrocarbons, and chlorides. At the discharge end, emissions are mainly iron and calcium oxides. Sinter strand windbox emissions commonly are controlled by cyclone cleaners followed by a dry or wet ESP, high pressure drop wet scrubber, or baghouse. Crusher and hot screen emissions, usually controlled by hooding and a baghouse or scrubber, are the next largest emissions source. Emissions are also generated from other material handling operations. At some sinter plants, these emissions are captured and vented to a baghouse.

### 12.5.2.2 Blast Furnace -

The primary source of blast furnace emissions is the casting operation. Particulate emissions are generated when the molten iron and slag contact air above their surface. Casting emissions also are generated by drilling and plugging the taphole. The occasional use of an oxygen lance to open a clogged taphole can cause heavy emissions. During the casting operation, iron oxides, magnesium oxide and carbonaceous compounds are generated as particulate. Casting emissions at existing blast furnaces are controlled by evacuation through retrofitted capture hoods to a gas cleaner, or by suppression techniques. Emissions controlled by hoods and an evacuation system are usually vented to

a baghouse. The basic concept of suppression techniques is to prevent the formation of pollutants by excluding ambient air contact with the molten surfaces. New furnaces have been constructed with evacuated runner cover systems and local hooding ducted to a baghouse.

Another potential source of emissions is the blast furnace top. Minor emissions may occur during charging from imperfect bell seals in the double bell system. Occasionally, a cavity may form in the blast furnace charge, causing a collapse of part of the burden (charge) above it. The resulting pressure surge in the furnace opens a relief valve to the atmosphere to prevent damage to the furnace by the high pressure created and is referred to as a "slip".

#### 12.5.2.3 Hot Metal Desulfurization -

Emissions during the hot metal desulfurization process are created by both the reaction of the reagents injected into the metal and the turbulence during injection. The pollutants emitted are mostly iron oxides, calcium oxides, and oxides of the compound injected. The sulfur reacts with the reagents and is skimmed off as slag. The emissions generated from desulfurization may be collected by a hood positioned over the ladle and vented to a baghouse.

#### 12.5.2.4 Steelmaking -

The most significant emissions from the BOF process occur during the oxygen blow period. The predominant compounds emitted are iron oxides, although heavy metals and fluorides are usually present. Charging emissions will vary with the quality and quantity of scrap metal charged to the furnace and with the pour rate. Tapping emissions include iron oxides, sulfur oxides, and other metallic oxides, depending on the grade of scrap used. Hot metal transfer emissions are mostly iron oxides.

BOFs are equipped with a primary hood capture system located directly over the open mouth of the furnaces to control emissions during oxygen blow periods. Two types of capture systems are used to collect exhaust gas as it leaves the furnace mouth: closed hood (also known as an off gas, or O. G., system) or open, combustion-type hood. A closed hood fits snugly against the furnace mouth, ducting all particulate and CO to a wet scrubber gas cleaner. CO is flared at the scrubber outlet stack. The open hood design allows dilution air to be drawn into the hood, thus combusting the CO in the hood system. Charging and tapping emissions are controlled by a variety of evacuation systems and operating practices. Charging hoods, tapside enclosures, and full furnace enclosures are used in the industry to capture these emissions and send them to either the primary hood gas cleaner or a second gas cleaner.

#### 12.5.2.5 Steelmaking - Electric Arc Furnace -

The operations which generate emissions during the electric arc furnace steelmaking process are melting and refining, charging scrap, tapping steel, and dumping slag. Iron oxide is the predominant constituent of the particulate emitted during melting. During refining, the primary particulate compound emitted is calcium oxide from the slag. Emissions from charging scrap are difficult to quantify, because they depend on the grade of scrap utilized. Scrap emissions usually contain iron and other metallic oxides from alloys in the scrap metal. Iron oxides and oxides from the fluxes are the primary constituents of the slag emissions. During tapping, iron oxide is the major particulate compound emitted.

Emission control techniques involve an emission capture system and a gas cleaning system. Five emission capture systems used in the industry are fourth hold (direct shell) evacuation, side draft hood, combination hood, canopy hood, and furnace enclosures. Direct shell evacuation consists of ductwork attached to a separate or fourth hole in the furnace roof which draws emissions to a gas cleaner. The fourth hole system works only when the furnace is up-right with the roof in place. Side draft hoods collect furnace off gases from around the electrode holes and the work doors after the gases leave the furnace. The combination hood incorporates elements from the side draft and fourth hole ventilation systems. Emissions are collected both from the fourth hole and around the electrodes. An air gap in the ducting introduces secondary air for combustion of CO in the exhaust gas. The combination hood requires careful regulation of furnace interval pressure. The canopy hood is the least efficient of the 4 ventilation systems, but it does capture emissions during charging and tapping. Many new electric arc furnaces incorporate the canopy hood with one of the other 3 systems. The full furnace enclosure completely surrounds the furnace and evacuates furnace emissions through hooding in the top of the enclosure.

#### 12.5.2.6 Steelmaking - Open Hearth Furnace -

Particulate emissions from an open hearth furnace vary considerably during the process. The use of oxygen lancing increases emissions of dust and fume. During the melting and refining cycle, exhaust gas drawn from the furnace passes through a slag pocket and a regenerative checker chamber, where some of the particulate settles out. The emissions, mostly iron oxides, are then ducted to either an ESP or a wet scrubber. Other furnace-related process operations which produce fugitive emissions inside the shop include transfer and charging of hot metal, charging of scrap, tapping steel, and slag dumping. These emissions are usually uncontrolled.

#### 12.5.2.7 Semifinished Product Preparation -

During this activity, emissions are produced when molten steel is poured (teamed) into ingot molds, and when semifinished steel is machine or manually scarfed to remove surface defects. Pollutants emitted are iron and other oxides (FeO,  $Fe_2O_3$ ,  $SiO_2$ , CaO, MgO). Teeming emissions are rarely controlled. Machine scarfing operations generally use as ESP or water spray chamber for control. Most hand scarfing operations are uncontrolled.

#### 12.5.2.8 Miscellaneous Combustion -

Every iron and steel plant operation requires energy in the form of heat or electricity. Combustion sources that produce emissions on plant property are blast furnace stoves, boilers, soaking pits, and reheat furnaces. These facilities burn combinations of coal, No. 2 fuel oil, natural gas, coke oven gas, and blast furnace gas. In blast furnace stoves, clean gas from the blast furnace is burned to heat the refractory checker work, and in turn, to heat the blast air. In soaking pits, ingots are heated until the temperature distribution over the cross-section of the ingots is acceptable and the surface temperature is uniform for further rolling into semifinished products (blooms, billets, and slabs). In slab furnaces, a slab is heated before being rolled into finished products (plates, sheets, or strips). Emissions from the combustion of natural gas, fuel oil, or coal in the soaking pits or slab furnaces are estimated to be the same as those for boilers. (See Chapter 1 of this document.) Emission factor data for blast furnace gas and coke oven gas are not available and must be estimated. There are 3 facts available for making the estimation. First, the gas exiting the blast furnace passes through primary and secondary cleaners and can be cleaned to less than  $0.05 \text{ g/m}^3$  (0.02 g/ft<sup>3</sup>). Second, nearly one-third of the coke oven gas is methane. Third, there are no blast furnace gas constituents that generate particulate when burned. The combustible constituent of blast furnace gas is CO, which burns clean. Based on facts 1 and 3, the emission factor for combustion of blast furnace gas is equal to the particulate loading of that fuel, 0.05 g/m<sup>3</sup> (2.9 lb/10<sup>6</sup> ft<sup>3</sup>) having an average heat value of 3092 J/L (83  $Btu/ft^3$ ).

Emissions for combustion of coke oven gas can be estimated in the same fashion. Assume that cleaned coke oven gas has as much particulate as cleaned blast furnace gas. Since one-third of the coke oven gas is methane, the main component of natural gas, it is assumed that the combustion of this methane in coke oven gas generates  $0.06 \text{ g/m}^3$  (3.3 lb/10<sup>6</sup> ft<sup>3</sup>) of particulate. Thus, the emission factor for the combustion of coke oven gas is the sum of the particulate loading and that generated by

the methane combustion, or 0.1 g/m<sup>3</sup> (6.2 lb/10<sup>6</sup> ft<sup>3</sup>) having an average heat value of 19,222 J/L (516  $Btu/ft^3$ ).

The particulate emission factors for processes in Table 12.5-1 are the result of an extensive investigation by EPA and the American Iron and Steel Institute.<sup>3</sup> Particle size distributions for controlled and uncontrolled emissions from specific iron and steel industry processes have been calculated and summarized from the best available data.<sup>1</sup> Size distributions have been used with particulate emission factors to calculate size-specific factors for the sources listed in Table 12.5-1 for which data are available. Table 12.5-2 presents these size-specific particulate emission factors. Particle size distributions are presented in Figure 12.5-2, Figure 12.5-3, and Figure 12.5-4.CO emission factors are in Table 12.5-3.<sup>6</sup>

#### 12.5.2.9 Open Dust Sources -

Like process emission sources, open dust sources contribute to the atmospheric particulate burden. Open dust sources include vehicle traffic on paved and unpaved roads, raw material handling outside of buildings, and wind erosion from storage piles and exposed terrain. Vehicle traffic consists of plant personnel and visitor vehicles, plant service vehicles, and trucks handling raw materials, plant deliverables, steel products, and waste materials. Raw materials are handled by clamshell buckets, bucket/ladder conveyors, rotary railroad dumps, bottom railroad dumps, front end loaders, truck dumps, and conveyor transfer stations, all of which disturb the raw material and expose fines to the wind. Even fine materials, resting on flat areas or in storage piles are exposed and are subject to wind erosion. It is not unusual to have several million tons of raw materials stored at a plant and to have in the range of 9.7 to 96.7 hectares (10 to 100 acres) of exposed area there.

Open dust source emission factors for iron and steel production are presented in Table 12.5-4. These factors were determined through source testing at various integrated iron and steel plants.

As an alternative to the single-valued open dust emission factors given in Table 12.5-4, empirically derived emission factor equations are presented in Section 13.2 of this document. Each equation was developed for a source operation defined on the basis of a single dust generating mechanism which crosses industry lines, such as vehicle traffic on unpaved roads. The predictive equation explains much of the observed variance in measured emission factors by relating emissions to parameters which characterize source conditions. These parameters may be grouped into 3 categories: (1) measures of source activity or energy expended (e. g., the speed and weight of a vehicle traveling on an unpaved road), (2) properties of the material being disturbed (e. g., the content of suspendible fines in the surface material on an unpaved road) and (3) climatic parameters (e. g., number of precipitation free days per year, when emissions tend to a maximum).<sup>4</sup>

Because the predictive equations allow for emission factor adjustment to specific source conditions, the equations should be used in place of the factors in Table 12.5-4, if emission estimates for sources in a specific iron and steel facility are needed. However, the generally higher-quality ratings assigned to the equations are applicable only if (1) reliable values of correction parameters have been determined for the specific sources of interest and (2) the correction parameter values lie within the ranges tested in developing the equations. Section 13.2 lists measured properties of aggregate process materials and road surface materials in the iron and steel industry, which can be used to estimate correction parameter values for the predictive emission factor equations, in the event that site-specific values are not available.

Use of mean correction parameter values from Section 13.2 reduces the quality ratings of the emission factor equation by one level.

# Table 12.5-1 (Metric And English Units). PARTICULATE EMISSION FACTORS FOR IRON AND STEEL MILLS<sup>a</sup>

Source	Unite	Emissio	Factor	EMISSION FACTOR RATING	Particle Size Data
Source	Onits	Linssion		KAIINO	Size Data
Sintering					
Windbox	kg/Mg (lb/ton) finished sinter				
Uncontrolled					
Leaving grate		5.56	(11.1)	В	Yes
After coarse particulate removal		4.35	(8.7)	А	
Controlled by dry ESP		0.8	(1.6)	В	
Controlled by wet ESP		0.085	(0.17)	В	Yes
Controlled by venturi scrubber		0.235	(0.47)	В	Yes
Controlled by cyclone		0.5	(1.0)	В	Yes
Sinter discharge (breaker and hot screens)	kg/Mg (lb/ton) finished sinter				
Uncontrolled		3.4	(6.8)	В	
Controlled by baghouse		0.05	(0.1)	В	Yes
Controlled by venturi scrubber		0.295	(0.59)	А	
Windbox and discharge	kg/Mg (lb/ton) finished sinter				
Controlled by baghouse		0.15	(0.3)	А	

Table	12.5-1	(cont.).
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Source	Units	Emission	Factor	EMISSION FACTOR RATING	Particle Size Data
Blast furnace					
Slip	kg/Mg (lb/ton) slip	39.5	(87.0)	D	
Uncontrolled casthouse	kg/Mg (lb/ton) hot metal				
Roof monitor <sup>b</sup>		0.3	(0.6)	В	Yes
Furnace with local evacuation <sup>c</sup>		0.65	(1.3)	В	Yes
Taphole and trough only (not runners)		0.15	(0.3)	В	
Hot metal desulfurization	kg/Mg (lb/ton) hot metal				
Uncontrolled <sup>d</sup>		0.55	(1.09)	D	Yes
Controlled by baghouse		0.0045	(0.009)	D	Yes
Basic oxygen furnace (BOF)					
Top blown furnace melting and refining	kg/Mg (lb/ton) steel				
Uncontrolled		14.25	(28.5)	В	
Controlled by open hood venter to:					
ESP		0.065	(0.13)	А	
Scrubber		0.045	(0.09)	В	

Г

Source	Units	Emissio	n Factor	EMISSION FACTOR RATING	Particle Size Data
Controlled by closed hood vented to:					
Scrubber		0.0034	(0.0068)	А	Yes
BOF Charging	kg/Mg (lb/ton) hot metal				
At source		0.3	(0.6)	D	Yes
At building monitor		0.071	(0.142)	В	
Controlled by baghouse		0.0003	(0.0006)	В	Yes
BOF Tapping	kg/Mg (lb/ton) steel				
At source		0.46	(0.92)	D	Yes
At building monitor		0.145	(0.29)	В	
Controlled by baghouse		0.0013	(0.0026)	В	Yes
Hot metal transfer	kg/Mg (lb/ton) hot metal				
At source		0.095	(0.19)	А	
At building monitor		0.028	(0.056)	В	
BOF monitor (all sources)	kg/Mg (lb/ton) steel	0.25	(0.5)	В	
Q-BOF melting and refining	kg/Mg (lb/ton) steel				
Controlled by scrubber		0.028	(0.056)	В	Yes

Table	12.5-1	(cont.).
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Source	Units	Emission Factor		EMISSION FACTOR RATING	Particle Size Data
Electric arc furnace					
Melting and refining	kg/Mg (lb/ton) steel				
Uncontrolled carbon steel		19.0	(38.0)	С	Yes
Charging, tapping, and slagging	kg/Mg (lb/ton) steel				
Uncontrolled emissions escaping monitor		0.7	(1.4)	С	
Melting, refining, charging, tapping, and slagging	kg/Mg (lb/ton) steel				
Uncontrolled					
Alloy steel		5.65	(11.3)	А	
Carbon steel		25.0	(50.0)	С	
Controlled by: <sup>e</sup>					
Building evacuation to baghouse for alloy steel		0.15	(0.3)	А	
Direct shell evacuation (plus charging hood) vented to common baghouse for carbon steel		0.0215	(0.043)	E	Yes

Source	Units	Emissi	on Factor	EMISSION FACTOR RATING	Particle Size Data
Open hearth furnace					
Melting and refining	kg/Mg (lb/ton) steel				
Uncontrolled		10.55	(21.1)	D	Yes
Controlled by ESP		0.14	(0.28)	D	Yes
Roof monitor		0.084	(0.168)	С	
Teeming					
Leaded steel	kg/Mg (lb/ton) steel				
Uncontrolled (measured at source)		0.405	(0.81)	А	
Controlled by side draft hood vented to baghouse		0.0019	(0.0038)	А	
Unleaded steel					
Uncontrolled (measured at source)		0.035	(0.07)	А	
Controlled by side draft hood vented to baghouse		0.0008	(0.0016)	А	
Machine scarfing	kg/Mg (lb/ton) metal through scarfer				
Uncontrolled		0.05	(0.1)	В	
Controlled by ESP		0.0115	(0.023)	А	

Source	Units	Emissio	n Factor	EMISSION FACTOR RATING	Particle Size Data
Miscellaneous combustion sources <sup>f</sup>		f	f		
Boiler, soaking pit, and slab reheat	kg/10 <sup>9</sup> J (lb/10 <sup>6</sup> Btu)				
Blast furnace gas <sup>g</sup>		0.015	(0.035)	D	
Coke oven gas <sup>g</sup>		0.0052	(0.012)	D	

Reference 3, except as noted.

Typical of older furnaces with no controls, or for canopy hoods or total casthouse evacuation. b

<sup>c</sup> Typical of large, new furnaces with local hoods and covered evacuated runners. Emissions are higher than without capture systems because they are not diluted by outside environment.

Emission factor of 0.55 kg/Mg (1.09 lb/ton) represents 1 torpedo car; 1.26 kg/Mg (2.53 lb/ton) for 2 torpedo cars, and 1.37 kg/Mg d (2.74 lb/ton) for 3 torpedo cars.

e f

Building evacuation collects all process emissions, and direct shell evacuation collects only melting and refining emissions. For various fuels, use the emission factors in Chapter 1 of this document. The EMISSION FACTOR RATING for these fuels in boilers is A, and in soaking pits and slab reheat furnaces is D.

<sup>g</sup> Based on methane content and cleaned particulate loading.

	EMISSION	Particle	Cumulative	Cumulat Emissio	ive Mass n Factor
Source	RATING	Size (µm) <sup>a</sup>	Mass $\% \leq$ Stated Size	kg/Mg	lb/ton
Sintering					
Windbox					
Uncontrolled leaving grate	D	0.5	4 <sup>b</sup>	0.22	0.44
		1.0	4	0.22	0.44
		2.5	65	0.28	0.56
		5.0	9	0.50	1.00
		10	15	0.83	1.67
		15	20 <sup>c</sup>	1.11	2.22
		d	100	5.56	11.1
Controlled by wet ESP	С	0.5	18 <sup>b</sup>	0.015	0.03
		1.0	25	0.021	0.04
		2.5	33	0.028	0.06
		5.0	48	0.041	0.08
		10	59 <sup>b</sup>	0.050	0.10
		15	69	0.059	0.12
		d	100	0.085	0.17
Controlled by venturi scrubber	С	0.5	55	0.129	0.26
		1.0	75	0.176	0.35
		2.5	89	0.209	0.42
		5.0	93	0.219	0.44
		10	96	0.226	0.45
		15	98	0.230	0.46
		d	100	0.235	0.47
Controlled by cyclone <sup>e</sup>	С	0.5	25 <sup>c</sup>	0.13	0.25
		1.0	37 <sup>b</sup>	0.19	0.37
		2.5	52	0.26	0.52
		5.0	64	0.32	0.64
		10	74	0.37	0.74
		15	80	0.40	0.80
		d	100	0.5	1.0

### Table 12.5-2 (Metric And English Units). SIZE SPECIFIC EMISSION FACTORS

Table 12.5-2 (cont.).

	EMISSION	Particle	Cumulative	Cumulative Mass ve Emission Factor	
Source	RATING	(μm) <sup>a</sup>	Stated Size	kg/Mg	lb/ton
Controlled by baghouse	С	0.5	3.0	0.005	0.009
		1.0	9.0	0.014	0.027
		2.5	27.0	0.041	0.081
		5.0	47.0	0.071	0.141
		10.0	69.0	0.104	0.207
		15.0	79.0	0.119	0.237
		d	100.0	0.15	0.3
Sinter discharge breaker and hot	C	0.5	ab	0.001	0.002
screens controlled by bagnouse	C	0.5	2-	0.001	0.002
		1.0	4	0.002	0.004
		2.5	11	0.006	0.011
		5.0	20 aab	0.010	0.020
		10	32°	0.016	0.032
		15 d	420	0.021	0.042
		u	100	0.05	0.1
Blast furnace					
emissions					
Roof monitor <sup>f</sup>	С	0.5	4	0.01	0.02
		1.0	15	0.05	0.09
		2.5	23	0.07	0.14
		5.0	35	0.11	0.21
		10	51	0.15	0.31
		15	61	0.18	0.37
		d	100	0.3	0.06

Table 12.5-2 (cont.).

	EMISSION	Particle	Cumulative Mas Cumulative Emission Factor		ive Mass n Factor
Source	RATING	(μm) <sup>a</sup>	Stated Size	kg/Mg	lb/ton
Furnace with local evacuation <sup>g</sup>	С	0.5	7 <sup>c</sup>	0.04	0.09
		1.0	9	0.06	0.12
		2.5	15	0.10	0.20
		5.0	20	0.13	0.26
		10	24	0.16	0.31
		15	26	0.17	0.34
		d	100	0.65	1.3
Hot metal desulfurization <sup>h</sup>					
Uncontrolled	Е	0.5	j		
		1.0	2 <sup>c</sup>	0.01	0.02
		2.5	11	0.06	0.12
		5.0	19	0.10	0.22
		10	19	0.10	0.22
		15	21	0.12	0.23
		d	100	0.55	1.09
Hot metal desulfurization <sup>n</sup>					
Controlled baghouse	D	0.5	8	0.0004	0.0007
		1.0	18	0.0009	0.0016
		2.5	42	0.0019	0.0038
		5.0	62	0.0028	0.0056
		10	74	0.0033	0.0067
		15	78	0.0035	0.0070
		d	100	0.0045	0.009

Table 12.5-2 (cont.).

	EMISSION	Particle	Cumulative	Cumulat Emissic	tive Mass on Factor
Source	RATING	Size (µm) <sup>a</sup>	Stated Size	kg/Mg	lb/ton
Basic oxygen furnace BOF					
Top blown furnace melting and					
hood and vented to scrubber	С	0.5	34	0.0012	0.0023
		1.0	55	0.0019	0.0037
		2.5	65	0.0022	0.0044
		5.0	66	0.0022	0.0045
		10	67	0.0023	0.0046
		15	72 <sup>c</sup>	0.0024	0.0049
		d	100	0.0034	0.0068
BOF charging at source <sup>k</sup>	Е	0.5	8 <sup>c</sup>	0.02	0.05
		1.0	12	0.04	0.07
		2.5	22	0.07	0.13
		5.0	35	0.10	0.21
		10	46	0.14	0.28
		15	56	0.17	0.34
		d	100	0.3	0.6
Controlled by baghouse	D	0.5	3	9.0x10 <sup>-6</sup>	1.8x10 <sup>-5</sup>
		1.0	10	3.0x10 <sup>-5</sup>	6.0x10 <sup>-5</sup>
		2.5	22	6.6x10 <sup>-5</sup>	0.0001
		5.0	31	9.3x10 <sup>-5</sup>	0.0002
		10	45	0.0001	0.0003
		15	60	0.0002	0.0004
		d	100	0.0003	0.0006

Table 12.5-2 (cont.).

	EMISSION	Particle	Cumulative	Cumulat Emissio	ive Mass on Factor
Source	RATING	Size (µm) <sup>a</sup>	$(\mu m)^a$ Stated Size	kg/Mg	lb/ton
BOF tapping at source <sup>k</sup>	Е	0.5	j	j	j
		1.0	11	0.05	0.10
		2.5	37	0.17	0.34
		5.0	43	0.20	0.40
		10	45	0.21	0.41
		15	50	0.23	0.46
		d	100	0.46	0.92
BOF tapping					
Controlled by baghouse	D	0.5	4	5.2x10 <sup>-5</sup>	0.0001
		1.0	7	0.0001	0.0002
		2.5	16	0.0002	0.0004
		5.0	22	0.0003	0.0006
		10	30	0.0004	0.0008
		15	40	0.0005	0.0010
		d	100	0.0013	0.0026
Q-BOP melting and refining		0 <b>-</b>		0.010	0.005
controlled by scrubber	D	0.5	45	0.013	0.025
		1.0	52	0.015	0.029
		2.5	56	0.016	0.031
		5.0	58	0.016	0.032
		10	68	0.019	0.038
		15	85 <sup>c</sup>	0.024	0.048
		d	100	0.028	0.056

Table 12.5-2 (cont.).

	EMISSION	Particle	Cumulative	Cumulative Mass Emission Factor	
Source	RATING	Size (µm) <sup>a</sup>	Mass $\% \leq$ Stated Size	kg/Mg	lb/ton
Electric arc furnace melting and refining carbon steel					
Uncontrolled <sup>m</sup>	D	0.5	8	1.52	3.04
		1.0	23	4.37	8.74
		2.5	43	8.17	16.34
		5.0	53	10.07	20.14
		10	58	11.02	22.04
		15	61	11.59	23.18
		d	100	19.0	38.0
Electric arc furnace					
Melting, refining, charging, tapping, slagging					
Controlled by direct shell evacuation plus charing hood					
for carbon steel <sup>n</sup>	Е	0.5	74 <sup>b</sup>	0.0159	0.0318
		1.0	74	0.0159	0.0318
		2.5	74	0.0159	0.0318
		5.0	74	0.0159	0.0318
		10	76	0.0163	0.0327
		15	80	0.0172	0.0344
		d	100	0.0215	0.043
Open hearth furnace					
Melting and refining					
Uncontrolled	Е	0.5	1 <sup>b</sup>	0.11	0.21
		1.0	21	2.22	4.43
		2.5	60	6.33	12.66
		5.0	79	8.33	16.67
		10	83	8.76	17.51
		15	85 <sup>c</sup>	8.97	17.94
		d	100	10.55	21.1

Table 12.5-2 (cont.).

	EMISSION	Particle	Cumulative	Cumulative Mass Emission Factor	
Source	RATING	Size (µm) <sup>a</sup>	Mass $\% \leq$ Stated Size	kg/Mg	lb/ton
Open hearth furnaces					
Controlled by ESP <sup>p</sup>	Е	0.5	10 <sup>b</sup>	0.01	0.02
		1.0	21	0.03	0.06
		2.5	39	0.05	0.10
		5.0	47	0.07	0.13
		10	53 <sup>b</sup>	0.07	0.15
		15	56 <sup>b</sup>	0.08	0.16
		d	100	0.14	0.28

<sup>a</sup> Particle aerodynamic diameter micrometers (µm) as defined by Task Group on Lung Dynamics. (Particle density =  $1 \text{ g/cm}^3$ ).

- <sup>b</sup> Interpolated data used to develop size distribution.
- <sup>c</sup> Extrapolated, using engineering estimates.
- <sup>d</sup> Total particulate based on Method 5 total catch. See Table 12.5-1.
- <sup>e</sup> Average of various cyclone efficiencies.
- <sup>f</sup> Total casthouse evacuation control system.
- <sup>g</sup> Evacuation runner covers and local hood over taphole, typical of new state-of-the-art blast furnace technology.
- <sup>h</sup> Torpedo ladel desulfurization with CaC<sub>2</sub> and CaCO<sub>3</sub>. <sup>j</sup> Unable to extrapolate because of insufficient data and/or curve exceeding limits.
- <sup>k</sup> Doghouse-type furnace enclosure using front and back sliding doors, totally enclosing the furnace, with emissions vented to hoods.
- <sup>m</sup>Full cycle emissions captured by canopy and side draft hoods.
- <sup>n</sup> Information on control system not available.
- <sup>p</sup> May not be representative. Test outlet size distribution was larger than inlet and may indicate reentrainment problem.

### Table 12.5-3 (Metric And English Units). UNCONTROLLED CARBON MONOXIDE EMISSION FACTORS FOR IRON AND STEEL MILLS<sup>a</sup>

### EMISSION FACTOR RATING: C

Source	kg/Mg	lb/ton
Sintering windbox <sup>b</sup> Basic oxygen furnace <sup>c</sup>	22 69	44 138
Electric arc furnace <sup>c</sup>	9	18

<sup>a</sup> Reference 6.

<sup>b</sup> kg/Mg (lb/ton) of finished sinter.

<sup>c</sup> kg/Mg (lb/ton) of finished steel.



(Calculated according to the Task Group Lung Dynamics definition of Aerodynamic Diameter)

Figure 12.5-2. Particle size distribution of sinter plant emissions.

#### Source Category / Controls



(Calculated according to the Task Group Lung Dynamics definition of Aerodynamic Diameter)

Figure 12.5-3. Particle size distribution of basic oxygen furnace emissions.
#### Source Category / Controls



(Calculated according to the Task Group Lung Dynamics definition of Aerodynamic Diameter)

Figure 12.5-4. Particle size distribution of blast furnace, open hearth, electric arc furnace and hot metal desulfurization emissions.

	Emissions By Particle Size Range (Aerodynamic Diameter)					EMISSION	
Operation	≤ 30 µm	≤ 15 µm	≤ 10 µm	≤ 5 µm	≤ 2.5 µm	Units <sup>b</sup>	RATING
Continuous Drop Conveyor transfer station sinter <sup>c</sup>	13 0.026	9.0 0.018	6.5 0.013	4.2 0.0084	2.3 0.0046	g/Mg lb/ton	D D
Pile formation stacker pellet ore <sup>c</sup>	1.2 0.0024	0.75 0.0015	0.55 0.0011	0.32 0.00064	0.17 0.00034	g/Mg lb/ton	B B
Lump ore <sup>c</sup>	0.15 0.00030	0.095 0.00019	0.075 0.00015	0.040 0.000081	0.022 0.000043	g/Mg lb/ton	C C
Coal <sup>d</sup>	0.055 0.00011	0.034 0.000068	0.026 0.000052	0.014 0.000028	0.0075 0.000015	g/Mg lb/ton	E E
Batch drop Front end loader/truck <sup>c</sup>							
High silt slag	13 0.026	8.5 0.017	6.5 0.013	4.0 0.0080	2.3 0.0046	g/Mg lb/ton	C C
Low silt slag	4.4 0.0088	2.9 0.0058	2.2 0.0043	1.4 0.0028	0.8 0.0016	g/Mg lb/ton	C C
Vehicle travel on unpaved roads Light duty						kg/VKT lb/VMT	C C
vehicle <sup>d</sup>	0.51 1.8	0.37 1.3	0.28 1.0	0.18 0.64	0.10 0.36		
Medium duty vehicle <sup>d</sup>	2.1 7.3	1.5 5.2	1.2 4.1	0.70 2.5	0.42 1.5	kg/VKT lb/VMT	C C
Heavy duty vehicle <sup>d</sup>	3.9 14	2.7 9.7	2.1 7.6	1.4 4.8	0.76 2.7	kg/VKT lb/VMT	B B
Vehicle travel on paved roads Light/heavy							C C
vehicle mix <sup>c</sup>	0.22 0.78	0.16 0.58	0.12 0.44	0.079 0.28	0.042 0.15	kg/VKT lb/VMT	

# Table 12.5-4 (Metric And English Units).UNCONTROLLED PARTICULATE EMISSIONFACTORS FOR OPEN DUST SOURCES AT IRON AND STEEL MILLS<sup>a</sup>

<sup>a</sup> Predictive emission factor equations are generally preferred over these single values emission factors. Predictive emission factor estimates are presented in Chapter 13, Section 13.2.

VKT = Vehicle kilometers traveled. VMT = Vehicle miles traveled.

<sup>b</sup> Units/unit of material transferred or units/unit of distance traveled.

<sup>c</sup> Reference 4. Interpolation to other particle sizes will be approximate.

<sup>d</sup> Reference 5. Interpolation to other particle sizes will be approximate.

References For Section 12.5

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# BAR MILL GROUP

PLYMOUTH DIVISION

February 13, 2018

Bryce Bird – Executive Director Utah Division of Air Quality 195 North 1950 West P.O. Box 144820 Salt Lake City, Utah 84114-4820

#### Attn: Nando Meli

Re: Further Response – Serious Nonattainment BACT

Dear Mr. Bird;

This letter is in response to your requests presented to me during our meeting on January 17, 2018. We understand that your division is seeking further information on the possibility of emission reduction for emission sources at our facility in northern Box Elder County. It was described that the Division is seeking further information or clarification on the BACT information previously submitted by specific sources that will be addressed individually in the State Implementation Plan. Nucor Utah is one of those sources. The further information you have requested is to address the previous analysis provided with regards to timing of additional controls that could be implemented by the year 2024, rather than the previous effective date of year 2019. In addition, you asked specifically about our Reheat Furnace #1, as this furnace has higher allowed emission rates than our Reheat Furnace #2 in all permit documents.

Nucor has provided a Serious Nonattainment Area BACT analysis early in 2017, and supplemental information provided later that year in response to questions on that analysis from your office. Further, a BACT analysis has very recently been provided for all pollutants for the entire plant which led to a revised PSD permit in late 2013. Historically, it has been Nucor's choice to revisit BACT periodically and obtain a new PSD permit to both minimize potential emissions and eliminate potential concerns by others that the correct permitting process has been completed over time. Because of the recent permitting activities, and because of the recent analyses completed for SIP purposes, BACT application to Nucor emissions is found to be up-to-date. There are no aged BACT analyses that could be updated with existing known available technology.

It is our understanding that there may be some cases where known new BACT technology could be found applicable, but the length of time to install the technology may be too extensive to have met the modeled attainment demonstration needed for 2019. If modeling cannot demonstrate attainment in 2019, then further analyses may be needed on what measures can be taken by 2024. Nucor's analysis addressed all known technology and found that BACT is already in place. There is no circumstance where a BACT technology does exist that could be applied to any Nucor emission source which was ruled out because of a lengthy time for installation. Had an available technology been identified, the analysis would have taken the further step of identifying the time for a completed installation to determine if it could have been completed by 2019. Since no available technology was found, and installation timeline was not addressed. Nucor's emission sources all do currently have BACT installed.

Since the Division did ask specifically about our Reheat Furnace #1, we are hereby providing further analysis. This furnace does, in fact, represent higher allowed emissions than our Reheat Furnace #2. Some of the difference expressed in units of lbs/hour can be accounted for by the fact that this furnace is a larger capacity furnace. It is associated with the



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rolling line that can and does roll larger products. Larger products can typically be rolled at higher production rates, because less reduction of a billet is needed through the roll line. The heat rate of this furnace is higher, therefore, to match the capable speed of the equipment downstream of the reheat furnace. In addition to simply having a higher heating capacity, this furnace also has a slightly higher emission rate in lbs per unit of natural gas consumed. We refer back to previous information submitted in 2017 that describes the reasons for this circumstance. The emission rate of the furnace does meet BACT as determined by EPA and Nucor as part of a study of what can be done to limit emissions from reheat furnaces at steel mills. Nucor's Reheat Furnace #1 was found to be able to meet lower emissions at a time of rebuild and a rebuild of the furnace to achieve lower emission rates in the mid-2000's. This modification involved changing the size of the furnace to accommodate Low NOx burners. A summary of the costs for this recent modification areas follows:

Description	Date	Amount
Steel and Fabrication	September 2007	\$220,117
Core System (Added Controls)	January 2008	\$179,052
Electrical Installation	September 2007	\$223,699
Core System (Burners)	September 2007	\$1,187,567
Refractory	September 2007	\$288,497
Mechanical	September 2007	\$570,000

Total \$2,668,932

These costs are only capital expenditures where purchase orders were issued or direct contractor costs were captured. Additional costs would have occurred in the form of Nucor supplied labor, and loss of product production/sales associated with the extended downtime needed to make these modifications.

Nucor has already completed a significant expenditure on this furnace to lower emission rates. This change was made to lower NOx emissions, a pollutant to be addressed for the Serious Nonattainment Area, from the previously allowed 20.71 lbs/hr to the existing allowed emission rate of 15.0 lbs/hr. A copy of an excerpt of the Approval Order for this modification is included as Attachment 1.

Replacement of Reheat Furnace #1 is not warranted at this time. Nucor has replaced the Reheat Furnace #2 to achieve lower NOx emissions just prior to the rebuild of Reheat Furnace #1. Using historic information of the capital costs for replacement of that furnace, combined with other more recent information, the replacement costs can be estimated.

Historic costs for replacement of Reheat Furnace #2 are as follows:

Description	Date	Amount
Building Modifications Refractory Foundations Electrical Install Hydraulics Mechanical Installation Crane and Hotrail Installation Steel Fabrication	March 2006 March 2006 March 2006 March 2006 March 2006 March 2006 March 2006 March 2006	\$261,552 \$1,475,671 \$582,379 \$684,758 \$15,573 \$677,481 \$26,657 \$1,101,174

Total \$4,798,588

Scaling these dollars up at a typical inflation rate of 1.75% per year results in a cost in today's dollars of \$5,909,170. Again these costs would not include costs for Nucor labor contributed to the project, and costs associated with any lost production. Further, demolition costs for the former reheat furnace are not included in the costs summarized above. Nucor Plymouth has conducted further research in the probable costs for installation of a replacement furnace for Reheat Furnace #1. One other Nucor division is planning to install a new Reheat Furnace to add to production capabilities.



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Quotes for an entirely new, added, furnace from 3 vendors are provided below:

Added Reheat Furnace	Vendor 1	Vendor 2	Vendor 3
Basic engineering for emergency pumping station			
Ability to accept billet info into level II			
PCR			
Pre-Assembled Furnace w/ Refractory			
Stainless Recuperator			
Hydraulics, compressed air, lube and purge (w/air) piping in SS			
Waste gas ducting and stack w/refractories and sampling ports			
Individual drives for entry/exit rollers			
Commissioning Spares			
Capital Spares (listed below)			
Combustion Air Fan impellar assembly			
Combustion Air Fan motor			
discharging roller assembly (w/ supports, gearmotor and joint)			
lift cylinder with assembly			
traverse cylinder with assembly			
Erection and Commissioning - Site Services			
number of man-days included in base price above	200	200	200
(daily rate for services above base - as per Nucor rate - \$750 per 10-hr day + \$150 per diem)			
Training			
Delivery Terms	DDP	DDP	DDP
Delivery Period (months)	Begin 11- end 13	12.5	12 to 15.5
RHF Total Weight (shtons)	1,450	1520	1150
Total RHF	\$5,590,000	\$6,297,000	\$6,350,000

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The quotations for an added new furnace compares with the scaled up costs from Nucor Plymouth's replacement furnace. Again, these costs would not include Nucor supplied labor, lost production considerations, and demolition costs. Further, the quotations above are for a smaller capacity furnace than would be needed in the Plymouth operations.

For the purposes of this analysis, a cost of \$7,500,000 will be used. Actual costs with all cost components quantified would likely find an actual cost much greater. A complete cost analysis would take considerable time and has not been completed. There has not been an operational reason to consider replacement of this furnace.

Nucor typically capitalizes equipment purchases for a period of 12 years. The actual life of the equipment may exceed, or be less than, this period. The life of equipment is highly dependent on markets of products; is it suitable for making products customers currently purchase, the design of equipment and its longevity before irreparable damage occurs, and available technology. 12 years is the appropriate time period to use in this analysis. Therefore, the cost of \$7,500,000 dollars divided by 12 years is \$625,000 per year. This simple calculation excludes the time value of money which would add to the annual cost of the replacement.

As with Reheat Furnace #2 replacement, the emission rate permitted for a replacement furnace would be 0.07 lbs/mmbtu, compared to the permitted emission rate of the existing furnace of 0.09 lb/mmbtu. Assuming no capacity change would be required, an approximate 11 ton per year reduction in NOx potential emissions could result. The cost per ton per year of reduction in this broad analysis is therefore \$625,000 divided by 12 years, or, \$52,083 per ton of reduction. This cost per ton of reduction exceeds the amount that is needed to meet BACT in a Serious Nonattainment Area.

Not addressed in this analysis is the bigger overall picture of a complex topic. A furnace redesign is accomplished to accommodate burners that can produce lower NOx emissions. Staged combustion that is needed for Low NOx burners require greater space (a larger furnace). Greater space represents greater heat loss to be made up with greater gas consumption. But a bigger factor is the possible loss in efficiency that comes along with lowering peak combustion temperatures. Referring back to Attachment 1 for the modification of Reheat Furnace #1 it is noticed a Carbon Monoxide increase accompanies the NOx decrease. An increase in Carbon Monoxide is an indicator in a loss of combustion efficiency requires a greater gas firing capacity furnace. While the NOx amount may decrease per unit of gas fired, it is possible that the total NOx increases because more gas is consumption as well. See Attachment 2 which includes a case specific example of this occurrence. Every situation/installation is different. It has not been determined if this is the case for Nucor Plymouth's applications. It isn't necessary because of the high cost implications for making the change (\$/ton reduction of NOx) without including this level of detail which would only increase this cost estimate.

If you have any questions please do not hesitate to contact me at 435-458-2415

Sincerely

Douglas Jones Environmental Department Manager



# Attachment 1

# **Reheat Furnace #1 Approval Order Excerpt**

**NOx Decrease** 

#### Abstract

Nucor Steel – Plymouth (Nucor) is required by a Consent Decree with EPA to readdress the Best Available Control Technology on the reheat furnaces at their plants. Nucor has determined that installing Low  $NO_x$  Burners on their reheat furnaces would satisfy the BACT requirement that is required. Nucor replaced the #2 reheat furnace in 2006 and is requesting approval to install low  $NO_x$ burners on the #1 reheat furnace.

The Nucor plant is located in Box Elder County which is an attainment area for all pollutants. Nucor is a Prevention of Significant Deterioration (PSD) source and a Title V source. Nucor is currently regulated by the New Source Performance Standard (NSPS) Subpart AA a (Standards for Steel Plants: Electric Arc Furnaces and Argon-Oxygen Decarbourization Vessels Constructed after August 7, 1983). This AO is not intended to contradict any conditions in the EPA consent decree for Nucor dated July 20, 2001. The emissions (in tons per year) will change as follows: NOx - 23.41, and CO + 37.24. The changes in emissions will result in the following, in tons per year, potential to emit totals:  $PM_{10} =$ 132.02,  $NO_x = 418.21$ ,  $SO_2 = 328.75$ , CO = 2,917.86, VOC = 172.98 and HAPs = 13.02.

The project has been evaluated and found to be consistent with the requirements of the Utah Administrative Code Rule 307 (UAC R307). A public comment period was held in accordance with UAC R307-401-7 and no comments were received. This air quality Approval Order (AO) authorizes the project with the following conditions, and failure to comply with any of the conditions may constitute a violation of this order.

#### **General Conditions:**

1. This AO applies to the following company:

Site Office

Nucor Steel – Plymouth Division P. O. Box 100 Plymouth, Utah 84330 Phone Number: (435) 458-2300 Fax Number: (435) 458-2309

The equipment listed in this AO shall be operated at the following location:

Three miles west of Plymouth, Box Elder County, Utah

Universal Transverse Mercator (UTM) Coordinate System: UTM Datum NAD27 4,637 kilometers Northing, 402 kilometers Easting, Zone 12

- 2. All definitions, terms, abbreviations, and references used in this AO conform to those used in the UAC R307 and Title 40 of the Code of Federal Regulations (40 CFR). Unless noted otherwise, references cited in these AO conditions refer to those rules.
- 3. The limits set forth in this AO shall not be exceeded without prior approval in accordance with R307-401.



# Attachment 2

# **Case Study**

# Unit NOx Reduction vs. Overall NOx Reduction



Industrial Gases/Combustion

# Improved NOx Limitation Standard to Reflect Combustion Efficiency





June 12, 2017

Martin Schoenfelder, Steven Mickey, and Dr. Joachim G. Wuenning In many locations throughout North America, nitrogen oxide (NOx) emissions of gas-heated furnaces are limited by law or code. This is typically the case in urban areas or in places where special topographical characteristics intensify the negative local and regional effects of NOx emissions.

While the approach of limiting hazardous emissions is for the benefit of the environment and society, the method used to define the limitation can significantly alter its outcome (e.g., if it does not account for the full extent of influencing factors). In particular, this is the case for the combustion efficiency in gas-heated industrial furnaces.

This article presents a simple example showing how a one-dimensional emissions-limitation standard can lead to adverse effects, preventing a well-intended initiative from achieving its goals or even leading to the exact opposite. It further outlines an approach for a very simple correction of the current one-dimensional formula in order to properly reflect combustion efficiency and, therefore, actually achieve its intended goals.

# NOx Formation in Gas-Heated Industrial Furnaces

Nitrogen oxides are highly undesirable emissions because they can be directly harmful to our health and contribute to ozone formation and acid rain.<sup>[1]</sup> NOx can be generated in combustion processes, even if "clean fuels" such as hydrogen or natural gas are being used. The main source of NOx in gas-heated industrial furnaces is called thermal NO. There are two other modes of formation: prompt NO and fuel-bound NO. These are, however, both negligible in industrial furnaces.

The formation of thermal NO is defined by the "extended Zeldovich Mechanism."<sup>[5,6]</sup>

 $N_2 + O \rightarrow NO + N$   $N + O_2 \rightarrow NO + O$   $N + OH \rightarrow NO + H$ As implied by the name "thermal NO," the formation is temperature-driven and can be described with an

exponential function. Peak temperatures, therefore, contribute greatly to NOx emissions. The peak temperature in a combustion process is typically found in the reaction zone (conventionally this is the "flame"). Traditionally, this has led to a trade-off between burner efficiency and NOx emissions, because preheating combustion air (being the most effective efficiency technology) also increases the flame temperature and, thus, leads to higher NOx emissions.

Lowering peak temperatures while still maintaining complete combustion is the goal of NOx-reduction techniques, which has been a main focus in combustion research over the last several decades. The most common methods currently used in industrial furnaces are air/gas staging, flue-gas recirculation and flameless-combustion techniques such as FLOX® (Fig. 1).<sup>[2]</sup>

# Example

A company is planning to build a new forge furnace in the Los Angeles, Calif., area. Per design, the furnace needs to be operated up to 2282°F (1250°C) and requires a net heat input of 10 MMBTU/hour (3,000 kW LHV) for the intended application. The furnace is going to be operated 6,000 hours per year with an average load factor of 75%. Since electricity is very expensive and also not desirable for heating industrial furnaces for environmental reasons, the company's preferred technology is natural gas heating.

Due to the location of the furnace, the South Coast Air Quality Management District (SCAQMD) has set a strict limit of 0.06 pound/MMBTU (50 ppm) NOx @3% O<sub>2</sub> for the combustion process at the highest furnace temperature. This limit is based on a one-dimensional approach and, as such, does not consider adjustments for high-efficiency technology. The limit is also not defined on an absolute scale such as pounds per year, but it is given as a concentration in the exhaust gas. This implies that all available technologies emit the same total volume of exhaust gases. This assumption is false, however, due to different combustion efficiencies of the various available combustion technologies.

In this example, the high furnace temperature and the operating time per year make efficiency measures highly desirable. Compared to a cold-air burner system (i.e., no heat recovery), a modern regenerative-burner system will achieve fuel savings on the order of 53%. While a cold-air burner system will achieve the required NOx concentration of 0.06 pounds/MMBTU (50 ppm) @3% O<sub>2</sub>, the high air preheat of a regenerative-burner system would lead to an increase in its specific NOx emissions (i.e., concentration in the exhaust).

Due to the use of appropriate NOx-reduction techniques such as FLOX combustion, the regenerative system can still achieve 0.08 pounds/MMBTU (70 ppm) @3% O<sub>2</sub>. Based on the limits defined by the SCAQMD, however, the company is being forced to use the inefficient cold-air burner system since the highly efficient regenerative burners lead to a slightly higher NOx concentration than the specified limit of 0.06 pounds/MMBTU (50 ppm) @3% O2.

The one-dimensional standard defined by the authorities, therefore, prevents the use of the best-available technology since the limitation of a concentration (pounds/MMBTU or parts per million pollutant in exhaust at a specified oxygen content) does not consider the total amount of exhaust gas produced by each alternative combustion setup. The reference cold-air burner system only achieves an efficiency of approximately 37% LHV at the specified furnace temperature. Hence, an equivalent of roughly two-thirds of the natural gas combusted is wasted through the stack of the furnace. At the same time, the alternative regenerative-burner solution achieves a combustion efficiency of 78% LHV and a significantly decreased use of natural gas along with proportionally less exhaust gases (Fig. 2).

The resulting annual energy savings compared to the cold-air burner system equates to 19 GWh, which equals the annual natural gas use of 851 average U.S. households.<sup>[4]</sup> Even though the specific NOx emissions of the regenerative-burner system are slightly higher than the reference system, the absolute amount of NOx emitted is, in fact, significantly lower.

The inefficient cold-air burner system emits 8,172 pounds (3,707 kg) of NOx per year, whereas the highefficiency regenerative system only emits 5,419 pounds (2,458 kg). This equates to 33% lower actual NOx emissions in the same time span (values derived from energy-based emission factors for natural gas H).<sup>[2]</sup>

At the same time, a  $CO_2$  reduction of approximately 4,244 (3,850 metric) tons per year can be achieved due to the increased fuel efficiency (based on  $CO_2$ -emission factor 0.126 pounds/ft<sup>3</sup> (2.02 kg/m<sup>3</sup>) for natural gas H). For just one furnace, this difference is equivalent to removing 820 passenger cars from the road.<sup>[3]</sup>

To summarize, the way the standard is currently defined favors the inefficient and higher-emission technology rather than a far more advantageous combustion technology using less energy with significantly lower overall emissions. The next section introduces a simple correction method to account for the differences in efficiency. This method can be used to correct the emissions limit in order to easily equate two or more alternative technologies.

# Improved Formula for Emissions-Limit Calculation

In general, there are two possible methods to better define the emissions limitation in order to make sure its actual goal will be achieved.

- 1. The overall absolute emissions of a pollutant can be limited. For example, the limit could be given in "pounds per year."
- 2. The limitation of an emissions concentration in flue gases can be corrected with an efficiency factor.

While option 1 seems to be straightforward at first, it can be difficult to verify compliance in real-world applications. There is typically no emissions-monitoring device permanently installed to prove the true absolute amounts of a pollutant emitted per year. It would be possible, however, to use extrapolated values based on actual measurements to prove compliance with the limitation defined as an absolute value.

Option 2 could be used in a very similar way to today's standard approach. Currently, the limitation of the concentration of a pollutant in the exhaust is spot-checked over the course of a typical operation cycle. In the case of NOx emissions, an exhaust-gas analyzer probe is inserted into the exhaust system and several NOx readings are taken over a certain period of time. These values are then averaged in order to compare them to the limit previously set for the audited furnace.

At the same time, exhaust-gas analyzers typically also determine the efficiency of a combustion system based on the CO<sub>2</sub> content and the temperature of the exhaust. These efficiency readings or the published/guaranteed efficiency from the manufacturer can then be used to adjust the emissions limitation for increased efficiency (or vice versa, penalize the inefficient technology with the same factor).

Assume that the reference system (ref) is defined as the most efficient combustion technology that still achieves the emissions concentration limit EB as defined by the authorities. If the reference technology is able to achieve lower specific emissions, EB should be set according to this lower value. Furthermore, assume that there is a more fuel-efficient technology available (eff) that does not meet the limitation for specific emissions.

The corrected emissions concentration limit  $E_N$  shall serve as the new limit for the high-efficiency technology because it represents the value at which the total absolute emissions of the more efficient system are equal to those emitted by the less efficient system. If the high-efficiency alternative stays below this new emissions limit  $E_N$ , it is the environmentally favorable solution, because not only is the total amount of pollutant emitted lower than for the reference system but also the total fuel consumption.

$$E_N = \frac{\eta_{eff}}{\eta_{ref}} * E_B$$

For the example defined in the previous section, the corrected specific emissions limit  $E_N$  for NOx computes to:

$$E_N = \frac{78\%}{37\%} * 0.06 \frac{lb}{MMBTU} @3\% O_2$$

$$E_N = 0.14 \frac{lb}{MMBTU} @3\% O_2$$

The regenerative-burner system emitting 0.08 pounds/MMBTU (70 ppm) @3%  $O_2$  stays well below the corrected limit  $E_N$  of approximately 0.14 pounds/MMBTU (105 ppm) @3%  $O_2$ , thus saving 33% NOx emissions per year compared to the option that would have had to be selected previously.

Figure 3 illustrates a broader comparison of cold-air and regenerative-burner systems over a range of operating temperatures. The graphs show that the more efficient combustion system consistently offers lower overall NOx emissions and also leads to significant energy savings. In addition, the energy-savings effect increases with the operating temperature, making the overall environmental benefits especially important for high-temperature applications.

# Conclusions

This article shows that the method currently used to define the limitation of pollutant concentration in the exhaust of a combustion system often does not achieve its intended goal. Without proper quantification and integration of the process inputs (fuel), the standard method can even act

counterproductively to its intentions.

An undifferentiated limitation of volume-based pollutant concentration (NOx) is only possible if all available technologies use the exact same amount of fuel to heat a furnace. Since this is rarely the case, we propose using an emissions limit corrected for combustion efficiency. Its compliance can be checked just as easily as the current, typically undifferentiated concentration limit since exhaust-gas analyzers not only reveal emission concentration but also the efficiency of a combustion system. As an alternative, authorities could also easily define classes of combustion equipment based on existing literature showing typical combustion efficiencies for different available technologies.<sup>[2,7]</sup>

The example discussed represents a typical furnace application. Due to the disincentive set by the current approach for defining the emissions limitation, less efficient technology has to be selected. For only one exemplary furnace, this leads to 19 GWh of additional energy use, 4,244 (3,850 metric) tons of additional CO<sub>2</sub> emissions and 33% higher NOx emissions than what could be achieved with a more sophisticated combustion system. This equates to potential savings equivalent to the average annual natural gas use of 851 U.S. households and NOx reductions equivalent to removing 820 passenger cars from the road.

Extrapolated to hundreds of furnaces, the effects quickly become highly relevant to the public and society. A simple correction to the standards set by the authorities will therefore lead to significant positive effects for both the environment and the economy.

**For more information:** Contact Dr. Martin Schönfelder, VP technical sales; WS Thermal Process Technology Inc., 8301 West Erie Avenue, Lorain, OH 44053; tel: 440-385-6829; fax: 440-960-5454; e-mail: wsinc@flox.com; web: www.flox.com

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# <u>PM<sub>2.5</sub> SIP Evaluation Report – Nucor Steel</u>

# UTAH PM<sub>2.5</sub> SIP SERIOUS SIP

Salt Lake City Nonattainment Area

Utah Division of Air Quality Major New Source Review Section

July 1, 2018

# PM<sub>2.5</sub> SIP EVALUATION REPORT NUCOR STEEL

#### 1.0 Introduction-Purpose

The following is an updated version of the original RACT evaluation that was completed on October 1, 2013 as a part of the Technical Support Documentation for Section IX, Parts H.11, 12 and 13 of the Utah SIP; to address the Salt Lake City PM2.5 and Provo, Utah PM2.5 Nonattainment Areas.

During the period of the development of the PM<sub>2.5</sub> SIP for moderate nonattainment, UDAQ also processed an application submitted by Nucor for a major modification. Nucor is a PSD source that is located in a newly designated nonattainment area for PM<sub>2.5</sub>. In their application Nucor addressed BACT for the entire source for total emissions (not incremental increases) for all existing sources, and, as required by regulation for new emission sources located in a nonattainment area, Lowest Achievable Emission Rate (LAER) for any new emission sources, which was approved under Approval Order DAOE-AN100080041-18. Further, modeling was completed for all pollutants using the best representative background data including for the pollutant PM<sub>2.5</sub>. No exceedances of NAAQS were found to occur in the area of Nucor operations. Background concentrations plus Nucor's impact does not result in an exceedance of the NAAQS for any pollutant at their location. Since Nucor is located within a boundary chosen as a nonattainment area, offsets were purchased by Nucor and utilized so that an Approval Order dated December 3, 2013 could be issued. Because of this permitting action, BACT has recently been analyzed for the entire Nucor operation. No grandfathered emission units which did not meet current BACT were allowed by the newly issued Approval Order. This analysis reassesses BACT status for the period since the issuance of the recent Approval Order where BACT was addressed.

# 1.1 Facility Identification

Name: Nucor Steel Utah Address: West Nucor Rd PO Box 100 Plymouth, Utah 84330 Owner/Operator: Nucor Corporation UTM coordinates: 401,000 m Easting; 4,637,500 m Northing

#### 1.2 Facility Process Summary

Nucor Steel (Nucor) is an Electric Arc Furnace (EAF) shop, commonly known as a minimill. The facility is a recycling center which utilizes scrap steel as a raw feedstock. Scrap steel is purchased from a number of sources and sorted. The steel is loaded into charge buckets and transported to one of two EAFs. Oxyfuel burners and electricity are

used to melt the steel into a liquid form. Alloys are added until the desired product is achieved. The molten material is then continuously molded and cut into billets for stockpiling. The billets are then reheated and transferred to the rolling mill to be shaped and shipped to the customer.

# 1.3 Facility 2016 Baseline Emissions

Plant-wide 2016 Actual Emissions (tons/yr)

PM <sub>2.5</sub>	NO <sub>x</sub>	$SO_2$	VOC
31.20	162.91	116.87	39.61

# 1.4 Facility Criteria Air Pollutant Emissions Sources

Emission Unit	Current Plant-wide Potential to Emit (tons/yr)				
	PM <sub>2.5</sub>	NO <sub>x</sub>	SO <sub>2</sub>	VOC	
Electric Arc	87.40	247.99	325.93	97.24	
Furnace Baghouse					
EAF Meltshop	13.55	7.44	9.78	2.76	
Fugitives					
Caster Spray					
Chamber Exhaust	0.90				
Lime Silos 1&2					
Baghouse					
(Outdoor)	0.36				
EAF 1 Carbon Silo					
Bin Vent	0.36				
EAF 2 Carbon Silo					
Bin Vent	0.36				
Scrap Stockpiles	0.12				
Alloy Stockpiles	0.005				
Lime Stock Piles	0.005				
Alloy Railcar					
Unloading NE	0.005				
Alloy Railcar					
Unloading					
Meltshop Belly					
Dump/Hopper					
System	0.005				
Slag Stockpiles 1					
& 2	0.005				
Slag Loading to					
Truck	0.01				
Lime Unloading	0.02				
EAF Baghouse					
Miscellaneous	2.14				

PSD PTE				
Reheat #1 Stack	5.02	61.88	0.40	3.63
Reheat #2 Stack	2.79	21.94	0.22	2.02
Reheat Fugitives	0.93	7.31	0.07	0.67
Hot Steel Rolling	0.83			
Abrasive Saw	0.00			
Stack	5.40			
Jump Mill				
Baghouse Stack to				
Outdoors	2.88			
Heat Retention				
Boxes	0.33	2.19	0.03	0.24
Roll Mill Roll Line				
1 Baghouse	18.00			
Roll Mill PSD				
PTE	36.18	93.32	0.72	6.57
Truck Scale				
Emergency	0.01			
Generator	0.01	0.08	0.01	0.01
Main Office				
Emergency	0.01	0.00	0.01	0.01
Generator	0.01	0.08	0.01	0.01
Caster Emergency	0.01	0.08	0.01	0.01
Veguerator	0.01	0.08	0.01	0.01
Vacuulli Degassel	0.33	0.25	0.25	0.25
Financial Gas Fired				
Concretor 1	0.00	0.01	0.00	0.01
Natural Gas Fired	0.00	0.01	0.00	0.01
Emergency				
Generator 2	0.00	0.01	0.00	0.01
Desalination	0.00	0.01	0.00	0.01
Plant/Plantwide				
Chlorine				
Emissions	0.00	0.00	0.00	0.00
Roll Mill Contact				
Cooling Water				
Tower				
Arrangement	0.05			
Roll Mill Non-				
Contact Cooling				
Tower				
Arrangement	0.03			
Caster Water				
Cooling Tower	0.07			

Arrangement				
DEC Water				
Cooling Tower				
Arrangement	0.14			
Plantwide				
Torching/Lancing	1.31	0.42	0.00	0.02
Plantwide HVAC	0.08	0.94	0.01	0.00
Sandblasting	0.001			
Paints and				
Solvents	0.00	0.00	0.00	8.50
Gasoline/Diesel				
Storage Tanks	0.00	0.00	0.00	1.50
Plantwide				
Miscellaneous				
PSD PTE	2.03	1.87	0.27	10.31
Paved and				
Unpaved Roads	1.36			
Pickups, haul				
trucks, welders,				
miscellaneous				
portable equipment	3.55	46.30	5.20	8.66

The following emission units are not source specific. A separate BACT analysis has been conducted on these common emission units. The technical support for these sources is in the  $PM_{2.5}$  Serious SIP – BACT for Small Source document ("PM2.5 Serious SIP – BACT for Small Sources.," 2017).

Lime Silo #1 and #2 Baghouse Vents	Paved Roadway Fugitives
SAND: Sandblasting operations	Generators and Pumps
Roll Mill	Roll Mill #1 Baghouse
Abrasive Saw Baghouse	Jump Mill Baghouse
Contact/Non-Contact Cooling Towers	DEC Cooling Towers
Caster Cooling Tower	Unpaved Roadway Fugitives
TANKS: Miscellaneous tank emissions	Raw Material Fugitive Sources
MISC VOC: Painting and solvent cleaning a	activities
Miscellaneous emissions from desalination	plant, acetylene combustion, natural
gas/propane combustion for comfort heating	g, and lab

#### 2.0 BACT Selection Methodology

The general procedure for identifying and selecting BACT is through use of a process commonly referred to as the "top-down" BACT analysis. The top-down process consists of five steps which consecutively identify control measures, and gradually eliminate less effective or infeasible options until only the best option remains. This process is performed for each emission unit and each pollutant of concern. The five steps are as follows:

- 1. Identify All Existing and Potential Emission Control Technologies: UDAQ evaluated various resources to identify the various controls and emission rates. These include, but are not limited to: federal regulations, Utah regulations, regulations of other states, the RBLC, recently issued permits, and emission unit vendors.
- 2. Eliminate Technically Infeasible Options: Any control options determined to be technically infeasible are eliminated in this step. This includes eliminating those options with physical or technological problems that cannot be overcome, as well as eliminating those options that cannot be installed in the projected attainment timeframe.
- 3. Evaluate Control Effectiveness of Remaining Control Technologies: The remaining control options are ranked in the third step of the BACT analysis. Combinations of various controls are also included.
- 4. Evaluate Most Effective Controls and Document Results: The fourth step of the BACT analysis evaluates the economic feasibility of the highest ranked options. This evaluation includes energy, environmental, and economic impacts of the control option.
- 5. Selection of BACT: The fifth step in the BACT analysis selects the "best" option. This step also includes the necessary justification to support the UDAQ's decision.

Should a particular step reduce the available options to zero (0), no additional analysis is required. Similarly, if the most effective control option is already installed, no further analysis is needed.

The final BACT evaluations for the Nucor site were performed using data that Nucor submitted (Douglas Jones, 2017), (Douglas Jones, 2018a)comments received from Techlaw on the Nucor BACT submittal, comments received from EPA, comments received from individuals, AOs, and the Title V permit.

# 2.1 Emission Unit (EU) and Existing Controls

#### 2.1.1 Electric Arc Furnace

#### **Description:**

The existing electric arc furnaces (EAFs) operate in a batch mode whereby the scrap steel and potentially scrap substitutes are charged, melted, and tapped. Nucor is subject to 40 CFR 60, Subpart AAa, Standards of Performance for Steel Plants: Electric Arc Furnaces and Argon-Oxygen Decarburization Vessels Constructed After August 17, 1983 (Environmental Protection & Agency, 2005). During normal operation, cold scrap metal and scrap substitutes, carbon and fluxing agents are charged into the EAF shell, powered by a high-powered transformer. A large electrical potential is applied to the carbon electrodes. The combination of the heat from the arcing process, burners, and carbon sources melt the scrap and scrap substitutes into molten steel. The temperature of the exhaust gas from the EAF increases appreciably as the scrap begins to melt. As melting progresses, oxygen lancing and carbon injection are performed, the temperature of the exhaust gas stream can approach 3,000 °F, which is approximately the temperature of molten steel. This operational cycle is repeated for each batch, which can take up to one hour to complete.

The capture system for exhaust gases from the EAF is a direct evacuation control (DEC) and an overhead roof exhaust system consisting of a canopy hood. The DEC duct locally evacuates the exhaust gases directly from the furnace to the main duct system directed to the EAF baghouse. The roof exhaust system evacuates fugitive fumes from the closed roof plenums located over the EAF and direct them through the main duct system directed to the EAF baghouse.

The air moving mechanism for the system consists of multiple blowers. Nucor Steel has installed a Continuous Emissions Monitoring System (CEMS) for the pollutants CO,  $NO_x$ , and  $SO_2$  and a bag leak detection system (BLDS) for particulates.

#### **Emissions Summary:**

The potential to emit emissions (tons/yr) for both EAF 1 and EAF 2 are as follows:

PM <sub>2.5</sub>	$SO_2$	NO <sub>x</sub>	VOC	NH <sub>3</sub>
87.40	325.93	247.99	97.24	0.00

# Pollutant [NO<sub>x</sub>]

 $NO_x$  is formed from the chemical reaction between nitrogen and oxygen at high temperatures.  $NO_x$  formation occurs by different mechanisms. In the case of EAF,  $NO_x$ predominantly forms from thermal dissociation and subsequent reaction of nitrogen and oxygen molecules in the combustion air. This mechanism of  $NO_x$  formation is referred to as thermal  $NO_x$ . The other mechanisms of  $NO_x$  formation such as fuel  $NO_x$  (due to the evolution and reaction of fuel-bound nitrogen compounds with oxygen) and prompt  $NO_x$ (due to the formation of HCN followed by oxidation to  $NO_x$ ) are thought to have lesser contributions to  $NO_x$  emissions from EAFs.

Based on a review of the RBLC database and discussions with various individuals knowledgeable about steel mill operations, it was revealed that control technologies for  $NO_x$  abatement have not been successfully implemented for EAF emissions. However,  $NO_x$  control technologies are currently available for fossil-fueled boilers, stationary combustion engines and turbines. Thus, these control alternatives are potentially available to control NO<sub>x</sub> from an EAF. These control options have been reviewed for technical feasibility in this BACT analysis. Due to the lack of successful application of such controls to an EAF, they are considered a "technology transfer". The present limit (about 0.32 lb/ton) is at the lower end of the BACT range for EAFs.

#### **Control Options:**

The alternatives available to control NO<sub>x</sub> emissions from the existing EAF include the following:

Combustion Control options -Low Excess Air (LEA); Oxyfuel Burner; Overfire Air (OFA); Burners Out Of Service (BOOS): Reduced Combustion Air Temperature; Load Reduction; Flue Gas Recirculation (FGR) Selective Catalytic Reduction (SCR); Non-Selective Catalytic Reduction (NSCR); SCONOx Catalytic Oxidation/Absorption; Shell DeNOx System (modified SCR); Selective Non-Catalytic Reduction (SNCR) options -Exxon's Thermal DeNO<sub>x</sub><sup>®</sup> Nalco Fuel Tech's NO<sub>x</sub>OUT<sup>®</sup> Low Temperature Oxidation (LTO)

## **Technological Feasibility:**

The LEA option is typically used in conjunction with some of the other options. The use of this option will result in the generation of additional CO emissions. In addition, LEA is not very effective for implementation in EAFs which do not operate with combustion air feeds, since the combustion process is not modulated with the near-atmospheric furnace conditions. Thus, this option is considered technically infeasible for this application.

The Nucor Utah EAF's are equipped with oxy-fuel burners in conjunction with oxygen lances. Oxy-fuel burners provide oxygen to the burner, as opposed to air.  $NO_x$  emissions from burners are caused with high peak flame temperatures in the presence of nitrogen. Oxy-fuel burners obtain all of the needed oxygen to support combustion from pure oxygen injected into the burner, reducing the amount of nitrogen present in the vessel and inhibiting the formation of  $NO_x$ .

The OFA option is geared primarily for fuel  $NO_x$  reduction. Fuel  $NO_x$  is not a significant portion of the total  $NO_x$  generated in a furnace. OFA is not feasible in an EAF because of the high turbulence in the furnace environment.

The BOOS and Load Reduction (or Deration) options incorporate a reduction in furnace load, thereby, potentially reducing  $NO_x$  formation. This reduction must be balanced, however, against a longer period of  $NO_x$  generation resulting from the furnace's inability

to efficiently melt scrap and scrap substitutes. Furthermore, both BOOS and Load Reduction are fundamentally inconsistent with the design criterion for the furnace, which is to increase furnace loadings to achieve enhanced production. The furnace would need to be over-designed to allow this technology to operate. Accordingly, these options are judged technically infeasible for this particular application.

The Reduced Combustion Air Temperature option inhibits thermal  $NO_x$  production. However, the option is limited to equipment with combustion air preheaters which are not applicable to EAFs. Thus, this option is considered technically infeasible for this application.

The FGR option involves recycling a portion of the cooled exit flue gas back into the primary combustion zone. Typically, FGR is useful in reducing thermal  $NO_x$  formation by lowering the oxygen concentration in the combustion zone. The primary limitation of FGR is that it alters the distribution of heat (resulting in cold spots) and lowers the efficiency of the furnace. Since it may be necessary to add additional burners (hence, increasing emissions of other pollutants) to the EAF to reduce the formation of cold spots, FGR technology to reduce EAF  $NO_x$  emissions is not considered feasible. Since the EAF does not operate on burner combustion, but relies upon the electric arc and chemical energy for oxidation, neither pathway is amenable to FGR application. Thus, this option is considered technically infeasible for this application.

In the SCR ammonia  $(NH_3)$  is usually diluted with air or steam, and is injected through a grid system into the exhaust gas stream upstream of a catalyst bed. On the catalyst surface the  $NH_3$  reacts with  $NO_x$  to form molecular nitrogen and water. Technical factors related to this technology include the catalyst reactor design, optimum operating temperature, sulfur content of the charge, catalyst deactivation due to aging, ammonia slip emissions and design of the ammonia injection system.

In order for an SCR system to effectively reduce  $NO_x$  emissions, the exhaust gas stream should have relatively stable gas flow rates,  $NO_x$  concentrations, and temperature. In addition, certain elements such as iron, nickel, chrome, and zinc can react with platinum catalysts to form compounds or alloys which are not catalytically active. These reactions are termed "catalytic poisoning", and can result in premature replacement of the catalyst. An EAF flue gas may contain a number of these catalytic poisons. In addition, any solid material in the gas stream can form deposits and result in fouling or masking of the catalyst. Masking occurs when solids obstruct the cell openings within the catalyst. Masking occurs when a film forms on the surface of catalyst over time. The film prevents contact between the catalytic surface and the flue gas. Both of these conditions can result in frequent cleaning and/or replacement requirements. Due to the above effective technical applicability constraints, SCR technology has never been applied to EAF operations. The SCR option is considered technically infeasible for applications related to an EAF.

The NSCR system is a post-combustion add-on exhaust gas treatment system. It is often referred to as a "three-way conversion" catalyst since it reduces  $NO_x$ , unburned

hydrocarbons (UBH), and CO simultaneously. In order to operate properly, the combustion process must be stoichiometric or near-stoichiometric which is not maintained in an EAF and varies widely under regular operation. Under stoichiometric conditions, in the presence of the catalyst,  $NO_x$  is reduced by CO, resulting in nitrogen and carbon dioxide. Currently, NSCR systems are limited to rich-burn IC engines with fuel rich ignition system applications. Moreover, potential problems with NSCR systems include catalyst poisoning by oil additives such as phosphorus and zinc (present in galvanized scrap steel charged in the EAF). In view of the above limitations, the NSCR option is considered technically infeasible for this application.

SCONOx-Catalytic Oxidation/Absorption, this is a catalytic oxidation/absorption technology that has been applied for reductions of NO<sub>x</sub>, CO and VOC from an assortment of combustion applications that mostly include – small turbines, boilers and lean burn engines. However, this technology has never been applied for steel mill EAFs. The technology was developed as an alternative to traditional SCR applications which utilize ammonia resulting in additional operational safeguards, unfavorable environmental impacts and excessive costs. The SCONOx technology is not readily adaptable to high temperature applications outside the 300-700 °F range and is susceptible to thermal cycling that will be experienced in the EAF application. This technology has never been proposed nor successfully implemented for similar industry applications. SCONOx is considered technically infeasible for the EAF application.

Shell DeNOx System is a variant of traditional SCR technology which utilizes a high activity dedicated ammonia oxidation catalyst based on a combination of metal oxides. The system is comprised of a catalyst contained in a modular reactor housing where in the presence of ammonia  $NO_x$  in the exhaust gas is converted to nitrogen and water. The catalyst is contained in a low pressure drop lateral flow reactor (LFR) which makes best use of the plot space available. Due to the intrinsically high activity of the catalyst, the technology is suited for NO<sub>x</sub> conversions at lower temperatures with a typical operating range of 250 - 660°F. If the system was placed downstream of the EAF baghouse, it still does not render it completely safe from the prospect of particulate fouling. The catalyst will still be exposed to particulates which can inflict a masking effect impairing the effective control efficiency of the system. Optimum Shell DeNOx operation is predicated by stable gas flow rates, NO<sub>x</sub> concentrations and temperature. The nature of EAF operations do not afford any of these conditions which will significantly impair the effective control efficiency of the Shell DeNOx system. The Shell DeNOx option is considered technically infeasible with unresolved technical issues for the use on controlling NO<sub>x</sub> emission from an EAF.

Exxon's Thermal DeNOx® system is a non-catalytic process for NO<sub>x</sub> reduction. The process involves the injection of gas-phase ammonia (NH<sub>3</sub>) into the exhaust gas stream to react with NO<sub>x</sub>. The temperature of the exhaust gas stream is the primary criterion controlling the reaction. The optimum temperature window for the Thermal DeNOx® process is approximately 1,600-1,900 °F. The above reaction temperature window can be shifted down to approximately 1,300 - 1,500 °F with the introduction of readily

oxidizable hydrogen gas. In addition, the process also requires a minimum of 1.0 second residence time in the desired temperature window for any significant  $NO_x$  reduction. In order for the Thermal DeNOx® system to effectively reduce  $NO_x$  emissions, the exhaust gas stream should have relatively stable gas flow rates; ensuring the required residence time and be within the prescribed temperature range. Therefore, any projected application of the process to EAF operations would be considered a "technology transfer". Thermal deNO<sub>x</sub> technology is considered technically infeasible.

The Nalco Fuel Tech's  $NO_xOUT^{(B)}$  process is very similar in principle to the Thermal DeNOx<sup>(B)</sup> process, except that it involves the injection of a liquid urea into the high temperature combustion zone to promote  $NO_x$  reduction. However, the process still has similar constraints as the Thermal DeNOx<sup>(B)</sup> system. A  $NO_xOUT^{(B)}$  system requires steady gas flows and prescribed residence times, thermal cycling and the ability of the control option to load-follow varying pollutant concentrations. This would make it impossible to continually comply with an hourly emission rate for an EAF application. If the required residence time or other optimum operation parameters are not available, secondary production ammonia will be released directly to the atmosphere. The use of  $NO_xOUT^{(B)}$  technology to control  $NO_x$  emissions from steel mill EAF operations is not known. Therefore, any projected application of the process to the Nucor application would be considered a "technology transfer". With the requirements listed above and the fact that it has not been used on an EAF application, the  $NO_xOUT^{(B)}$  option is considered technically infeasible.

LTO technology is mainly used for industrial boilers and cogeneration gas turbines. The technology is a variant of SNCR technology using ozone. The ozone is injected into the gas stream and the NO<sub>x</sub> in the gas stream is oxidized to nitrogen pentoxide vapor which is absorbed in the scrubber as dilute nitric acid. The nitric acid is then neutralized with caustic (NaOH) in the scrubber water forming sodium nitrate. For optimal performance, the technology requires stable gas flows, lack of thermal cycling, invariant pollutant concentrations and residence times on the order of 1 - 1.5 seconds. In addition, LTO technology requires frequent calibration of analytical instruments which sense the  $NO_x$ concentrations for proper adjustment of ozone injection. Since LTO uses ozone injection, it has a potential for ozone slip which can vary between 5 - 10 ppmv. Also, the technology requires a cooler flue gas of less than 300 °F at the point of ozone injection, otherwise the reactive gas is rendered redundant. The technology is neither applicable nor proven for steel mill EAF applications and attendant limitations render it technically infeasible in its current manifestation. After reviewing the requirements for an LTO control system, the LTO control option is considered technically infeasible for controlling NO<sub>x</sub> from an EAF.

Ranking is not required because only one option is feasible – Oxy-fuel burners

#### **Economic Feasibility:**

Economic feasibility was not performed because all control options are considered technically infeasible except oxy-fuel burners.

# **BACT Selection:**

The only feasible control option for controlling  $NO_x$  emissions from the Nucor EAFs is oxy-fuel burners. BACT for the EAFs at Nucor is natural gas oxy-fuel fired burners and oxygen lances"

#### **Implementation Schedule:**

The EAFs at Nucor Steel are already equipped with oxy fuel burners.

#### Startup/Shutdown Considerations

The EAF and associated equipment are designed to operate on a continuous basis. The operations are in shutdown or startup modes during scheduled maintenance, plant shutdowns and during periods of natural gas or electric curtailments

The emissions for the EAF are limited during startup/shutdown by hour short term limits for  $NO_x$  and/or  $SO_2$  that are monitored by CEMs.

Startup and shutdown operations are regulated by EPA's NESHAP YYYYY which requires procedures to be followed which ensure proper operation of the EAF baghouse during these events. Specific procedures for startup and shutdown have been developed for the EAF and record keeping is completed. These procedures are developed based on design of its operations and best management practices specific to Nucor's operation.

# Pollutant [PM<sub>2.5</sub>]

Particulate emissions from the EAF will be captured by the DEC and a roof exhaust system and ultimately exhausted through a baghouse.

The capture system for exhaust gases from the EAF is a DEC and an overhead roof exhaust system consisting of a canopy hood. The DEC duct locally evacuates the exhaust gases directly from the furnace to the main duct system directed to the EAF baghouse.

The dust collection equipment for the EAF baghouse consists of a reverse-air type multicompartment positive pressure baghouse. Each module currently contains multiple bags, with all necessary bag cleaning mechanisms, gas flow control, and collected material transfer and removal equipment. The design of the multi-compartment EAF baghouse will allow for on-line maintenance and cleaning.

The New Source Performance Standard (NSPS) for particulate matter emissions from an EAF is 0.0052 grains/dscf of total PM. Fabric filtration in baghouses is the predominant control device for EAFs. The  $PM_{2.5}$  emissions are currently controlled by the EAF baghouse. At the time the NSPS was developed, condensables were not considered. More recently, condensables have been identified as a concern, and is now incorporated

into the NSPS limitation, effectively reducing the combined amount that can be emitted.

## **Control Options:**

Scrubbers Baghouses Electrostatic Precipitators Cyclones

## **Technological Feasibility:**

Fabric filtration is the predominant control option for abatement of particulate emissions (PM,  $PM_{10}$ ,  $PM_{2.5}$ ) from an EAF application. Other particulate control options are not considered as effective or technically feasible for an EAF application. Based on a review of the information resources referenced earlier, it was revealed that these control alternatives have not been successfully implemented to reduce particulate emissions from EAFs. Thus, the projected use of any of these technologies would be considered a "technology transfer." Since, only a single control option was ascertained to be technically feasible, no ranking of control alternatives has been provided.

#### **Economic Feasibility:**

Since, only a single control option was ascertained to be technically feasible, an economic feasibility was not performed.

# **BACT Selection:**

A review of the RBLC database revealed that other steel mills have a similar emission limit. None of the steel mills reviewed in this analysis have proposed or successfully implemented any controls besides fabric filtration. The other control options have been shown to be technically infeasible.

Based on a review of similar EAF melt shop applications, the use of a baghouse for controlling  $PM_{2.5}$  emissions and a baghouse emission limit represent BACT for the EAF melt shop application.

# **Implementation Schedule:**

The EAFs at Nucor Steel are already equipped with baghouses.

# Startup/Shutdown Considerations

The EAF and associated equipment are designed to operate on a continuous basis. The operations are in shutdown or startup modes during scheduled maintenance, plant shutdowns and during periods of natural gas or electric curtailments

Startup and shutdown operations are regulated by EPA's NESHAP YYYYY which requires procedures to be followed which ensure proper operation of the EAF baghouse during these events. Specific procedures for startup and shutdown have been developed for the EAF and record keeping is completed. These procedures are developed based on design of its operations and best management practices specific to Nucor's operation.

# Pollutant [VOC]

VOC emissions from the EAF will be intermittent and limited to the brief period during EAF charging when organic compounds such as oil or paint present in the scrap are volatilized. The combustion controls of having a DEC furnace shell evacuation system, with cooling, and a combustion air gap is essentially what all EAF furnaces have, including Nucor Plymouth. A combustion gap is necessary to control CO emissions, and does contribute to incineration of VOC's.

# **Control Options:**

Catalytic or Thermal Oxidation; Degreasing of scrap metal prior to charging in the EAF Scrap management program.

# **Technological Feasibility:**

Based upon a review of the EAF sites, there is no known application of oxidation catalysts to control VOC emissions from an EAF. The optimal working temperature range for VOC oxidation catalysts is approximately 850 - 1,100 °F with a minimum exhaust gas stream temperature of 500 °F for minimally acceptable control. Exhaust gases from the EAF will undergo rapid cooling as they are ducted from the furnace. Thus, the temperature will be far below the minimum 500 °F threshold for effective operation of CO oxidation catalysts. Additionally, the particulate loading in the exhaust gas stream is anticipated to be too high for efficient operation of an oxidation catalyst. Masking effects such as plugging and coating of the catalyst surface would almost certainly result in impractical maintenance requirements, and would significantly degrade the performance of the catalyst. Consequently, this control alternative is considered technically infeasible for this application.

Degreasing of scrap metal prior to charging in the EAF is impractical. The amount of pollution generated by degreasing scrap would be greater than the amount of pollution generated by melting the scrap. There would be thousands of gallons of solvent required to degrease the large amount of scrap used annually in the EAFs. Therefore, this control option is considered technically infeasible.

The mill utilizes a scrap management program to eliminate the purchase of scrap steel that is heavily oiled. The scrap is inspected before it is received. An EPA regulation NESHAP YYYYY is applicable to mini mills and prohibits the receipt of free oils in scrap steel charged to EAFs. This regulation applies to Nucor, including inspection and

recordkeeping requirements.

## **Economic Feasibility:**

Since only a single control option was ascertained to be technically feasible, an economic feasibility was not performed. The technically feasible control has already been implemented at Nucor.

## **BACT Selection:**

EAF steel mills reviewed for this BACT analysis have not successfully implemented any controls besides scrap management. Scrap management constitutes BACT for the Nucor Steel EAF operations.

#### **Implementation Schedule:**

The scrap management plan for the EAFs at Nucor Steel is already being implemented.

#### Startup/Shutdown Considerations

The EAF and associated equipment are designed to operate on a continuous basis. The operations are in shutdown or startup modes during scheduled maintenance, plant shutdowns and during periods of natural gas or electric curtailments

Startup and shutdown operations are regulated by EPA's NESHAP YYYYY. Specific procedures for startup and shutdown have been developed for the EAF and record keeping is completed. These procedures are developed based on design of its operations and best management practices specific to Nucor's operation.

#### Pollutant [SO<sub>2</sub>]

 $SO_2$  emissions from the EAF come from the sulfur content of the raw materials that are charged in the EAF, primarily sulfur contained in the steel itself. The sulfur content of oil on the scrap steel also contributes to the  $SO_2$  emissions but to a lesser extent.

#### **Control Options:**

Scrap Management Lower-Sulfur Charge Substitution Flue Gas Desulfurization (FGD) options: Wet Scrubbing Spray Dryer Absorption (SDA) Dry Sorbent Injection (DSI)

# **Technological Feasibility:**

Lower-Sulfur Charge Substitution.

Charge substitution with lower sulfur bearing raw materials is not practical due to inconsistent availability of the raw materials. Changing the sulfur content of charge materials and carbon is infeasible.

Flue Gas Desulfurization -- FGD systems currently in use for  $SO_2$  abatement can be classified as wet and dry systems. FGD system control technologies have not been successfully implemented for controlling  $SO_2$  emissions from EAFs.

Wet scrubbers are regenerative processes which are designed to maximize contact between the exhaust gas and an absorbing liquid. Wet scrubbing has never been successfully implemented for EAF steel mill applications. The wet scrubber option is considered technically infeasible for the Nucor EAF operation.

Dry scrubbing or spray-dryer absorption (SDA) is an alternative to wet scrubbing. As in wet scrubbing, the gas-phase  $SO_2$  is removed by intimate contact with a suitable absorbing solution. SDA has never been successfully implemented for similar steel mill applications. This makes SDA technically infeasible for this application.

Dry Sorbent Injection (DSI) involves the injection of dry powders into either the furnace or post-furnace region of utility-sized boilers. DSI has never been successfully implemented for EAF steel mill applications. The DSI dry scrubbing option is considered technically infeasible for the EAF steel mill operation.

# **Economic Feasibility:**

Since, only a single control option was ascertained to be technically feasible, an economic feasibility was not performed. The technically feasible control has already been implemented at Nucor.

#### **BACT Selection:**

BACT for controlling EAF  $SO_2$  emissions is a scrap management program with a limitation on the  $SO_2$  emissions monitored through the use of CEMs.

#### **Implementation Schedule:**

The scrap management plan for the EAFs at Nucor Steel is already being implemented.

#### Startup/Shutdown Considerations

The EAF and associated equipment are designed to operate on a continuous basis. The operations are in shutdown or startup modes during scheduled maintenance, plant shutdowns and during periods of natural gas or electric curtailments

The emissions for the EAF are limited during startup/shutdown by hour short term limits

for  $NO_x$  and/or  $SO_2$  that are monitored by CEMs.

Startup and shutdown operations are regulated by EPA's NESHAP YYYYY. Specific procedures for startup and shutdown have been developed for the EAF and record keeping is completed. These procedures are developed based on design of its operations and best management practices specific to Nucor's operation.

## 2.1.2 Caster and Caster Steam Vent emission

#### **Description:**

The caster forms a solid continuous slab as molten steel passes through a water-cooled mold. Fugitive PM emissions may be generated during the casting of hot metal; however, the emissions are evacuated to the EAF melt shop baghouse. A small amount of fugitive PM emissions is included with the emissions from the melt shop building.

The caster steam vent is a forced air evacuation of the caster spray chamber. The caster spray chamber is a large box where billets exit the caster molds. In the mold, the surface of the steel is cooled enough to be a solid, while liquid steel remaining inside the billet as it exits. In the spray chamber, water is sprayed on the billets to further cool them so that the liquid steel inside the billet is cooled enough to also solidify. When the billet reaches the torch tables, the entire billet is a solid so that it may be cut to length.

While the purpose of the spray chamber is for cooling of billets, it is essentially a wet scrubber. The nozzles for the water spray make cone shaped patterns of water droplets to evenly distribute for needed cooling. These sprays, through contact with the billet, remove particulate (oxidizing steel or scale) that forms on the surface of the billets at their high temperatures. Further, the droplets present in the spray chamber box capture airborne particulates in the box. The water from the spray system falling through the chamber carry this particulate into the circulating water system, where the particulates are removed first through settling basins then through the use of sand filters.

The spray chamber functions as a wet scrubber. Wet scrubbers are an emission control device. Therefore the caster steam vent is exhaust from an emission control device.

#### Pollutant [PM<sub>2.5</sub>]

#### **Control Options:**

Baghouse

#### **Technological Feasibility:**

Further add-on emission control with a fabric filter for the caster vent emissions cannot be achieved. Very high temperatures exist near hot billets so that some water exists as a gas at those areas, but much of the temperatures within the chamber is below the boiling point of water, as is needed to achieve cooling. The chamber is evacuated by fans and the temperature of the exhaust is below water boiling temperature causing any steam to condense as a fine water droplet. The exhaust from the caster steam vent contains condensed water vapor. A noticeable condensed water vapor plume exists much of the time (winter and nighttime year round for example). Fabric filters would immediately plug when moisture is present. Further add on control is not feasible.

## **Economic Feasibility:**

A baghouse is already used for the caster emissions that are vented to the melt shop.

Additional controls are technically infeasible for the caster vent emissions. Therefore, an economic feasibility was not performed.

#### **BACT Selection:**

The use of a baghouse to control emissions from the caster operations that are vented to the EAF melt shop is BACT.

#### **Implementation Schedule:**

Baghouse control is already in place.

#### **Startup/Shutdown Considerations**

The EAF and associated equipment are designed to operate on a continuous basis. The operations are in shutdown or startup modes during scheduled maintenance, plant shutdowns and during periods of natural gas or electric curtailments

Startup and shutdown operations are regulated by EPA's NESHAP YYYYY. Specific procedures for startup and shutdown have been developed for the EAF and record keeping is completed. These procedures are developed based on design of its operations and best management practices specific to Nucor's operation.

# 2.1.3 Caster Area Roof Emissions

#### **Description:**

The caster emissions include emissions from the tundish and ladle preheating, skull lancing, ladle stirring, and other caster operations. The preheating of the ladle and tundish is done with natural gas fired burners. The skull lancing is an operation that removes excess steel from the tundish and ladles through the use of cutting torches. This process takes place inside the caster building and some of the emissions are assumed to escape the building. This source is not in continuous operation.

The original Moffit brand ventilator originally serviced the caster area for the purposes of

reducing heat loads in the area of the west side of the meltshop. This ventilator also allowed some smoke to exit directly above the caster, until a modification was made to duct both the heat and smoke to the EAF baghouse. The old ventilator serves as both a high-temperature-air reservoir being the highest point as well as a large collection duct for the evacuation system that finally discharges through the stack of the EAF baghouse.

## Pollutant [PM<sub>2.5</sub>]

#### **Control Options:**

Control of fugitive PM<sub>2.5</sub> emissions Scrubbers, Baghouses Electrostatic Precipitators Cyclones

#### **Technological Feasibility:**

As outlined in the EAF BACT analysis, additional controls are technically infeasible for the EAF baghouse, which the caster roof emissions are vented to.

#### **Economic Feasibility:**

As outlined in the EAF BACT analysis, additional controls are technically infeasible for the EAF baghouse, which the caster roof emissions are vented to. Therefore, an economic feasibility was not performed.

#### **BACT Selection:**

Use of the meltshop evacuation system which vents to the EAF baghouse is BACT.

#### **Implementation Schedule:**

Baghouse control is already in place.

#### Startup/Shutdown Considerations

The EAF and associated equipment are designed to operate on a continuous basis. The operations are in shutdown or startup modes during scheduled maintenance, plant shutdowns and during periods of natural gas or electric curtailments.

Startup and shutdown operations are regulated by EPA's NESHAP YYYYY. Specific procedures for startup and shutdown have been developed for the EAF and record keeping is completed. These procedures are developed based on design of its operations and best management practices specific to Nucor's operation.
## **Pollutant [NO<sub>x</sub>, SO<sub>2</sub>, and VOC]**

## **Control Options:**

Combustion emissions from preheating Diesel Natural gas

## **Technological Feasibility:**

All fuels for ladle preheating are technically feasible.

## **Economic Feasibility:**

Natural gas is already in use for the preheating operations. Therefore, it is more cost effective to use natural gas as a fuel for preheating.

## **BACT Selection:**

The use of natural gas for preheating is BACT as use of other fuels represent higher emission rates.

### **Implementation Schedule:**

Controls are already in place.

## Startup/Shutdown Considerations

The EAF and associated equipment are designed to operate on a continuous basis. The operations are in shutdown or startup modes during scheduled maintenance, plant shutdowns and during periods of natural gas or electric curtailments.

Startup and shutdown operations are regulated by EPA's NESHAP YYYYY. Specific procedures for startup and shutdown have been developed for the EAF and record keeping is completed. These procedures are developed based on design of its operations and best management practices specific to Nucor's operation.

## 2.1.4 Billet Reheat Furnaces

### **Description:**

After cooling, the slab, bloom, or billet must be reheated and "softened" for the next forming operation (such as rolling, forging, or extrusion) by raising its temperature to a range of 1,600 - 2,500°F. This process is performed in a reheat furnace, a steel structure protected internally by refractory materials. There are many different reheat furnace

designs, a walking beam furnace, a walking hearth furnace, a rotary hearth furnace, a pusher-type furnace, and a batch-type furnace. Each of these furnace types varies in length, capacity, width, temperature profile, and refractory design, depending upon the configuration and temperature requirements of the product being heat-treated. Nucor utilizes two furnaces, one is a pusher-type furnace and the other is a walking beam type furnace.

Nucor has two reheat furnaces. Reheat furnace No. 1 is rated at a maximum of 160 MMBtu/hr; limited to 1,320,000,000 ft<sup>3</sup> natural gas/year and has a NO<sub>x</sub> emission rate of 0.09375 lb/MMBtu. Reheat furnace No. 2 is rated at a maximum of 134 MMBtu/hr; limited to 980,000,000 ft<sup>3</sup> natural gas /year and has a NO<sub>x</sub> emission rate of 0.0597 lb/MMBtu.

## Pollutant [NO<sub>x</sub>]

### **Control Options:**

Low NO<sub>x</sub> Burners Ultra-Low NO<sub>x</sub> Burners Furnace Replacement

### **Technical Fesibility:**

The amount of NO<sub>x</sub> emissions from reheat furnaces is dependent on the overall design of the furnace itself. Reheat furnaces can be over fired, side fired, and end fired, and usually consist of a combination of burner placements. Both the type of burner design and the general size of the furnace itself are factors in determining what can be achieved, with other factors considered. Not all  $NO_x$  in a furnace is generated at the burner itself. The high temperature environment of the furnace, the presence of tramp air introduced through exits and entrances, as well as excess air for burner combustion, all contribute to  $NO_x$  formation.  $NO_x$  is formed in most areas of the furnace. Billets in the furnace are typically heated to near 2,000 °F for an appropriate rolling temperature, requiring the atmosphere in the furnace to be at a much hotter temperature. NO<sub>x</sub> begins to form at temperatures of 1,800  $^{\circ}$ F. Because of this, even if burners that generate no NO<sub>x</sub> could be used (ex. electric heating), NO<sub>x</sub> emissions would still exist because of the conversion of nitrogen in the air at high temperatures. Because of the final temperature of the product needed, the consideration of NO<sub>x</sub> emissions (lb/mmBtu or ppmv) is considerably different than a home water heater, for example. Reheat furnaces have NO<sub>x</sub> emissions associated with the furnace, not specifically the burners used.

One major factor that must be considered is burner impingement on the product being heated. Because of quality issues and production issues, burner impingement must be avoided. Low  $NO_x$  burners achieve high peak flame temperatures through either staged air or staged fuel combustion, resulting in a longer flame with lower peak temperatures with nearly the same total heat provided. Because impingement must be avoided, and a longer flame is associated with Low  $NO_x$  burners, greater space is required between the

burner and the product. Greater space means a larger furnace with more free space. A larger furnace means less efficiency, because a greater space exists and heat is lost through the walls of the furnace. It can be compensated for with greater fuel consumption, but increasing the volume of gas consumed only for being able to claim less NO<sub>x</sub> per unit volume can be somewhat counterproductive to the overall goal

Recently designed furnaces can be engineered for lower  $NO_x$  emission burners to reduce  $NO_x$  by considering burner placement to avoid impingement even with a longer flame. The burners can be placed preferentially in the sides to avoid impingement rather than the top while minimizing free space with efficiency consideration in mind. However, to achieve the necessary even heating, it is often found necessary to place burners in areas where a longer flame cannot be used. Retrofitting older designed furnaces that utilized standard burners is considerably more difficult. Being able to install different Low  $NO_x$  designed burners, and their associated burner block in locations where a standard burner was previously installed can be a retrofit that may not be able to be achieved, even if the use of the Low  $NO_x$  burner at that location wouldn't cause impingement issues.

In addition, newer furnaces are likely to be "Pusher" type furnaces, with a solid hearth where billets are skidded across the bottom solid hearth from the entry to the exit. Older furnaces are likely to be walking hearth or walking beam furnaces where portions of the bottom of the furnace first raise, then move forward, then lower to the hearth again. to "walk" the billets through the furnace. These walking furnaces tend to be less efficient because gaps in the hearth are necessary, which lose heat as well as allow additional tramp air to enter the furnace, contributing to further NOx emissions.

For these reasons, a retrofit furnace with the intent of lower  $NO_x$  emissions, vs. a new furnace can be expected to have different  $NO_x$  performance characteristics.

Nucor has a newer pusher type furnace in one mill designed for reduced  $NO_x$  burners. This is Reheat Furnace #2. This furnace was installed for the purpose of lowering  $NO_x$  emissions by replacing a furnace that had a higher  $NO_x$  emission rate. The permitted  $NO_x$  emission rate of this furnace is a lbs/hr rate based on 0.07 lb/mmBtu.

The second reheat furnace utilized is a walking type furnace which has been modified to lower  $NO_x$  emissions. This is Reheat Furnace #1. The modification included installing a new raised roof to accommodate longer flame and differently designed burners so that impingement issues would not occur. As a retrofit of an older furnace, this furnace is permitted at a  $NO_x$  lbs/hr emission rate that is based on a  $NO_x$  rate of 0.09 lb/mmBtu.

The most common reference document for emission permitting emission calculations, EPA's AP-42, quantify emission rate Low NOx burners (as well as uncontrolled and FGR controlled) for Large Wall Fired Boilers greater than 100 mmBTU. This factor is most representative of reheat furnaces because both of Nucor's reheat furnaces are greater than 100 mmBTU/hr. It should be noted here, as was discussed in the section above, there are other types of external combustion sources described in this document with much different emission rates also described as resulting from the use of Low NOx

burners. This difference in emissions between equipment (of smaller size) with the same technology demonstrates that Low NOx burners achieve vastly different emission rates utilizing Low NOx burners. For large units, AP-42, Table 1.4-1, describes Low NOx burners as achieving the following:

Low NOx Burners	140 lb/mmscf.
Converted to lb/mmBtu	0.137
Approximate PPMV Conversion	113 ppmv

Nucor's permitted NOx emission rates (lbs/hr) are based on the following performance  $NO_x$  emission rates with burners designed for reduced  $NO_x$ .

Reheat Furnace 1	
0.09 lb/mmBtu	
Converted to lb/MMscf	91.8
Converted to ppmv	74
Reheat Furnace 2	
0.07 lb/mmBtu	
Converted to lb/mmscf	71.4
Converted to ppmv	58

The permitted NOx emission rate for Reheat Furnace 1, and Reheat Furnace 2, is 65% and 51%, respectively, of the emissions defined by that achieved by Low NOx burners. The permitted rates for these furnaces should be considered "Ultra Low NOx" demonstrated by this analysis alone.

EPA's RACT/BACT/LAER clearinghouse includes a category of steel manufacturing. Three reheat furnaces could be identified in this category. One identified a reheat furnace installation of <u>Ultra</u> Low NOx burners with a permitted rate of 0.07 lb/mmscf. Likely the correct unit should be lb/mmBtu for this identified unit. A second installation also referenced <u>Ultra</u> Low NOx burners at 0.07 lb/mmBtu. The third and last comparable installation in this search found an installation with <u>Ultra</u> Low NOx Burners with a rate of 0.10 lb/mmBTU.

Both of Nucor's reheat furnaces are within the range of what is a defined emission rate of <u>Ultra</u> Low NOx burners for reheat furnaces in the RBLC clearinghouse, including the

retrofit furnace which can be expected to have higher emissions. Nucor's furnaces are already permitted to not exceed emission rates of this performance standard.

In 2007 Nucor replaced Reheat Furnace #2, a pusher type reheat furnace, to achieve the  $NO_x$  emission rate of 0.07 lb/mmBTU. Reheat Furnace #1, a walking beam type reheat furnace, achieved a 30% reduction in  $NO_x$  emissions when it was modified in 2007 and the current emission rate is 0.09 lb/mmbtu. It would need to be replaced in order to achieve the same emission rate as Reheat Furnace #2 while maintaining the current production capacity. As discussed above, if Reheat Furnace #1 was replaced it would need to be a larger furnace.

Currently Reheat Furnace #1 has an actual  $NO_x$  emission rate of 50 tpy. If the emission rate was reduced from 0.09 lb/mmBTU to 0.07 lb/mmBTU, the actual emissions would be 39 tpy. This is a reduction of 11 tpy.

A review of technologies applied to other reheat furnaces found that in all cases, reduced  $NO_x$  burners are utilized to meet BACT. Other technologies are not used to achieve the lowest  $NO_x$  emission rates.

It is technically feasible to replace reheat Furnace #1.

## **Economic Feasibility:**

Additional controls have not been applied to reheat furnaces. Therefore, an economic feasibility was not performed on additional controls.

## **BACT Selection:**

Ultra-Low  $NO_x$  burners are BACT. Reheat furnace #1 is an existing original reheat furnace and it has been retrofitted with new burners with comparable emissions defined as Ultra-Low  $NO_x$  in the RACT/BACT/LAER Clearinghouse. It meets the emission limit of 0.09 lb  $NO_x$ /MMBtu

Reheat furnace #2 is a replacement reheat furnace and it has new reduced NO<sub>x</sub> burners meeting emission rates defined as that achieved by Ultra-Low NO<sub>x</sub> Burners in the RACT/BACT/LAER Clearinghouse. It meets the emission limit of 0.07 lb NO<sub>x</sub>/MMBtu.

### **Implementation Schedule:**

The reheat furnaces at Nucor Steel are already retrofitted or designed to utilize reduced NO<sub>x</sub> burners to minimize NO<sub>x</sub> emissions.

### **Startup/Shutdown Considerations**

The Reheat furnaces #1 and #2 are designed to operate on a continuous basis. The operations are in shutdown or startup modes (primarily idle modes) during scheduled

maintenance, plant shutdowns and during periods of natural gas curtailments

These furnaces are natural gas fired and operated using automatic computer control systems that regulate proper combustion with appropriate air fuel ratios. Startup and shutdown emissions are not a concern with this type of equipment.

## Pollutant [SO<sub>2</sub>, VOC, and PM<sub>2.5</sub>]

## **Control Options:**

Use of pipeline quality natural gas Good combustion practices Good design and proper operation

## **Technological Feasibility:**

All control technologies are technically feasible

## **Economic Feasibility:**

An economic feasibility analysis was not performed for these activities as they are already being performed.

### **BACT Selection:**

Use of pipeline quality natural gas, good combustion practices, good design and proper operation of the reheat furnaces constitute BACT for this emission source.

### **Implementation Schedule:**

The reheat furnaces at Nucor Steel already use pipeline quality natural gas, good combustion practices, and have been designed for lower emissions. They conduct proper operation of the reheat furnaces.

### **Startup/Shutdown Considerations**

The Reheat furnaces #1 and #2 are designed to operate on a continuous basis. The operations are in shutdown or startup modes (primarily idle modes) during scheduled maintenance, plant shutdowns and during periods of natural gas curtailments

These furnaces are natural gas fired and operated using automatic computer control systems that regulate proper combustion with appropriate air fuel ratios. Startup and shutdown emissions are not a concern with this type of equipment.

## 2.1.5 Natural Gas-Fired Preheaters and Dryers

## **Description:**

Nucor's natural gas fired preheaters and dryers are located and exhausted in the melt shop building. Emissions from these small preheaters and dryers primarily result from combustion by-product of the fuel.

## Pollutants [NO<sub>X</sub>, SO<sub>2</sub>, VOC, and PM<sub>2.5</sub>]

These emission sources exhaust through the EAF baghouse. Nucor's EAF emission rates are already established as BACT. The emissions of the Preheaters and Dryers are added to the EAF emissions and included in the compliance limit for the EAF baghouse. Based on a review of similar natural gas fired applications, the proposed emission limit for the EAF baghouse, including the Preheaters and Dryers, represents BACT for the burners and dryers.

## **Control Options:**

Use of pipeline quality natural gas Good combustion practices Good design and proper operation

### **Technological Feasibility:**

Due to the relatively small emissions from natural gas combustion, the application of add-on controls is considered infeasible. A review of steel mills did not indicate the application of add-on control alternatives for  $NO_x$  control from similar sized natural gas-fired combustion equipment in other industries.

### **Economic Feasibility:**

An economic feasibility analysis was not performed for these activities as they are already being performed.

### **BACT Selection:**

Use of pipeline quality natural gas, good combustion practices, good design and proper operation of the reheat furnaces constitute BACT for this emission source.

### **Implementation Schedule:**

The preheaters and dryers already use pipeline quality natural gas, good combustion practices, and have been designed for lower emissions. They conduct proper operation of the reheat furnaces.

## **Startup/Shutdown Considerations**

There are no startup/shutdown operations to be considered for these sources.

## 2.1.6 Plant Wide Torches and Lancing

### **Description:**

Nucor conducts various torching and lancing throughout the mill utilizing either acetylene or natural gas as a fuel.

Lancing occurs on site in the EAF process and the Caster process. In the EAF as melting progresses, oxygen lancing is performed, and in the caster building, skull lancing is performed to remove excess steel from the tundish and ladles.

## **Pollutant** [NO<sub>x</sub>, SO<sub>2</sub>, and VOC]

 $NO_x$ ,  $SO_2$  and emissions from these torches primarily result from combustion by-product of the fuel.

### **Control Options:**

A review of the similar sources did not indicate the application of add-on control alternatives for  $NO_x$ ,  $SO_2$  and VOCs emissions control for torches.

### **Technological Feasibility:**

Due to the relatively small emissions from combustion, the application of add-on controls is considered infeasible.

### **Economic Feasibility:**

Additional controls are technically infeasible for the torches and lances. Therefore, an economic feasibility was not performed. The technically feasible control has already been implemented at Nucor.

### **BACT Selection:**

Proper operation of the torches and lances constitute BACT for this emission source.

### **Implementation Schedule:**

Proper operations are already in place.

### **Startup/Shutdown Considerations**

There are no startup/shutdown operations to be considered for these sources.

## Pollutant [PM<sub>2,5</sub>]

Particulate matter emissions from these torches primarily result from carryover of noncombustible trace constituents in the fuel and particulate from the burning of steel. Based on a review of the previously listed information, no other control technologies for particulate abatement have been successfully implemented for small torches.

Torching operations are conducted plant wide both within large buildings and outdoors. Mostly the torching operations are intermittent at various locations where capturing these emissions is not practical. Torches utilized at the caster at a permanent location are located below a ventilation system where much of the emissions are captured and passed through the EAF baghouse which controls particulate emissions.

## **Control Options:**

A review of the similar sources did not indicate the application of add-on control alternatives for  $PM_{2.5}$  emissions from torches and lances.

## **Technological Feasibility:**

Due to the relatively small emissions from combustion, the application of add-on controls is considered infeasible.

## **Economic Feasibility:**

Additional controls are technically infeasible for the torches and lances. Therefore, an economic feasibility was not performed.

## **BACT Selection:**

Proper operation of the torches and lances constitute BACT for this emission source.

### **Implementation Schedule:**

Proper operations are already in place.

### Startup/Shutdown Considerations

There are no startup/shutdown operations to be considered for these sources.

## 2.1.7 Rolling Mill

### **Description:**

Fumes in roll mill are associated with the hot steel rolling process. The steel is sprayed with water to reduce its temperature and minimize  $PM_{2.5}$  emissions. A high level of control is assumed due to continuous water spray and because the operation is contained within a building. Because oils are lost to the water and the water contacts hot steel, some VOC emissions result from the vaporization of the heavy oils.

The two roll mills, packaging, warehousing, and shipping cover a single roof in an open building of approximately 13 acres. The height averages approximately 30 feet. Some emissions occur from rolling operations. And some is from mobile equipment that is operated within the building. To meet ventilation requirements for safety, the roll mills have a ridge type vent over the rolling operations. The rest of the building is ventilated through open doorways.

# Pollutant [PM<sub>2.5</sub> and VOC]

PM<sub>2.5</sub> and VOC emissions from the roll mills are from vapors and vaporization of oils.

## **Control Options:**

Baghouse Scrubber

## **Technological Feasibility:**

To manage heat loads for proper working conditions, exposures to fumes and dust, etc. it is estimated that the proper air change rate of at least 50 air changes per hour. So, a baghouse would need to be sized for approximately 20,000,000 acfm. Because of the large area of the emission source within the building and the large volume of air to be evacuated, it is not practical to capture particulate and VOC emissions from the rolling operations.

## **Economic Feasibility:**

Additional controls are technically infeasible for the roll mills. Therefore, an economic feasibility was not performed.

## **BACT Selection:**

The best operational practices currently implemented and the current designs of the processes also represent the most stringent measure for the roll mills.

## **Implementation Schedule:**

Proper operations are already in place.

## Startup/Shutdown Considerations

There are no startup/shutdown operations to be considered for these sources.

## 2.1.8 Material Handling and Stockpiles

## **Description:**

Scrap Steel handling can cause emissions of  $PM_{2.5}$  resulting from dirt and rust on the steel. Existing BACT controls are in place that consists of the following: direct from railcar; handled from covered truck dump; handled to and from stockpiles; and handled from uncovered truck dump.

Material handling consists of the following: Scrap steel handling; alloy/lime stockpiles (3-sided roofed bin); alloy handling railcar unloading NE (Water sprays); alloy handling railcar unloading melt shop belly dump (within building); small slag storage pile for truck bed lining (controlled by size); slag transfer to truck transfer below grade; and belly dump lime unloading at melt shop.

## Pollutant [PM<sub>2.5</sub>]

Stockpile or Handling Point	Potential PM <sub>2.5</sub> Emissions (tpy)		
Scrap Stockpiles	0.11		
Alloy Stockpiles	0.005		
Lime Stockpiles	0.005		
Alloy Railcar Unloading (2)	0.005		
Slag Stockpiles	0.005		
Slag Loading to Truck	0.01		
Lime Unloading	0.02		
EAF Dust Handling	0.005		

## **Control Options:**

Buildings enclosing the stockpiles equipped with a baghouse Water sprays

## Scrap Steel Stockpiles

The scrap stock piles are the primary raw material for the product of Nucor. Scrap steel stockpiles are used to balance the non-steady delivery of scrap steel to feed the 24-hour operation of the meltshop. The area covered by scrap steel is about 15 acres, in individual stockpiles. These stockpiles are loaded and unloaded with large dump trucks, or by a crawler crane. Open ended buildings for rail access, truck access, and crane

access would be needed, thereby lowering the overall effectiveness of reducing dirt, dust and rust from accumulating. Given that the building or buildings would need to be 40 to 50 feet tall, cover 15 acres, and be open ended it can be concluded that utilizing buildings for scrap steel stockpiling would be infeasible because of the ineffectiveness of an open building for control of PM<sub>2.5</sub> emissions.

The majority of scrap processed by Nucor is not stockpiled but rather loaded directly to charge buckets from railcars, or dumped in a below grade pit. Further, emission controls are in place with water misting sprays utilized in the truck dump pit, and water soaking/spraying of scrap is completed for open stockpiles as necessary to meet the more stringent opacity regulations for fugitive emissions in the nonattainment area. These controls are already in place.

### Slag Loading to a Truck

Slag is retrieved from within the meltshop building with a loader. The meltshop building is evacuated to the EAF baghouse, and the slag is at a very high temperature. The buoyant particulate emissions resulting from picking up the slag, do in part rise through openings in the meltshop building slag pit area to the EAF baghouse hood, which is directly above the furnaces/slag pit. The loader backs out of doorways in the meltshop building slag pit area to empty the bucket into a truck that is located below grade. The fact that the truck loading portion of the operation is below grade greatly minimizes emissions because of the minimized exposure to ambient winds. Slag loading emissions are already substantially controlled.

Slag that is processed outside is handled as an orange-hot material with specialty equipped loaders and large mine haul trucks. Enclosing this operation in a building would require large volumes of air to be evacuated through a baghouse to manage high heat loads that would exist. Adding a building with a baghouse to the outdoor portion of handling slag is not feasible.

### Lime Unloading

Lime unloading is completed in a building which is an extension of the meltshop building. The meltshop building is evacuated to the EAF baghouse. These emissions are substantially controlled in this manner. Further, lime is received in either belly dump hopper railcars or trucks where the unloading process is to unload into a below-grade pit in the building. The lime is removed from the pit by an enclosed auger system. Emissions escaping to the atmosphere from normal lime delivery is minimal.

Infrequently, excess lime may be received where space is not available in the storage silos. This lime is placed on concrete surfaces with the belly dump trucks by opening the gates and driving forward so that a string of lime can be deposited. This method of unloading has very little emissions. The concrete surface is adjacent to the stockpile of lime that is enclosed in a roofed, three sided, storage bunker. Emissions from the storage bunker stockpile are greatly reduced because of the minimal exposure to wind. The

stockpile is loaded by moving the placed lime to the storage pile with a loader.

The majority of lime material handling emissions are controlled by a baghouse. Stockpile and associated handling emissions are managed in a manner where emissions are minimized and an added building with a baghouse is not warranted.

## **Technological Feasibility:**

All controls are technically feasible.

## **Economic Feasibility:**

The best operational practices currently implemented and the current designs of the processes also represent the most stringent control for the material handling and stockpiles. Therefore, an economic feasibility was not performed.

## **BACT Selection:**

Unloading Scrap Steel

Processing a majority of scrap steel as it is unloaded, with backup piles to facilitate the continued EAF operation, is the process utilized by Nucor.

## Furnace Slag Unloading

Emptying the furnace of slag is conducted inside the meltshop building with the meltshop being exhausted to the EAF baghouse.

Unloading of Lime

Unloading of lime in a building with the air being exhausted to the EAF baghouse and placing excess lime in storage bunker.

## **Implementation Schedule:**

Proper operations and controls are already in place.

## Startup/Shutdown Considerations

There are no startup/shutdown operations to be considered for these sources.

## 2.1.9 Paved/Unpaved Roads

### **Description:**

The mill has paved and unpaved roads for the transportation of raw materials and slag, in addition to other miscellaneous vehicle travel. Nucor reduces PM2.5 emissions associated with vehicular traffic on paved roadways by periodically sweeping or water flushing. Permanent, heavy use, roads have been paved. 97% of the vehicle miles

traveled at the plant are on paved roads.

The  $PM_{2.5}$  emissions from vehicular traffic on unpaved roadways is reduced by water spray and/or chemical treatment .

## Pollutant [PM<sub>2.5</sub>]

## **Control Options:**

Paved Roads – Sweeping or water spray Unpaved roads – Paving, water spray and/or chemical treatment

## **Technological Feasibility:**

Unpaved roads that are not suitable for paving are the roads that have scrap steel delivery trucks traveling on the same surfaces that heavy tracked crawler cranes travel. Paved surfaces would immediately be torn up by the tracked equipment on these surfaces. Areas where both scrap steel and finished steel are stored frequently change location making paving infeasible.

## **Economic Feasibility:**

All controls are currently being implemented. Therefore, an economic feasibility was not performed.

## **BACT Selection:**

All roads that are not used by heavy equipment, are currently paved, which is considered BACT for fugitive  $PM_{2.5}$  emissions from haul roads.

Using chemical treatment and water sprays on unpaved roads.

### **Implementation Schedule:**

Proper operations and controls are already in place.

### **Startup/Shutdown Considerations**

There are no startup/shutdown operations to be considered for these sources.

## 2.1.10 Cooling Towers

### **Description:**

Nucor has the following cooling tower installations: roll mill contact (8,000 gpm); roll mill and melt shop non contact (4,600 gpm); DEC (10,000 gpm); and the caster system

(4,000 gpm). The cooling towers are equipped with drift mist eliminators that have a drift rate of 0.0006 percent, except for the DEC system which has a drift rate of 0.001 percent. The maximum PM emissions associated with the towers are 1.57 tpy and assumed all  $PM_{2.5}$ . PM emissions were calculated using the factor of 0.16 presented in the technical paper "Calculating Realistic  $PM_{10}$  Emissions from Cooling Towers" (Reisman and Frisbie).

## **Control Options:**

## PM<sub>2.5</sub> Emissions

 $PM_{2.5}$  emissions are generated as water evaporates from a cooling tower and small droplets of water become entrained in the air stream and are carried out as drift droplets. The drift droplets will often contain impurities from the water flowing through the system, so they are considered a type of emission (USEPA, 2015). These impurities are often from water treatment additives, such as anti-fouling or anti-corrosion additives, or from direct contact between the cooling water and the process fluid (Brady et al., 1998).

## **RBLC** and Technical Documents

The following control technologies were identified as available options for PM2.5 emissions from cooling towers:

- Use of dry cooling (no water circulation) heat exchanger units
- High efficiency drift eliminators
- Limitations on TDS in the circulating water

## Dry Cooling Towers

Dry cooling towers use fans to move dry ambient air through the towers and cool the process stream. Because these towers do not rely on the evaporation of water for heat transfer, they do not generate drift emissions (Baker et al., 2001).

## Drift Eliminators

High efficiency drift eliminators remove droplets before the air is discharged to the atmosphere. Drift eliminators are rated by the percentage of emissions from the cooling tower water circulation rate. The drift rates in the RBLC database range between 0.0005% and 0.02%; the majority of drift rates reported are under 0.001%.

## Limitations on TDS in Circulating Water

Dissolved solids in the circulating water increase in concentrations as the circulating water evaporates (USEPA, 2015). TDS can also occur as a result of the addition of anticorrosion or anti-biocide additives. A filtration system can be used to reduce TDS concentrations in circulating water (Reisman & Frisbie, 2002). Monitoring the TDS content in circulation water is an effective approach to ensure that excess emissions are not generated as a result of high TDS levels in circulation water. The TDS concentration limitations in the RBLC database range between 1,000 mg/L and 6,009 mg/L.

#### **VOC Emissions**

VOC emissions are caused when a VOC-containing process stream contaminates circulation water due to a leak in the system or if the circulation water is treated with VOC-containing material (TCEQ, 2003). VOC emissions from cooling towers are more likely to occur in petroleum refineries or chemical manufacturing

### **RBLC** and Technical Documents

Identifying leaks by routinely monitoring VOC concentrations in circulation water was the only control technology identified as an available option for VOC control from cooling towers.

Elevated VOC concentrations can be an indication of leaks in the system. By routinely monitoring VOC concentrations in circulation water, leaks can be identified and repaired. The El Paso Method is commonly used to monitor VOC concentrations in circulation water (TCEQ, 2003). TCEQ established a VOC concentration of 0.08 ppmw for identifying a leak in the system. The RBLC database identified a VOC limit of 0.05 ppm.

## **BACT Selection:**

Evaluation of Findings & Control Selection:

The cooling towers operating at major sources in the  $PM_{2.5}$  nonattainment area are equipped with drift eliminators with loss rates ranging from 0.2% to 0.0005%. Routine monitoring of TDS concentrations in circulating water is a common operating practice for these cooling towers.

DAQ has determined that BACT for PM2.5 emissions from cooling towers is drift eliminators combined with TDS limitations. A specific drift eliminator efficiency and TDS limitation is not specified in this BACT analysis as these limitations are dependent on the specific cooling tower design and the industrial process.

DAQ has determined that BACT for VOC emissions from cooling towers is implementation of a leak detection program, in accordance to an applicable Subpart and/or with the El Paso Method. This is only applicable to process streams that may contain VOC or if the circulated water is treated with VOC-containing materials.

### 2.1.11 Emergency Generators and Pumps

### **Description:**

Nucor operates diesel-fueled, gasoline powered, and natural gas fired generators. As emergency generators, they are seldom used with periodic maintenance firing and occasional use with loss of power. The majority are hand carry sized used to backup UPS systems for computers in the event of extended loss of power. Some larger generators are installed in stationary locations to handle critical operations such as emergency equipment or molten steel. All stationary generators meet the applicable requirements for generators contained in EPA's NESHAP or NSPS, which is BACT for generators. These federal regulations address NO<sub>x</sub>, organic emissions, and particulates.

The generator with the highest use, providing power to the data center/clinic, has been converted to natural gas. Permitting was completed with an Approval Order dated March 9, 2015. Previously, emergency power was supplied by a permitted diesel fired generator. This location is the most appropriate location for a change in the type of fuel fired because this generator is the most critical and frequently used. Power outages can cause critical loss of data and operating programs needed to operate the facility. Further, the clinic, supported by this generator, is important to address emergency considerations as well as the need for refrigeration of medical supplies kept at this clinic. For these reasons, this generator is used most frequently. The previous diesel generator that was used for the data center and clinic was relocated to a location where there would be limited use as a means of reducing emissions.

The second most frequently used emergency engine is the mold water pump (not a generator). This engine is also natural gas fired. Because the meltshop equipment utilizing cooling water is processing liquid steel, a loss of cooling can cause catastrophic equipment damage if cooling is lost. This pump is test fired as frequently as daily, though its run time is typically 1 minute or less.

Two other stationary diesel fired engines are also not generators, but emergency pumps. One ran approximately 100 hours and the other approximately 80 hours, in calendar year 2016 Replacing these low use engines in not cost effective. Emissions from these engines are addressed through RICE regulations, whether through NESHAP or NSPS, to allowed time of use and maintenance practices to minimize emissions. These regulations meet BACT requirements.

## **Control Options:**

Control Options for PM<sub>2.5</sub>:

- Catalyzed Diesel Particulate Filter (CleanAIR Systems, 2009)
- Diesel Oxidation Catalyst (CS, 2009)
- Diesel Particulate Filter (CS, 2009)

Control Options for NO<sub>x</sub>:

- Exhaust Gas Recirculation (CS, 2009)
- NOX Adsorber Catalyst (CS, 2009)
- Selective Catalytic Reduction (CS, 2009)
- Turbocharging and aftercooling (US EPA, 1993)
- Engine Ignition Timing Retardation (US EPA, 1993)
- Modifying air-to-fuel ratio (US EPA, 1993)

Control Options for SO<sub>2</sub>:

• Ultra-Low Sulfur Diesel Fuel (Bradley Nelson, 2010)

Control Options for VOC:

- Catalyzed Diesel Particulate Filter (CS, 2009)
- Diesel Oxidation Catalyst (CS, 2009)

## **BACT Selection:**

Evaluation of Findings & Control Selection:

Control Options for  $PM_{2.5}$ : The DAQ did not find any  $PM_{2.5}$  controls that were cost effective for controlling  $PM_{2.5}$  emissions. Therefore, BACT for direct  $PM_{2.5}$  emissions is proper maintenance and operation of the emergency stationary diesel engine.

Control Options for  $NO_x$ : The installation of a new emergency stationary diesel engine subject to the newest requirements for stationary emergency engines as specified in 40 CFR 60 Subpart IIII could potentially be cost effective and feasible for this source category, depending on a site-by-site analysis. This is assuming an old engine that is not currently subject to 40 CFR 60 Subpart IIII. This control selection is not applicable to newer engines. In the absence of replacing an old engine with a new engine, the installation of exhaust gas recirculation technology on older engines could be cost effective and feasible, again depending on a site-by-site basis of actual cost to retrofit the stationary emergency diesel engine on site. This control selection is assuming an old engine that is not currently subject to 40 CFR 60 Subpart IIII.

Control Options for  $SO_2$ : The DAQ recommends the use of ultra-low sulfur diesel fuel as BACT for  $SO_2$  control.

Control Options for VOC: The DAQ did not find any VOC controls that were cost effective for controlling VOC emissions. Depending on the age of the engine and site-specific information, a diesel oxidation catalyst could be cost effective for controlling VOC emissions. However, the DAQ does not recommend a diesel oxidation catalyst as BACT for this source category due to the fact this control option is probably not cost effective. Therefore, the DAQ recommends proper maintenance and operation of the emergency stationary diesel engine as BACT for control of VOC emissions. A site-specific cost/ton removed could be derived for making a determination on the requirement of installing a diesel oxidation catalyst.

## 2.1.12 Miscellaneous Painting

## **Description:**

## BACT Analysis for Miscellaneous Painting

Nucor has miscellaneous painting and solvent use. Painting is conducted plant wide on buildings, equipment, for safety markings, and to identify products. Present VOC emissions are included in plantwide permit limitations for the amounts that can be purchased or used. Typically, a BACT analysis for painting operations identifies that a paint booth with particulate filters is necessary to meet BACT. VOC emissions control is

not considered feasible, due to the small emissions levels from the miscellaneous painting. Because painting is conducted plant wide a specific paint booth with add-on control is not possible for miscellaneous painting operations. However, spray most painting is performed inside a building which greatly limits the PM emissions to the atmosphere. Similarly, miscellaneous solvent use is utilized plant wide. Miscellaneous solvent use is distinguished from the utilization of parts washers in that solvents are used at the location of the repair. The majority of these solvents used are in aerosol cans which are sprayed on the equipment part at the operating location where it may be repaired on-line or at a designated repair location. The equipment is typically too large to be placed in a parts washer with a closing lid.

## **Control Options:**

Paint booth with particulate filters Use of low VOC paint

## **Technological Feasibility:**

Because painting is conducted plant wide a specific paint booth with add-on control is not possible for miscellaneous painting operations.

## **Economic Feasibility:**

All remaining controls are economically feasible.

## **BACT Selection:**

Nucor does have a painting process at the operation for providing painted product to customers. This process was installed as a dip operation, instead of a spray operation, to minimize  $PM_{2.5}$  emissions. As part of the process, this painting operation is limited to the types of paint that can be used to limit VOC emissions. The rule is applicable in nonattainment areas and is 2.3 lbs/VOC per gallon of paint. Nucor utilizes a water based paint to comply with this rule. Compliance with this rule meets VOC BACT for painting used in a process. As a dip process is already installed no particulate emissions result where a BACT analysis is necessary.

## Implementation Schedule:

Proper operations and controls are already in place.

## Startup/Shutdown Considerations

There are no startup/shutdown operations to be considered for these sources.

### 2.1.13 Sandblasting

#### **Description:**

Sandblasting can represent significant emissions of PM if substantial sandblasting is completed and the operations are uncontrolled. Nucor conducts sandblasting within a 3-sided building with a roof. Sand blasting is not part of Nucor's manufacturing process. Rather it is used for equipment maintenance or functionality. The amount of  $PM_{2.5}$  is very limited due to the small utilization and containment within buildings. Control is achieved by limiting air movement around the operations so that PM settles in the immediate area. Nucor's controls meet the sandblasting requirements contained in R307-206, UAC and BACT.

## **Control Options:**

#### **RBLC** and Technical Documents

No control options were identified in the RBLC database. The following control options were identified from technical documents as potential controls for  $PM_{2.5}$  emissions from abrasive blasting:

#### Blast Enclosures Controlled By Baghouses

Enclosed abrasive blasting operations are conducted in a confined area designed to contain blast debris and restrict pollutants from being emitted to the atmosphere. Emissions are vented through a baghouse prior to being discharged to the atmosphere. This is a common control used in a variety of applications (USEPA, 1997a).

#### **Reclaim Systems**

Reclaim systems capture abrasive media and debris. The abrasive media in these systems can be reused. These systems are typically found in vacuum blasters. Vacuum blasters collect surface coatings and abrasive blasting materials with a capture and collection system surrounding the blast nozzle (USEPA, 1997a).

### Drapes or Curtains

This control consists of drapes or curtains installed around the blast area to contain blasting media and debris. These curtains are available in a variety of materials (HDPE, polyester, or fabric) and can be installed in a variety of configurations. Drapes are relatively inexpensive but are not very effective. This technique is commonly applied to unconfined blasting operations or for large items (USEPA, 1997a).

## Water Curtains

Water curtains consist of a series of nozzles installed around the blasting area. Water is sprayed downward confining the blasting media and debris to the area enclosed by the nozzles and washing down the blasting media and debris to the ground. This technique is highly effective but consumes a lot of water. Furthermore, the water and washed out debris requires an additional clean-up or collection system (USEPA, 1997a).

### Wet Blasting

Wet blasting systems use high pressure water alone or high pressure water combined with an abrasive media. Abrasive media typically used in wet blasting consists of materials that will remain suspended in water, such as glass beads or sand (USEPA, 1997a).

#### Use of Low Dust Abrasives

Low dust abrasives include coal slag, copper slag, nickel slag, steel grit, steel shot, or other media with a free silica content of less than 1.0%.

### **BACT Selection:**

The majority of blasting operations conducted at major sources in the  $PM_{2.5}$  nonattainment area are enclosed and controlled by a baghouse.

BACT for  $PM_{2.5}$  emissions from abrasive blasting operations is to conduct blasting in an enclosed area controlled by a baghouse. BACT for baghouses is discussed in Section 3.

Unconfined abrasive blasting operations may only be conducted if the item to be blasted exceeds 8 feet in any dimension or the surface being blasted is situated at its permanent location. Unconfined abrasive blasting must be conducted using wet abrasive blasting, blasting with reclaim systems, or the abrasives defined in R307-306-6(2).

## 2.1.14 Volatile Organic Storage Tanks

### **Description:**

There are 2 diesel storage tanks and one gasoline storage tank. Emissions associated with these tanks are calculated with the USEPA TANKS program. These tanks are equipped with pressure relief devices to reduce breathing losses. VOC emissions are very small. Due to the small emissions associated with the filling and evaporative losses due to these tanks, no further control is necessary to meet BACT.

### **Control Options:**

### Fuel Oil

- Submerged Fill Pipes
- Vapor Control System

### Gasoline

- Stage I Vapor Recovery
- Stage II Vapor Recovery

## **BACT Selection:**

Evaluation of Findings & Control Selection:

Due to the minimal emissions associated with fuel oil storage tanks the only option that is feasible would be the use of submerged fill pipes. This is considered to be BACT for controlling fuel oil storage tanks less than 30,000 gallons.

Stage I recovery systems are both economically and technically feasible to implement for controlling VOC emissions from gasoline fueling operations. Due to the truck maintenance required to keep them in working order to pass either a MACT or NSPS level vacuum test, this testing is not economically feasible. A 70% control efficiency is still achievable with no testing and was selected as BACT for sources that have gasoline fueling operations.

Stage II recovery systems are not economically feasible.

## 2.1.15 Solvent Cleaning

## **Description:**

Solvent degreasers are used to remove various contaminants from pieces of equipment. Solvent degreasing is the physical process of using an organic or inorganic solvent to remove tars, greases, fats, oils, waxes, or soil from metal, plastic, printed circuit boards, or other surfaces. This cleaning is typically done prior to such processes as painting, plating, heat treating, and machining, or as part of maintenance operations. The solvent containers can be horizontal or vertical. The solvent may be agitated. Agitation increases the cleaning efficiency of the solvent. Agitation can be used with pumping, compressed air, vertical motion, or ultrasonics.

## **Control Options:**

- Carbon adsorption
- Refrigerated primary condensers
- Increased freeboard ratio
- Combination of covers
- Water covers
- Internal Draining Rack
- Spray hose/spray nozzle
- Reduced room drafts
- Selected operation and maintenance practices

## **BACT Selection:**

Compliance with the requirements of R307-335 is considered BACT for solvent degreasers.

## 2.1.16 Vacuum Ladle Degasser

## **Description:**

Nucor has permitted, but not yet installed, a vacuum ladle degasser that will process the molten steel in the melt shop. The vacuum degasser will be limited to 100,000 tons/year and approximately 1,500 hours/year. The exhaust gas will be ducted to a flare.

## Pollutant [NO<sub>x</sub>, PM<sub>2.5</sub>, SOo<sub>2</sub> and VOC]

BACT Control of Oxides of Nitrogen (NO<sub>x</sub>) Emissions

 $NO_x$  emissions from the vacuum degasser result from the degassing of the liquid steel and due to combustion by-product of the fuel in the flare (used for CO emissions control).

This equipment is included in the permit, but has not yet been installed. The vacuum ladle degasser included in the permit was selected because of the reduced emissions over the commonly found alternative. Many degassers installed at similar type steel manufacturing plants utilize a boiler to create a vacuum. The permitted degasser included in the permit is a mechanical type where vacuum is created without the combustion of fuels. The equipment selected represents emission reduction technology available for vacuum degassers.

### **Control Options:**

Using a boiler to create a vacuum Using a Mechanical degasser to create a vacuum

### **Technological Feasibility:**

All controls are technically feasible

## **Economic Feasibility:**

All controls are economically feasible.

## **BACT Selection:**

Use of a mechanical degasser to create a vacuum creates less emissions. Therefore, the mechanical degasser meets BACT.

### **Implementation Schedule:**

The ladle degasser with the mechanical vacuum system would be implemented after December 2018.

## Startup/Shutdown Considerations

There are no startup/shutdown operations to be considered for the degasser.

## 2.1.17 Roll Mill

### **Description:**

Fumes in roll mill are associated with the hot steel rolling process. The steel is spray with water to reduce its temperature and minimize  $PM_{2.5}$  emissions.

Because of the large area of the emission source within the building and the large volume of air to be evacuated, it is not practical to capture particulate and VOC emissions from the rolling operations to meet BACT.

### Pollutant [VOC]

A high level of control is assumed (99.9%) due to continuous water spray and because the operation is contained within a building. Because oils are lost to the water and the water contacts hot steel, some VOC emissions result from the vaporization of the heavy oils. These VOC emissions are addressed through a mass balance quantification methods by studies conducted by Nucor Corporation.

#### **Control Options:**

Using a boiler to create a vacuum Using a Mechanical degasser to create a vacuum

### **Technological Feasibility:**

Because of the large area of the emission source within the building and the large volume of air to be evacuated, it is not practical to capture particulate and VOC emissions from the rolling operations to meet BACT. All controls are technically infeasible

#### **Economic Feasibility:**

All technically feasible controls are currently being implemented. Therefore, an economic feasibility was not performed.

### **BACT Selection:**

Use of low VOC paint.

### **Implementation Schedule:**

The used of low VOC paint is already being implemented.

## Startup/Shutdown Considerations

There are no startup/shutdown operations to be considered for the Roll Mill.

## 2.1.18 Abrasive Saw Baghouse, Roll Mill #1 Baghouse, Jump Mill Baghouse

## **Description:**

Baghouses are used at a source to control particulate emissions. Pollutant laden air is forced through a chamber containing fabric filters (bags), which capture and remove particulates. Baghouses contain groups of fabric bags. The porous openings in the fabric bags allow air to flow through the bags but prevent particulate matter from passing through the bags. Systems also include a collection hopper that stores collected dust until the dust can be removed ("EPA-CICA Fact Sheet- Fabric Filters"). The number of bags in a baghouse is dependent on size, airflow (cfm), and air-to-cloth ratio design requirements.

Baghouse operations are dependent on the air pressure through the system; therefore, pressure drop parameters are monitored to ensure proper airflow. As the pressure moves out of the designated range, the bags are cleaned in one of two ways. Reverse-air baghouses use a reverse airflow to push captured particulates into a collection system. Pulsejet baghouses target individual bags within the baghouse with pulsed air to clean individual bags("APTI: Baghouse Plan Review," 1982).

Baghouses are used as a control device for multiple applications across many industries. State and federal regulations for baghouses are dependent on the type of operations controlled. Specific requirements are dependent on the federal and state applicability to these operations. For example, 40 CFR 63 subpart X, §63.548, specifies requirements for baghouses controlling lead smelting. The subpart requires best practices, including a source baghouse leak procedure. The procedures for these sources include daily pressure gauge inspections, weekly visual inspections of the dust collection hoppers, and quarterly inspections of the physical integrity of the bags and fans ("40 CFR 63.548").

## Pollutant [PM<sub>2.5</sub>]

## BACT Control of PM2.5 Emissions

Baghouses are considered a control for multiple source categories. There are no federal or state requirements that regulate baghouse selection or filter type. Typically, baghouse filters are rated with a control efficiency of 99%. Therefore, one percent of a source's emissions are vented into ambient air.

## **Control Options:**

Potential controls for the emitted particulates include using a more efficient filter in the baghouse. While fabric filters are typically rated at 99% efficiency, newer filters are available with a rating at 99.9% ("San Joaquin SIP," 2015,"PTFE Membrane Baghouse Filters," 2017).

## **Technological Feasibility:**

Replacing bags after wear and tear or at the end of a bag's lifespan is the normal procedure for a baghouse. Baghouse filters have a manufacturer recommended replacement date. In addition, filters may require replacement for potential operating failures. The replacement of polyester bags with high efficiency bags can be implemented during this change. However, based on phone conversations in July of 2017 with the company U.S. Air Filtration, Inc. (U.S Air) and Utah sources, different systems have different operational needs. According to U.S. Air, high efficiency filters such as PTFE bags operate with a different air-to-cloth ratio than the traditional system setups. Because of this difference, a greater differential pressure is present with high efficiency bags. U.S. Air, a company that specializes in filter setups, notes that these bags cannot operate within systems already designed to operate under high pressure.

## **Economic Feasibility:**

All controls are economically feasible.

## **BACT Selection:**

The use of 99.9% efficient filters is more efficient than the 99% fabric filters in controlling PM emissions. Proper maintenance and operation ensures that the baghouse is meeting the intended efficiency controls.

In some cases, using a more efficient filter is a cost effective, technically feasible control option that reduces particulate emissions. The higher efficiency filter bags require no additional operational or maintenance changes. The increased efficiency bags will reduce emissions and are considered BACT for this operation.

However, there are other operations where a higher efficiency bag is not technically feasible and/or cost effective.

Each site must evaluate the feasibility based on operation type and design.

In all operations, to ensure control efficiencies, operators must follow manufacturer recommended operation and maintenance. This includes monitoring and maintaining the pressure drop across filter bags, cleaning the filters, and replacing the filters as needed. This is considered standard practice for baghouse operations. (State of New Jersey Department of Environmental Protection, 2011).

In 40 CRF 63 Subpart X, §63.548, best practices include the development of a source baghouse leak procedure. The procedure includes daily pressure gauge inspections, weekly visual inspections of the dust collection hoppers, and quarterly inspections of the physical integrity of the bags and fans ("40 CFR 63.548"). This procedure could be implemented to all source categories using baghouses for controls.

## **Implementation Schedule:**

The use of baghouses is already being implemented..

## Startup/Shutdown Considerations

There are no startup/shutdown operations to be considered for the baghouse.

## 2.2 Consideration of Ammonia

The only source of ammonia emissions (Douglas Jones, 2018b) at the Nucor site is from the combustion of natural gas. The unreacted ammonia can be treated as a  $PM_{2.5}$  precursor. Although currently not being considered as a precursor pollutant in Utah's  $PM_{2.5}$  Serious SIP, the source's BACT analysis did include an analysis of BACT for ammonia emissions, which is being included here for completeness.

### **Control Options:**

Good combustion practices are the only control technology for minimizing NH<sub>3</sub> emissions from heaters.

## **Technological Feasibility:**

All identified control technologies are technically feasible.

### **Economic Feasibility:**

All control technologies are economically feasible.

## **BACT Selection:**

The technology identified for controlling  $NH_3$  emissions from the ovens and heaters is the use of pipeline quality natural gas and good combustion practices.

## **Implementation Schedule:**

Proper operations are already in place.

### **Startup/Shutdown Considerations**

There are no startup/shutdown operations to be considered for these sources.

### 3.0 Conclusion- Emissions Reduction through BACT implementation

The existing controls at the Nucor Steel site are recommended to meet the requirements of BACT, therefore, there are no further emission reductions.

#### 4.0 Implementation Schedule and Testing Requirements

The controls at the Nucor Steel site have already been implemented and the testing requirements are outlined in Section 5.0 below.

### 5.0 PM<sub>2.5</sub> SIP – Nucor Steel Specific Requirements

The Nucor Steel specific conditions in Section IX.H.12.m address those limitations and requirements that apply only to the Nucor smelter in particular.

- m. Nucor Steel Mills
  - i. Emissions to the atmosphere from the indicated emission points shall not exceed the following rates:
    - A. Electric Arc Furnace Baghouse
      - I. PM<sub>2.5</sub>
        - 1. 17.4 lbs/hr (24 hr. average filterable)
        - 2. 29.53 lbs/hr (condensable)
      - II. SO<sub>2</sub>
        - 1. 93.98 lbs/hr (3 hr. rolling average)
        - 2. 89.0 lbs/hr (daily average)
      - III. NO<sub>x</sub> 59.5 lbs/hr (calendar-day average)
      - IV. VOC 22.20 lbs/hr
    - B. Reheat Furnace #1 NO<sub>x</sub> 15.0 lb/hr
    - C. Reheat Furnace #2

NO<sub>x</sub> 8.0 lb/hr

ii. Stack testing to show compliance with the emissions limitations of Condition (i) above shall be performed as outlined in IX.H.11.e and as specified below:

	EMISSION POINT	POLLUTANT	TEST FREQUENCY
A.	Electric Arc Furnace Baghouse	PM <sub>2.5</sub> SO <sub>2</sub> NO <sub>x</sub> VOC	every year CEM CEM every year
B.	Reheat Furnace #1	NO <sub>x</sub>	every year
C.	Reheat Furnace #2	NO <sub>x</sub>	every year

- iii. Testing Status (To be applied to (i) and (ii) above)
  - A. To demonstrate compliance with the Electric Arc Furnace stack mass emissions limits for  $SO_2$  and  $NO_x$  of Condition (i)(A) above, Nucor shall calibrate, maintain and operate the measurement systems for continuously monitoring for  $SO_2$  and  $NO_x$  concentrations and stack gas volumetric flow rates in the Electric Arc Furnace stack. Such measurement systems shall meet the requirements of R307-170.
  - B. For  $PM_{2.5}$  testing, 40 CFR 60, Appendix A, Method 5D, or another EPA approved method acceptable to the Director, shall be used to determine total TSP emissions. If TSP emissions are below the  $PM_{2.5}$  limit, that will constitute compliance with the  $PM_{2.5}$  limit. If TSP emissions are not below the  $PM_{2.5}$  limit, the owner/operator shall retest using EPA approved methods specified for PM2.5 testing, within 120 days.
  - C. Startup/shutdown NO<sub>x</sub> and SO<sub>2</sub> emissions are monitored by CEMS.

#### 6.0 References

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Environmental Protection, & Agency. (2005, February 22). Standards of Performance for Steel

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After August 17, 1983.

PM2.5 Serious SIP – BACT for Small Sources. (2017, August 11). Utah DAQ Minor Source NSR.

# BEST AVAILABLE CONTROL TECHNOLOGY (BACT) DEMONSTRATIONS

Nucor's steel mill is subject to the PSD regulations for SO<sub>2</sub>, NO<sub>2</sub>, PM<sub>10</sub>, CO, VOC, and Pb, which mandate that a case-by-case Best Available Control Technology (BACT) analysis be performed to obtain a PSD permit. Nucor last received an updated PSD permit for all emission sources at the mill in 2013 where a BACT analysis was completed as if the facility were an entirely new source.

A review of the BACT analysis finds that the recently completed BACT analysis for the existing PSD permit remains unchanged, and that all necessary controls have been incorporated in to Nucor's Approval Order's, Title V Permit, and the Moderate SIP Nucor source specific limits. For development of the Serious Nonattainment area SIP for the pollutant PM 2.5, it is required that the pollutants of direct PM 2.5, and the precursor (SO2, NOx, VOC, and Ammonia) emissions, be examined for BACT applicability. This document includes a review of the analysis for these (only) pollutants that has already been incorporated into Nucor's permits

# BACT Definition and Applicability

The definition of BACT may be found in Section 165(a)(4) of the Clean Air Act or in the PSD regulations under 40 CFR 52.21(j). BACT is defined as:

"...an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under the Clean Air Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant. In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR Parts 60 and 61. If the Administrator determines that technological or economic limitations on the application of the measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology. Such standard shall, to the degree possible, set forth the emissions reduction achievable by the implementation of such design, equipment, work practice or operation, and shall provide for compliance by means which achieve equivalent results."

The present BACT analysis follows USEPA's top-down approach. In the top-down approach, progressively less stringent control technologies are analyzed until a level of control considered BACT is reached on the basis of environmental, energy and economic impacts. The key steps in the top-down process are:

- Identify viable options;
- Eliminate technically infeasible options;
- Rank remaining alternatives by control effectiveness;
- Evaluate most effective controls; and
- Select BACT.

The sources of information on control alternatives vary for the emission sources being analyzed. The following information resources may be consulted in searching for the alternatives:

- 1. Downloadable USEPA RACT/BACT Clearinghouse (RBLC) System;
- 2. USEPA/State/Local Air Quality Permits;
- 3. Federal/State/Local Permit Engineers;
- 4. Control Technology Vendors; and
- 5. Inspection/Performance Test Reports.

Once the technically feasible control alternatives have been identified, they should be ranked in order of control effectiveness, with the most effective control alternative at the top. The ranked alternatives are reviewed with respect to environmental, energy, and economic considerations specific to the proposed steel mill. However, an applicant proposing the top-rated control alternative need not provide costs and other economic information relative to the other control options (refer, "New Source Review Workshop Manual", USEPA, October 1990). If the analysis determines that the examined alternative is not appropriate as BACT due to any of these considerations, then the next most stringent alternative is subjected to the same review. This process is repeated until a control alternative is justified to represent BACT. The proposed BACT must provide emission limitations which are at least as stringent as the applicable federally-approved State Implementation Plan (SIP) or the federal NSPS and National Emission Standards for Hazardous Air Pollutants (NESHAP) emission standards.

The impact analysis of the BACT review focuses on environmental, energy, and economic impacts. The net environmental impact associated with the control alternative should be reviewed. This is generally satisfied with the dispersion modeling which is performed as a part of PSD review. The dispersion modeling normally considers a "worst-case" scenario, thus constituting an assessment of the maximum environmental impacts. The energy impact analysis estimates the direct energy impacts of the control alternatives in units of energy consumption. If possible, the energy requirements of the control option is assessed in terms of total and incremental (units of energy per ton of reduction) energy costs. The economic impact of a control option is typically assessed in terms of cost-effectiveness and ultimately whether the option is economically reasonable. Normally, the economic impacts are reviewed on a cost per ton of pollutant removed basis.

Several sources were consulted regarding recent steel mill operations and the associated control implemented. These sources included the RBLC database, recent permit applications, USEPA air permitting authorities, and equipment vendors.

Table 2-2 presents a summary of the BACT determinations for recent applications for new and modified electric arc furnaces. This list separates EAF that use the CONSTEEL process versus those using the traditional batch process. The CONSTEEL process consists of loading scrap onto a conveyor that continuously feeds the electric arc furnace (EAF). Lime and carbon are continuously added to the scrap prior to entering the EAF. Other alloys are added to the EAF using a conveyor from the alloy bin storage area. After initial charging by a charge bucket to develop a molten heel, the EAF will continuously receive scrap metal and other scrap substitutes, lime, carbon, and carbon units by the CONSTEEL process where the raw materials are melted into molten steel. The CONSTEEL process is a unique method of charging steel, where the scrap steel is conveyed into the EAF while the hot off-gases from the furnace are sent counter currently, thus preheating the scrap. The Utah mill EAF is the traditional bucket charged EAF.

## BACT/LAER Analysis for Electric Arc Furnaces

The existing electric arc furnaces (EAFs) operate in a batch mode whereby the scrap steel and potentially scrap substitutes are charged, melted, and tapped. During normal operation, cold scrap metal and scrap substitutes, carbon and fluxing agents are charged into the EAF shell, powered by a high-powered transformer. A large electrical potential is applied to the carbon electrodes. The combination of the heat from the arcing process, burners, and carbon sources melt the scrap and scrap substitutes into molten steel. As the scrap begins to melt, the temperature of the exhaust gas from the EAF increases appreciably. As melting progresses, oxygen lancing and carbon injection are performed, the temperature of the exhaust gas stream can approach 3,000 °F, which

is approximately the temperature of molten steel. This operational cycle is repeated for each batch, which can take up to one hour to complete.

The capture system for exhaust gases from the EAF is a direct evacuation control (DEC) and an overhead roof exhaust system consisting of a canopy hood. The DEC duct locally evacuates the exhaust gases directly from the furnace to the main duct system directed to the EAF baghouse. The roof exhaust system evacuates fugitive fumes from the closed roof plenums located over the EAF and direct them through the main duct system directed to the EAF baghouse.

The dust collection equipment for the EAF baghouse consists of a reverse-air type multi-compartment positive pressure baghouse. Each module currently contains multiple bags, with all necessary bag cleaning mechanisms, gas flow control, and collected material transfer and removal equipment. The design of the multi-compartment EAF baghouse will allow for on-line maintenance and cleaning. The air moving mechanism for the system consists of multiple blowers. Nucor Steel has installed a Continuous Emissions Monitoring System (CEMS) for the pollutants CO, NOx, and SO2 and a bag leak detection system (BLDS) for particulates.

# EAF BACT Control of Oxides of Nitrogen (NO<sub>x</sub>) Emissions

 $NO_x$  is formed from the chemical reaction between nitrogen and oxygen at high temperatures.  $NO_x$  formation occurs by different mechanisms. In the case of EAF,  $NO_x$ predominantly forms from thermal dissociation and subsequent reaction of nitrogen and oxygen molecules in the combustion air. This mechanism of  $NO_x$  formation is referred to as thermal  $NO_x$ . The other mechanisms of  $NO_x$  formation such as fuel  $NO_x$ (due to the evolution and reaction of fuel-bound nitrogen compounds with oxygen) and prompt  $NO_x$  (due to the formation of HCN followed by oxidation to  $NO_x$ ) are thought to have lesser contributions to  $NO_x$  emissions from EAFs.

Based on a review of the RBLC database and discussions with various individuals knowledgeable about steel mill operations, it was revealed that control technologies for  $NO_x$  abatement have not been successfully implemented for EAF emissions. However,  $NO_x$  control technologies are currently available for fossil-fueled boilers, stationary combustion engines and turbines. Thus, these control alternatives are potentially available to control  $NO_x$  from an EAF. These control options have been reviewed for technical feasibility in this BACT analysis. Due to the lack of successful application of such controls to an EAF, they are considered a "technology transfer". The present limit (about 0.32 lb/ton) is at the lower end of the BACT range for electric arc furnaces.

# Potential EAF NOx Control Alternatives

The alternatives available to control NO<sub>x</sub> emissions from the existing EAF include the following:

- 1. Combustion Controls;
- 2. Selective Catalytic Reduction (SCR);
- 3. Non-Selective Catalytic Reduction (NSCR);
- 4. SCONO<sub>x</sub> Catalytic Oxidation/ Absorption;
- 5. Shell DeNO<sub>x</sub> System (modified SCR);
- 6. Selective Non-Catalytic Reduction (SNCR) options -
  - Exxon's Thermal DeNO<sub>x</sub>®
  - Nalco Fuel Tech's NO<sub>x</sub>OUT<sup>®</sup>
  - Low Temperature Oxidation (LTO)

## Technical Feasibility of NO<sub>x</sub> Control Alternatives

The test for technical feasibility of any control option is whether it is both available and applicable to reducing  $NO_x$  emissions from the existing EAF. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

(1) <u>Combustion Controls</u> -- There is an entire family of combustion controls for NO<sub>x</sub> reduction from various combustion units as follows:

- a. Low Excess Air (LEA);
- b. Oxyfuel Burner;
- c. Overfire Air (OFA);
- d. Burners Out Of Service (BOOS);
- e. Reduced Combustion Air Temperature;
- f. Load Reduction; and

## g. Flue Gas Recirculation (FGR)

The **LEA option** is typically used in conjunction with some of the other options. The use of this option will result in the generation of additional CO emissions. In addition, LEA is not very effective for implementation in electric arc furnaces which do not operate with combustion air feeds, since the combustion process is not modulated with the near-atmospheric furnace conditions. Thus, this option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

The <u>**OFA option**</u> is geared primarily for fuel  $NO_x$  reduction. Fuel NOx is not a significant portion of the total NOx generated in a furnace. Overfire Air is not feasible in an electric arc furnace because of the high turbulence in the furnace environment.

The **BOOS and Load Reduction (or Deration) options** incorporate a reduction in furnace load, thereby, potentially reducing NO<sub>x</sub> formation. This reduction must be balanced, however, against a longer period of NO<sub>x</sub> generation resulting from the furnace's inability to efficiently melt scrap and scrap substitutes. Furthermore, both BOOS and Load Reduction are fundamentally inconsistent with the design criterion for the furnace, which is to increase furnace loadings to achieve enhanced production. In addition, adverse capital and installation costs would be realized in over-designing the furnace to allow this technology to operate. Accordingly, these options are judged technically infeasible for this particular application and will not be considered any further in this BACT analysis.

The **Reduced Combustion Air Temperature option** inhibits thermal NO<sub>x</sub> production. However, the option is limited to equipment with combustion air preheaters which are not applicable to EAFs. Thus, this option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

The <u>FGR option</u> involves recycling a portion of the cooled exit flue gas back into the primary combustion zone. Typically, FGR is useful in reducing thermal NO<sub>x</sub> formation by lowering the oxygen concentration in the combustion zone. The primary limitation of FGR is that it alters the distribution of heat (resulting in cold spots) and lowers the efficiency of the furnace. Since it may be necessary to add additional burners (hence, increasing emissions of other pollutants) to the EAF to reduce the formation of cold spots, FGR technology to reduce EAF NO<sub>x</sub> emissions is not considered feasible. Since the EAF does not operate on burner combustion, but relies upon the electric arc and chemical energy for oxidation, neither pathway is amenable to FGR application. Thus, this option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.
(2) <u>Selective Catalytic Reduction (SCR)</u> -- In this process, ammonia (NH<sub>3</sub>), usually diluted with air or steam, is injected through a grid system into the exhaust gas stream upstream of a catalyst bed. On the catalyst surface the NH<sub>3</sub> reacts with NO<sub>x</sub> to form molecular nitrogen and water. The basic reactions are as follows:

 $4NH_3 + 4NO + O_2 \rightarrow 4N_2 + 6H_2O$  (i)

 $8NH_3 + 6NO_2 \rightarrow 7N_2 + 12H_2O$  (ii)

The reactions take place on the surface of the catalyst. Usually, a fixed bed catalytic reactor is used for SCR systems. The function of the catalyst is to effectively lower the activation energy of the  $NO_x$  decomposition reactions. Technical factors related to this technology include the catalyst reactor design, optimum operating temperature, sulfur content of the charge, catalyst deactivation due to aging, ammonia slip emissions and design of the ammonia injection system.

Three types of catalyst bed configurations have been successfully applied to commercial sources: the moving bed reactor, the parallel flow reactor and the fixed bed reactor. The fixed bed reactor is applicable to sources with little or no particulate present in the flue gas. In this reactor design, the catalyst bed is oriented perpendicular to the flue gas flow and transport of the reactants to the active catalyst sites occurs through a combination of diffusion and convection.

Depending on system design, NO<sub>x</sub> removal of 80 - 90 percent may be achievable under optimum conditions (refer, USEPA "ACT Document - NO<sub>x</sub> Emissions from Iron and Steel Mills", Sept., 1994). The reaction of NH<sub>3</sub> and NO<sub>x</sub> is favored by the presence of excess oxygen. Another variable affecting NO<sub>x</sub> reduction is exhaust gas temperature. The greatest NO<sub>x</sub> reduction occurs within a reaction window at catalyst bed temperatures between 600 °F – 750 °F for conventional (vanadium or titanium-based) catalyst types, and 470 °F – 510 °F for platinum-based catalysts. Performance for a given catalyst depends largely on the temperature of the exhaust gas stream being treated. A given catalyst exhibits optimum performance when the temperature of the exhaust gas stream is at the midpoint of the reaction temperature window for applications where exhaust gas oxygen concentrations are greater than 1 percent. Below the optimum temperature range, the catalyst activity is greatly reduced, potentially allowing unreacted ammonia (referred to as "ammonia slip") to be emitted directly to the atmosphere.

The SCR system may also be subject to catalyst deactivation over time. Catalyst deactivation occurs through two primary mechanisms – physical deactivation and chemical poisoning. Physical deactivation is generally the result of either continual exposure to thermal cycling or masking of the catalyst due to entrainment of particulates or internal contaminants. Catalytic poisoning is caused by the irreversible

reaction of the catalyst with a contaminant in the gas stream. Catalyst suppliers typically guarantee a 3-year catalyst lifetime for a sustainable emission limit.

In order for an SCR system to effectively reduce NO<sub>x</sub> emissions, the exhaust gas stream should have relatively stable gas flow rates, NO<sub>x</sub> concentrations, and temperature. In addition, certain elements such as iron, nickel, chrome, and zinc can react with platinum catalysts to form compounds or alloys which are not catalytically active. These reactions are termed "catalytic poisoning", and can result in premature replacement of the catalyst. An EAF flue gas may contain a number of these catalytic poisons. In addition, any solid material in the gas stream can form deposits and result in fouling or masking of the catalytic surface. Fouling occurs when solids obstruct the cell openings within the catalyst. Masking occurs when a film forms on the surface of catalyst over time. The film prevents contact between the catalytic surface and the flue gas. Both of these conditions can result in frequent cleaning and/or replacement requirements. Due to the above effective technical applicability constraints, SCR technology has never been applied to EAF operations.

In addition to the above reservations regarding effective applicability of potential SCR application to EAFs, the technology is also associated with the following environmental impacts:

- 1. Unreacted ammonia (around 5-10 ppmv) would be emitted to the environment as ammonia slip. Based on conservative estimates of a 7 ppmv ammonia slip, approximately 97.0 tons/yr of ammonia could be potentially emitted from the existing EAF. Ammonia is also a pollutant of concern when addressing PM2.5. Any ammonia emissions would represent a negative impact on the desired results when addressing PM2.5;
- 2. Formation of ammonium salts can readily foul the catalyst section, resulting in reduced efficiency and increase back pressure;
- 3. Small amounts of ammonium salts would be emitted as  $PM_{10}$  and PM2.5.
- 4. Safety issues associated with the transportation, handling and storage of aqueous ammonia; and
- 5. Potentially hazardous waste handling and disposal of spent catalyst.

Successful applications of SCR technology to control NO<sub>x</sub> emissions from EAFs are not known. The analysis presented above discusses a number of effective technical applicability concerns regarding SCR. In order for the SCR system to effectively reduce NO<sub>x</sub> emissions, the exhaust gas stream should have relatively stable gas flow rates, NO<sub>x</sub> concentrations, and temperature. The temperature of the EAF exhaust gas will vary

widely over the melt cycle, and the gas flow rates and NO<sub>x</sub> concentrations will exhibit a wide amplitude. Moreover, the presence of particulates in the exhaust gas prior to the EAF baghouse may result in fouling of the catalyst, rendering it ineffective. Also, the SCR system cannot be installed after particulate removal in the EAF baghouse due to unacceptably low temperatures outside the effective operating range. Note that SCR technology has not been utilized to control NO<sub>x</sub> emissions from EAFs. Any projected application of SCR to EAFs would be considered a "technology transfer." In view of the above limitations, the SCR option is considered technically infeasible with unresolved technical issues and significant environmental impacts. Thus, this option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(3) <u>Non-Selective Catalytic Reduction (NSCR)</u> -- The NSCR system is a postcombustion add-on exhaust gas treatment system. It is often referred to as a "three-way conversion" catalyst since it reduces NO<sub>x</sub>, unburned hydrocarbons (UBH), and CO simultaneously. In order to operate properly, the combustion process must be stoichiometric or near-stoichiometric which is not maintained in an EAF and varies widely under regular operation. Under stoichiometric conditions, in the presence of the catalyst, NO<sub>x</sub> is reduced by CO, resulting in nitrogen and carbon dioxide. Currently, NSCR systems are limited to rich-burn IC engines with fuel rich ignition system applications. Moreover, potential problems with NSCR systems include catalyst poisoning by oil additives such as phosphorus and zinc (present in galvanized scrap steel charged in the EAF). In view of the above limitations, the NSCR option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(4) <u>SCONO<sub>x</sub>-Catalytic Oxidation/Absorption</u> -- This is a catalytic oxidation/absorption technology that has been applied for reductions of NO<sub>x</sub>, CO and VOC from an assortment of combustion applications that mostly include – small turbines, boilers and lean-burn engines. However, this technology has never been applied for steel mill EAFs. SCONO<sub>x</sub> employs a single catalyst for converting NO<sub>x</sub>, CO and VOC. The flue gas temperature should be preferably in the 300-700 °F range for optimal performance without deleterious effects on the catalyst assembly. The technology was developed as an alternative to traditional SCR applications which utilize ammonia resulting in additional operational safeguards, unfavorable environmental impacts and excessive costs. In the initial oxidation cycle, the CO is oxidized to  $CO_2$ , the NO gets converted to NO<sub>2</sub> and the VOC gets oxidized to carbon dioxide and water. The NO<sub>2</sub> is then absorbed on the potassium carbonate coated (K<sub>2</sub>CO<sub>3</sub>) catalyst surface forming potassium nitrites and nitrates (KNO<sub>2</sub>, KNO<sub>3</sub>). Prior to saturation of the catalyst surface, the catalyst enters the regeneration cycle.

In the regeneration phase, the saturated catalyst section is isolated with the expedient of moving hinged louvers and then exposed to a dilute reducing gas (methane in natural

gas) in the presence of a carrier gas (steam) in the absence of oxygen. The reductant in the regeneration gas reacts with the nitrites and nitrates to form water and elemental nitrogen. Carbon dioxide in the regeneration gas reacts with potassium nitrites and nitrates to recover the potassium carbonate, which is the absorber coating that was on the surface of the catalyst before the oxidation/absorption cycle began. Water (as steam) and elemental nitrogen are exhausted up the stack and the re-deposited K<sub>2</sub>CO<sub>3</sub> allows for another absorption cycle to begin.

SCONO<sub>x</sub> technology is a variation of traditional SCR technology and for optimal performance it makes similar demands such as - stable gas flows, lack of thermal cycling, invariant pollutant concentrations and residence times on the order of 1-1.5 seconds. However, the initial attractive feature of not using ammonia has been replaced by other potential operational problems that impair the effectiveness of the technology.

In summary, an effective  $SCONO_x$  application to a steel mill EAF application has the following reservations:

- 1. The technology is not readily adaptable to high-temperature applications outside the 300-700 °F range and is susceptible to thermal cycling that will be experienced in the Nucor application;
- 2. Scale-up is still an issue. The technology has not been demonstrated for larger applications and the vendor's contention in this context is still being debated upon;
- 3. Optimum SCONO<sub>x</sub> operation is predicated by stable gas flow rates, NO<sub>x</sub> concentrations and temperature. As discussed earlier, the nature of EAF operations do not afford any of these conditions which will significantly impair the effective control efficiency of the SCONO<sub>x</sub> system;
- 4. The catalyst is susceptible to moisture interference and the vendor indicates negation of its warranties and performance guarantees if the catalyst is exposed to any quantity of liquid water. However, during certain atmospheric conditions, the catalyst could be potentially exposed to moisture following a unit shutdown or leakage from water cooled ducts;
- 5. The prospect of moving louvers that effect the isolation of the saturated catalyst readily lends itself to the possibility of thermal warp and in-duct malfunctions in general. The process is dependent on numerous hot-side dampers that must cycle every 10-15 minutes. Directional flow solutions are not yet known to have been implemented for this technology;

- 6. The K<sub>2</sub>CO<sub>3</sub> coating on the catalyst surface is an active chemical reaction and reformulation site which makes it particularly vulnerable to fouling. On some field installations, the coating has been found to be friable and tends to foul in the harsh in-duct environment;
- 7. During the regeneration step, the addition of the flammable reducing gas (natural gas which contains 85% methane) into the hot flue gas generates the possibility of LEL exceedances and subsequently catastrophic failure in the event the catalyst isolation is not hermetic or there is a failure in the carrier steam flow; and
- 8. There is a possibility of some additional SO<sub>2</sub> emissions if the dry scrubber with the tandem "guard-bed" SCOSO<sub>x</sub> unit experiences a malfunction.

Thus, there are significant reservations regarding effective technical applicability of this control alternative for a steel mill EAF application. Moreover SCONO<sub>x</sub> technology has never been proposed nor successfully implemented for similar industry applications. In view of the above limitations, SCONO<sub>x</sub> is considered technically infeasible for the present application and will not be considered any further in this BACT analysis.

(5) <u>Shell DeNO<sub>x</sub> System (modified SCR)</u> -- The Shell DeNO<sub>x</sub> system is a variant of traditional SCR technology which utilizes a high activity dedicated ammonia oxidation catalyst based on a combination of metal oxides. The system is comprised of a catalyst contained in a modular reactor housing where in the presence of ammonia NO<sub>x</sub> in the exhaust gas is converted to nitrogen and water. The catalyst is contained in a low pressure drop lateral flow reactor (LFR) which makes best use of the plot space available. Due to the intrinsically high activity of the catalyst, the technology is suited for NO<sub>x</sub> conversions at lower temperatures with a typical operating range of 250-660 °F. In addition, the vendor contends that conventional SCR systems that use honeycomb catalysts generally operate in the temperature range of 610-720 °F with attendant pressure drops of between 2.8-4.0 inches WG. The Shell DeNO<sub>x</sub> technology can not only operate at a lower temperature but also have a lower pressure drop penalty of around 2 inches WG.

The low temperature operation is the only aspect of the Shell  $DeNO_x$  technology that marks its variance from traditional SCR technology. From an EAF application standpoint, there are no additional differences between this technology and SCR technology.

In summary, an effective Shell  $DeNO_x$  application to the EAF application has the following reservations:

- The Shell DeNO<sub>x</sub> system does not suffer from similar placement limitation considerations discussed earlier for SCRs. However, even a downstream of EAF baghouse placement of the system does not render it completely safe from the prospect of particulate fouling. The catalyst will still be exposed to particulates which can inflict a masking effect impairing the effective control efficiency of the system;
- 2. Optimum Shell DeNO<sub>x</sub> operation is predicated by stable gas flow rates, NO<sub>x</sub> concentrations and temperature. The nature of EAF operations do not afford any of these conditions which will significantly impair the effective control efficiency of the Shell DeNO<sub>x</sub> system;
- 3. Since steel is produced from scrap, there is the possibility of the presence of catalytic poisons which can adversely affect the Shell DeNO<sub>x</sub> catalyst resulting in impaired control efficiencies and frequent replacement of the catalyst;
- 4. The catalyst is particularly susceptible to thermal fluctuations. The vendor indicated a threshold temperature of around 680 °F for catalyst degradation;
- 5. The use of relatively large amounts of ammonia a regulated toxic chemical will have accidental release and hazardous impact implications; and
- 6. As discussed earlier, even a 7 ppmv ammonia slip from a 1,050,000 dscfm exhaust gas flow can result in the emission of approximately 97.0 tons/yr of ammonia which is a regulated hazardous air pollutant with well documented health impacts.

Thus, there are significant reservations regarding effective technical applicability of this control alternative for an EAF application. Moreover Shell DeNO<sub>x</sub> has never been proposed nor successfully implemented for similar steel mill applications. Any projected application of Shell DeNO<sub>x</sub> to EAFs would be considered a "technology transfer." In view of the above limitations, the Shell DeNO<sub>x</sub> option is considered technically infeasible with unresolved technical issues and significant environmental impacts for this application. Thus, it will not be considered any further in this BACT analysis.

(6) <u>Selective Non-Catalytic Reduction (SNCR)</u> -- The three commercially available SNCR systems are Exxon's Thermal DeNO<sub>x</sub><sup>®</sup> system, Nalco Fuel Tech's NO<sub>x</sub>OUT<sup>®</sup> system and Low Temperature Oxidation (LTO). These technologies are reviewed below for technical feasibility in controlling EAF NO<sub>x</sub> emissions.

**Exxon's Thermal DeNO**<sub>x</sub><sup>®</sup> - Exxon's Thermal DeNO<sub>x</sub><sup>®</sup> system is a non-catalytic process for NO<sub>x</sub> reduction. The process involves the injection of gas-phase ammonia (NH<sub>3</sub>) into

the exhaust gas stream to react with  $NO_x$ . The ammonia and  $NO_x$  react according to the following competing reactions:

 $2NO + 4NH_3 + 2O_2 \rightarrow 3N_2 + 6H_2O$  (i)  $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$  (ii)

The temperature of the exhaust gas stream is the primary criterion controlling the above selective reaction. Reaction (i) dominates in the temperature window of 1,600 °F - 2,200 °F resulting in a reduction of NO<sub>x</sub>. However above 2,200 °F, reaction (ii) begins to dominate, resulting in enhanced NO<sub>x</sub> production. Below 1,600 °F, neither reaction has sufficient activity to produce or destroy NO<sub>x</sub>. Thus, the optimum temperature window for the Thermal DeNO<sub>x</sub><sup>®</sup> process is approximately 1,600 oF - 1,900 °F. The above reaction temperature window can be shifted down to approximately 1,300 °F - 1,500 °F with the introduction of readily oxidizable hydrogen gas. In addition, the process also requires a minimum of 1.0 second residence time in the desired temperature window for any significant NO<sub>x</sub> reduction.

In order for the Thermal DeNO<sub>x</sub><sup>®</sup> system to effectively reduce NO<sub>x</sub> emissions, the exhaust gas stream should have relatively stable gas flow rates; ensuring the required residence time and be within the prescribed temperature range. Based on discussions with Exxon and vendors knowledgeable about steel mill operations, application of Thermal DeNO<sub>x</sub><sup>®</sup> technology to control NO<sub>x</sub> emissions from EAF operations are not known. Therefore, any projected application of the process to EAF operations would be considered a "technology transfer".

In summary, an effective Thermal  $DeNO_x^{(B)}$  application to the EAF application has the following reservations:

- 1. The placement of the Thermal DeNO<sub>x</sub><sup>®</sup> system in an adequate temperature regime. In order to achieve optimum operational efficiency the system should be located in a temperature region of at least 1,300 °F and preferably between 1,600 °F 1,900 °F which would put it upstream of the EAF baghouse. Such a placement configuration would not afford the desired temperature range which would be typically in the region of 300 °F 400 °F with an entry temperature of 210 °F at the inlet to the EAF baghouse. The system cannot be placed further upstream for operational hazard reasons. Also any injection mechanism upstream of the baghouse will be susceptible to prompt particulate fouling;
- 2. Optimum Thermal DeNO<sub>x</sub><sup>®</sup> operation is predicated by stable gas flow rates, NO<sub>x</sub> concentrations and temperature. The nature of EAF operations do not afford any of these conditions which will significantly impair the effective control efficiency of the Thermal DeNO<sub>x</sub><sup>®</sup> system;

- 3. The use of relatively large amounts of ammonia a regulated toxic chemical will have accidental release and hazardous impact implications; and
- 4. Even a 7 ppmv ammonia slip from a 1,050,000 dscfm exhaust gas flow can result in the emission of approximately 97.0 tons/yr of ammonia which is a regulated hazardous air pollutant with well documented health impacts.

Depending on system design, NO<sub>x</sub> removal of 40-70 percent may be achievable under optimum conditions (refer, USEPA "ACT Document - NO<sub>x</sub> Emissions From Iron and Steel Mills" Sept., 1994). In view of the concerns with the availability of steady gas flows and prescribed residence times, thermal cycling and the ability of the control option to load-follow varying pollutant concentrations and the fact that the source will be required to continually comply with an hourly emission rate, an effective NO<sub>x</sub> control efficiency will be hard to maintain for an EAF application. It should be noted that if the required residence time or other optimum operation parameters are not available, unreacted ammonia will be released directly to the atmosphere.

There are significant reservations regarding effective technical applicability of this control alternative for an EAF application. In order for the Thermal DeNO<sub>x</sub><sup>®</sup> system to effectively reduce NO<sub>x</sub> emissions, the exhaust gas stream should have relatively stable gas flow rates, ensuring the requisite residence time requirements and temperature. The temperature of the EAF exhaust gas will vary widely over the melt cycle, and will not remain in the desired temperature window during all phases of operation. Similarly, the gas flow rates will not remain stable during furnace operation, precluding the possibility of adequate residence time. Moreover, Thermal DeNO<sub>x</sub><sup>®</sup> technology has never been proposed nor successfully implemented to control NO<sub>x</sub> emissions from EAFs. Any projected application of the process to the EAF would be considered a "technology transfer". In view of the above limitations, the Thermal DeNO<sub>x</sub><sup>®</sup> option is considered technically infeasible with significant environmental impacts for this application and will not be considered any further in this BACT analysis.

<u>Nalco Fuel Tech's NO<sub>x</sub>OUT</u><sup>®</sup> - The NO<sub>x</sub>OUT<sup>®</sup> process is very similar in principle to the Thermal DeNO<sub>x</sub><sup>®</sup> process, except that it involves the injection of a liquid urea (NH<sub>2</sub>CONH<sub>2</sub>) compound (as opposed to NH<sub>3</sub>) into the high temperature combustion zone to promote NO<sub>x</sub> reduction. The chemical reaction proceeds as follows:

 $NH_2 + NO \rightarrow N_2 + H_2O$  (i)

The reaction involves the decomposition of urea at temperatures of approximately 1,700 °F - 3,000 °F. Certain proprietary additive developments have allowed the operational temperature window to shift to approximately 1,400 °F - 2,000 °F. However, the process still has similar constraints as the Thermal DeNO<sub>x</sub><sup>®</sup> system. The limitations are dictated by the reaction-controlling variables such as stable gas flow rates for a minimum

residence time of 1.0 second in the desired temperature window to ensure proper mixing.

As with the Thermal DeNO<sub>x</sub><sup>®</sup> system, the NO<sub>x</sub>OUT<sup>®</sup> system suffers from essentially similar limitations to effectively reduce NO<sub>x</sub> emissions from EAF operations. Moreover, applications of the NO<sub>x</sub>OUT<sup>®</sup> technology to control NO<sub>x</sub> emissions from steel mill EAF operations are not known. Therefore, any projected application of the process to the Nucor application would be considered a "technology transfer".

Similar to the Thermal DeNO<sub>x</sub><sup>®</sup> application, an effective NO<sub>x</sub>OUT<sup>®</sup> application to the EAF application has the following reservations:

- 1. The placement of the NO<sub>x</sub>OUT<sup>®</sup> system in an adequate temperature regime. In order to achieve optimum operational efficiency the system should be located in a temperature region preferably between 1,400 °F 2,000 °F which would put it upstream of the EAF baghouse. Firstly, such a placement configuration would not afford the desired temperature range which would be typically in the region of 300 °F -400 °F with an entry temperature of 210 °F at the inlet to the EAF baghouse. Also any injection mechanism upstream of the baghouse will be susceptible to prompt particulate fouling;
- 2. Optimum NO<sub>x</sub>OUT<sup>®</sup> operation is predicated by stable gas flow rates, NO<sub>x</sub> concentrations and temperature. The nature of EAF operations do not afford any of these conditions which will significantly impair the effective control efficiency of the NO<sub>x</sub>OUT<sup>®</sup> system; and
- 3. Although the NO<sub>x</sub>OUT<sup>®</sup> technology does not utilize ammonia directly, secondary chemical reactions under certain conditions (such as unreacted urea combining to form ammonia) can generate ammonia from the process. In fact the vendor indicates a 25 ppmv ammonia at the exhaust stack which is higher than direct ammonia applications discussed earlier. Even a 7 ppmv ammonia slip from a 1,050,000 dscfm exhaust gas flow can result in the emission of approximately 97.0 tons/yr of ammonia which is a regulated hazardous air pollutant with well documented health impacts.

Depending on system design, NO<sub>x</sub> removal of 40-70 percent may be achievable under optimum conditions (refer, USEPA "ACT Document - NO<sub>x</sub> Emissions From Iron and Steel Mills" Sept., 1994). In view of the concerns with the availability of steady gas flows and prescribed residence times, thermal cycling and the ability of the control option to load-follow varying pollutant concentrations and the fact that the source will be required to continually comply with an hourly emission rate, an effective NO<sub>x</sub> control efficiency will be hard to maintain for an EAF application. It should be noted that if the required residence time or other optimum operation parameters are not available, secondary production ammonia will be released directly to the atmosphere. In some instances, it may even be higher than direct ammonia applications discussed earlier.

There are significant reservations regarding effective technical applicability of this control alternative for an EAF application. In order for the NO<sub>x</sub>OUT<sup>®</sup> system to effectively reduce NO<sub>x</sub> emissions, the exhaust gas stream should have relatively stable gas flow rates, ensuring the requisite residence time requirements and temperature. The temperature of the EAF exhaust gas will vary widely over the melt cycle, and will not remain in the desired temperature window during all phases of operation. Similarly, the gas flow rates will not remain stable during furnace operation, precluding the possibility of adequate residence time. Moreover, NO<sub>x</sub>OUT<sup>®</sup> technology has never been proposed nor successfully implemented to control NO<sub>x</sub> emissions from EAFs. Any projected application of the process to the EAF would be considered a "technology transfer". In view of the above limitations, the NO<sub>x</sub>OUT<sup>®</sup> option is considered technically infeasible with significant environmental impacts for this application and will not be considered any further in this BACT analysis.

Low Temperature Oxidation (LTO) -- LTO technology has never been utilized for any steel mill EAF application. The vendor has listed applications for mostly industrial boilers and cogeneration gas turbines which have a more favorable energy balance. The technology is a variant of SNCR technology using ozone. The ozone is injected into the gas stream and the NO<sub>x</sub> in the gas stream is oxidized to nitrogen pentoxide (N<sub>2</sub>O<sub>5</sub>) vapor which is absorbed in the scrubber as dilute nitric acid (HNO<sub>3</sub>). The nitric acid is then neutralized with caustic (NaOH) in the scrubber water forming sodium nitrate (NaNO<sub>3</sub>). The overall chemical reaction can be summarized as follows:

 $NO_2 + NO + 2O_3 + NaOH \rightarrow HNO_3 + NaNO_3 + 2O_2$  (i)

For optimal performance, the technology requires stable gas flows, lack of thermal cycling, invariant pollutant concentrations and residence times on the order of 1 - 1.5 seconds. In addition, LTO technology requires frequent calibration of analytical instruments which sense the NO<sub>x</sub> concentrations for proper adjustment of ozone injection. Since LTO uses ozone injection, it has a potential for ozone slip which can vary between 5 - 10 ppmv. Also, the technology requires a cooler flue gas of less than 300 °F at the point of ozone injection, otherwise the reactive gas is rendered redundant. The technology also suffers from low NO<sub>x</sub> conversion rates (40% - 60%), potential for nitric acid vapor release (in the event of a scrubber malfunction) with subsequent regional haze impacts and the handling, treatment and disposal issues for the spent scrubber effluent.

In conclusion, the technology is still nascent and evolving out of the earlier bench scale solution to effect a reliable SNCR application utilizing reactive gas-phase ozone to

control NO<sub>x</sub> emissions from combustion applications. The technology is neither applicable nor proven for steel mill EAF applications and attendant limitations render it technically infeasible in its current manifestation. In view of the above, the LTO control option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

In order to implement an effective technical applicability for the control options discussed above, a stable temperature regime (along with non-varying gas flows and pollutant concentrations) for specific target windows is imperative which cannot be afforded by Nucor's EAF operation for the following reasons:

- 1. As discussed earlier, the add-on control options cannot be located upstream of the baghouse in order to acquire the requisite temperature window due to particulate interference which can severely degrade the effective technical applicability of the respective control alternative;
- 2. In order to avoid particulate interference, the add-on control options will have to be located downstream of the EAF baghouse. The exhaust gas temperatures exiting the baghouse vary according to the following:
  - a. Overall seasonal variation due to changes in the temperature of the ambient air;
  - b. Changes in ambient air relative humidity;
  - c. Operational cycle of the EAF tapping, charging, bucket charge, etc.; and
  - d. Type of materials being added to the furnace depending on the grade of steel being produced.
- 3. The add-on control systems are not very adept at load-follow with varying process conditions resulting in significant erosion of their effective technical applicability; and
- 4. The catalytic systems are susceptible to poisoning by certain interferents and heavy metals.

## Evaluation of Most Effective NOx Controls for EAF

Various control alternatives were reviewed for technical feasibility in controlling  $NO_x$  emissions from the EAF. With the exception of combustion control utilizing existing natural gas-fired oxyfuel burners, the applicability of the remaining control options is questionable and is considered technically infeasible. Since, only a single control option

was ascertained to be technically feasible, no ranking of control alternatives has been provided.

None of the steel mills reviewed for this analysis have proposed or successfully implemented any controls besides natural gas-fired oxyfuel burners. The other control options have been shown to be technically infeasible. Based on a review of similar EAF/LMF melt shop applications, the proposed controls represent the best available control technology for the existing EAF/LMF melt shop application.

## NO<sub>x</sub> BACT for EAF

As outlined above, for the existing EAF, the oxy-fuel fired burners are the only technically feasible control option. Review of the RBLC data shows limits established for EAFs ranging from 0.13 lb/ton to 1.0 lb/ton, with most facilities at 0.35 lb/ton or higher. One facility has a NO<sub>x</sub> limit at 0.13 lb/ton, which is an older limit not followed in any subsequent BACT determination and is considered unrealistically low. Two facilities have NO<sub>x</sub> limits just below 0.30 lb/ton.

### BACT Control of Volatile Organic Compound Emissions

VOC emissions from the EAF will be intermittent and limited to the brief period during EAF charging when organic compounds such as oil or paint present in the scrap are volatilized. Potential VOC control alternatives include the following:

(1) Catalytic or Thermal Oxidation;

- (2) Degreasing of scrap metal prior to charging in the EAF; and
- (3) Scrap management program.

<u>CO Oxidation Catalysts</u> -- Based upon a review of the previously listed information resources, there is no known application of oxidation catalysts to control VOC emissions from an EAF. The optimal working temperature range for VOC oxidation catalysts is approximately 850 °F - 1,100 °F with a minimum exhaust gas stream temperature of 500 °F for minimally acceptable control. Exhaust gases from the EAF will undergo rapid cooling as they are ducted from the furnace. Thus, the temperature will be far below the minimum 500 °F threshold for effective operation of CO oxidation catalysts. Additionally, the particulate loading in the exhaust gas stream is anticipated to be too high for efficient operation of a oxidation catalyst. Masking effects such as plugging and coating of the catalyst surface would almost certainly result in impractical maintenance requirements, and would significantly degrade the performance of the

catalyst. Consequently, this control alternative is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

Degreasing of scrap metal prior to charging in the EAF is impractical. The amount of pollution generated by degreasing scrap would be greater than the amount of pollution generated by melting the scrap. There would be thousands of gallons required to degrease the large amount of scrap used annually in the EAFs. Thus, both of these control alternatives are considered technically infeasible and will be precluded from further consideration in this BACT analysis.

The mill utilizes a scrap management program to eliminate the purchase of scrap steel that is heavily oiled. A broker or a Nucor representative is responsible for inspecting shipments of scrap received. The scrap inspector visually inspects the shipments and determine the category of the scrap. An EPA regulation NESHAP YYYYY applicable to mini mills requires that the receipt of free oils in scrap steel charged to furnaces be prohibited. This regulation applies to Nucor, including inspection and recordkeeping requirements.

## **Evaluation of Most Effective VOC Controls for EAF**

Various control alternatives were reviewed for technical feasibility in controlling VOC emissions from the EAF. With the exception of a scrap management program, the applicability of the remaining control options were determined to be technically infeasible. Based on a review of the information resources referenced earlier, it is revealed that these control alternatives have not been successfully implemented to reduce VOC emissions from EAFs. Thus, the projected use of any of these technologies would be considered a "technology transfer." Since, only a single control option was ascertained to be technically feasible, no ranking of control alternatives has been provided.

None of the steel mills reviewed in this analysis have proposed or successfully implemented any controls besides scrap management. The other control options have been shown to be technically infeasible.

Based on a review of similar EAF melt shop applications, the existing controls and the emission limit represent the best available control technology for the EAF melt shop application.

## **Proposal for VOC BACT for EAF**

BACT for controlling VOC emissions from the EAF is proposed as the utilization of the scrap steel management program which includes prohibiting utilizing scrap steel with free oils.

### BACT Control of Particulate Matter (PM/PM<sub>10</sub>) and LAER for PM<sub>2.5</sub> Emissions

Particulate emissions from the EAF will be captured by the DEC and a roof exhaust system and ultimately exhausted through a baghouse. The New Source Performance Standard (NSPS) and NESHAP for particulate matter emissions from an EAF are both 0.0052 grains/dscf. This limit has recently been interpreted to include the combination of condensable and filterable components of PM. Fabric filtration in baghouses is the predominant control device for EAFs. Other particulate control options are not considered as effective or technically feasible. A review of the RBLC database revealed that generally EAFs have been permitted at 0.0018 gr/dscf (filterable) for PM10.

### Evaluation of Most Effective PM/PM10/PM2.5 Controls for EAF

Fabric filtration is the predominant control option for abatement of particulate emissions (PM, PM<sub>10</sub>, PM<sub>2.5</sub>) from an EAF application. Other particulate control options are not considered as effective or technically feasible for an EAF application. Based on a review of the information resources referenced earlier, it was revealed that these control alternatives have not been successfully implemented to reduce particulate emissions from EAFs. Thus, the projected use of any of these technologies would be considered a "technology transfer." Since, only a single control option was ascertained to be technically feasible, no ranking of control alternatives has been provided.

 $PM_{2.5}$  emissions from the electric arc furnaces are generally identical to  $PM_{10}$  emissions. As indicated in AP-42 (Iron and Steel Production, Table 12.5-2), the particle size distribution for particulate matter emission from an EAF controlled by a baghouse shows that 76 percent of the emissions are  $PM_{10}$  and less and 74 percent of the emissions are  $PM_{2.5}$  and less. Thus, the  $PM_{2.5}$  emissions from the baghouse are estimated to be 97.4 percent (74/76) of the  $PM_{10}$  emissions.

A review of the RBLC database revealed that other steel mills have a similar emission limit. None of the steel mills reviewed in this analysis have proposed or successfully implemented any controls besides fabric filtration. The other control options have been shown to be technically infeasible.

Based on a review of similar EAF melt shop applications, the proposed controls and the emission limit represent the best available control technology for the EAF melt shop application.

#### Proposal for PM/PM<sub>10</sub> BACT and PM<sub>2.5</sub> LAER for EAF

BACT for controlling  $PM_{2.5}$  emissions from the EAF is proposed as the use of fabric filtration to meet a filterable  $PM_{2.5}$  limit of 17.4 lbs/hr and 0.00176 gr/dscf

## BACT Control of Sulfur Dioxide (SO<sub>2</sub>) Emissions

The source of SO<sub>2</sub> emissions from the EAF is attributable to the sulfur content of the raw materials charged in the EAF, materials which will be blown into the foaming slag process, and to a much lesser extent, the sulfur content of oil on the scrap steel.

## Potential EAF SO<sub>2</sub> Control Alternatives

The alternatives which are potentially available to control  $SO_2$  emissions from the EAF include the following:

- 1. Lower-Sulfur Charge Substitution; and
- 2. Flue Gas Desulfurization (FGD) options
  - a. Wet Scrubbing
  - b. Spray Dryer Absorption (SDA)
  - c. Dry Sorbent Injection (DSI)

# Technical Feasibility of SO2 Control Alternatives

The test for technical feasibility of any control option is whether it is both available and applicable to reducing SO<sub>2</sub> emissions from the EAF. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

(1) <u>Lower-Sulfur Charge Substitution</u> -- Based on discussions with plant personnel, charge substitution with lower sulfur-bearing raw materials is not practical due to inconsistent availability. Nucor has used low sulfur injection carbon and charge carbon in the steel making process, however, Nucor has found that these materials have uncertain future availability. For example, Nucor's low sulfur injection carbon may not always be available because the source does not offer long term contracts.

## CARBON TYPES

Carbon basically has 3 different uses at the EAF: scrap and scrap substitutes, charge carbon (bucket fed and top fed), and injection carbon. Each of these carbon types act differently on the operation. While there is some minor substitutability, none of these types can truly be a substitute for any of the others.

#### Scrap/Scrap Substitutes

This is carbon inherent in the scrap/scrap substitute charge fed to the furnace. This carbon is consumed in the liquid phase of the steel. As such, it has a very high heating efficiency and the majority of the sulfur remains dissolved in the steel.

### Charge Carbon (Bucket Fed)

This carbon is used to increase the amount of carbon in the liquid steel bath. While not as efficient as carbon already in the scrap/scrap substitutes, approximately 35 – 50% of the fixed carbon can be picked up in the bath depending on many variables. The balance of the fixed carbon acts on the slag (reducing FeO similar to injection carbon, but without the foaming effect) or burns in the top space.

### Charge Carbon (Top Fed)

This carbon is used to reduce the FeO in the slag. It has a relatively high efficiency, with approximately 75% of the fixed carbon reducing FeO. Reaction in the top of the slag layer means that approximately 2/3 of the sulfur leaves as SO<sub>x</sub>, while the remainder stays in the steel and slag.

#### **Injection** Carbon

This is a carbon media that is injected into the slag layer where it reduces FeO and generates CO gas. This foams the slag and improves electrical efficiency. It has a relatively high efficiency, with approximately 65 – 85% of the fixed carbon reducing FeO. Reaction in the middle of the slag layer means that approximately one-half of the sulfur leaves as SO<sub>x</sub>, while the remainder stays in the steel and slag.

#### **CARBON SOURCES**

The sources of this carbon can take many forms. Nucor is dealing with the chemically active "fixed" carbon and not the total carbon or BTU value. Volatiles in the carbon are flash distilled in the top space and play very little part in the furnace. Typical carbon sources are coal, metallurgical coke and petroleum coke.

## Petroleum Coke

For many years petroleum coke was the preferred injection carbon source. This material was very high in fixed carbon, relatively low in sulfur, less abrasive, low in ash, and inexpensive. Since it was only available in small sizes (<1/4'') it was not usable as charge carbon. In recent years low sulfur petroleum coke has been in high demand, costs have increased and availability is limited. Most places have tried substituting some blend of low and high sulfur petroleum cokes. As the supply tightened, more anthracite coal (eastern availability) and metallurgical coke were blended to compensate for reduced availability of petroleum coke. The coal has a different density and does not transport well with petroleum coke in pneumatic systems.

### Metallurgical Coke

Metallurgical coke has been used both as charge and injection carbon. As charge carbon, the material works well. The high fixed carbon content and large piece size makes a good combination. The only drawback is that the coke tends to retain water. Excess water can be an explosion hazard, and precautions to drain water and avoid ice are vital. As mentioned above, the abrasive nature of metallurgical coke with the 10 – 20% ash content causes many problems as an injection carbon. The higher ash content also causes inefficiencies in the furnace, raising power consumption, and creating greater slag amounts as the ash is moved to the slag.

#### <u>Coal</u>

Anthracite coal is the primary coal used in EAF steelmaking where it is available. Bituminous coal can be used. Due to higher volatile content, bituminous coal has lower ignition and flash points. This means that it can ignite and even explode under certain storage conditions. Some bituminous coal is used as charge carbon in Utah because of the local availability. Other than brief experiments, bituminous coal is not used as an injection carbon because of the hazards.

#### SUPPLY TRENDS

Petroleum coke has been rising in sulfur content for the past several years. As more of the world's available crude is heavier and higher in sulfur content, the sulfur levels in petroleum coke will continue to increase. Most domestic petroleum coke supplies are projected to be around 3-3.5% sulfur. Lower sulfur petroleum cokes are difficult to obtain.

Metallurgical coke is currently both manufactured in the U.S. and imported from overseas. Many of the U.S. producers are at least partially dependent on foreign coal.

In the early part of this decade over supply from China severely damaged domestic production capability and, when the Chinese government restricted the export of coke, a severe shortage developed. Metallurgical coke producers in the U.S. are also heavily dependent on a very few coking coal deposits in the Northeast.

Bituminous coal, while plentiful, is not suited to many steelmaking situations. The supply of low volatile low sulfur bituminous coal is not much better than that of the low sulfur anthracite discussed below. The low fixed carbon levels mean that much larger quantities are required to meet the carbon requirements of the EAF. These coals also pose a safety hazard in many existing storage and handling systems.

Anthracite coal could be an option for lower SO2 emissions but it presents its own operational problems and availability problems for use in a mill located in the west. U.S. production is confined almost exclusively to central Pennsylvania. The main alternative use of this material is home and industrial heating. This means that price and availability varies seasonally, and even within the seasons, weather conditions can drastically affect market conditions. Of greatest impact is the cost prohibitive rail rates of moving material across the US. China, Russia, and Vietnam can be foreign suppliers of this material. High ocean freights and market disruptions caused by expansion in China have made this imported material prohibitively expensive. Occasionally spot cargos have been offered when Far East demand temporarily drops, but these cargos disappear as soon as the Oriental demand returns. Traders that do extensive business with China have been informed that the Chinese government plans to continue increasing tariffs and export restrictions to make China a net importer of coal and conserve both future reserves and limited infrastructure, which is tied up moving coal to the coast, instead of expanding their domestic economy.

#### Assessment

Petroleum coke sulfur concentrations are increasing and low sulfur petroleum cokes are essentially unavailable. Metallurgical coke is limited in supply, not useable as an injection carbon, and is used for other critical industrial operations besides steelmaking, making it difficult to consistently obtain and subject to periodic price spikes. Bituminous coals are largely unsuited to steelmaking, leaving anthracite as the remaining major source. Anthracite sulfur concentrations are also increasing and the supply of the lower sulfur coals is diminishing both domestically and in the world market. Therefore, continued availability of low sulfur sources of carbon cannot be assured.

The fixed carbon is another important variable. As the percent of fixed carbon diminishes, correspondingly more of the carbon source must be used to achieve the same result. Not only are the lower sulfur coals and cokes decreasing in availability, but they are not cost effective. Because of the combined problems caused by decreasing

availability, increased cost, and the consequent difficulty in relying upon the lower sulfur feedstocks, lower sulfur feedstocks, including carbon sources, are not technically and economically feasible.

(2) <u>Flue Gas Desulfurization</u> -- FGD systems currently in use for SO<sub>2</sub> abatement can be classified as wet and dry systems. Note that based on a review of the RBLC database and discussions with various individuals knowledgeable about steel mill operations, it was revealed that control technologies for SO<sub>2</sub> abatement have not been successfully implemented for EAFs. However, FGD options which have been traditionally applied to utility boilers may be available to control SO<sub>2</sub> from the EAF. Therefore, the application of these technologies to the EAF will be examined further.

For FGD controls in general, the expected variability and low SO<sub>2</sub> concentrations in the gas stream are not amenable to responsive FGD treatment which is typically geared for high sulfur fuel combustion systems. In addition, the relatively large gas flow and the large amplitude temperature variations would cause insurmountable operational difficulties. The effective SO<sub>2</sub> control efficiencies would be significantly impaired.

(2a) Wet Scrubbing -- Wet scrubbers are regenerative processes which are designed to maximize contact between the exhaust gas and an absorbing liquid. The exhaust gas is scrubbed with a 5 - 15 percent slurry, comprised of lime (CaO) or limestone (CaCO<sub>3</sub>) in suspension. The SO<sub>2</sub> in the exhaust gas reacts with the CaO or CaCO<sub>3</sub> to form calcium sulfite (CaSO<sub>3</sub>.2H<sub>2</sub>O) and calcium sulfate (CaSO<sub>4</sub>). The scrubbing liquor is continuously recycled to the scrubbing tower after fresh lime or limestone has been added.

The types of scrubbers which can adequately disperse the scrubbing liquid include packed towers, plate or tray towers, spray chambers, and venturi scrubbers. In addition to calcium sulfite/sulfate, numerous other absorbents are available including sodium solutions and ammonia-based solutions.

There are various potential operating problems associated with the use of wet scrubbers. First, particulates are not acceptable in the operation of wet scrubbers because they would plug spray nozzles, packing, plates and trays. Thus, the scrubber would have to be located downstream of the EAF baghouse. This would substantially increase the capital cost of the wet scrubber, which is typically two to three times more expensive than the capital cost for a dry scrubber. Wet scrubbers also require handling, treatment, and disposal of a sludge by-product. In this case, air emissions would be exchanged for a large-scale water pollution problem. Treatment of wet scrubber wastes requires reverse osmosis (RO) units which are unreliable; requiring frequent maintenance by an experienced operator. Finally, the volumetric exhaust gas flow rate from through the baghouse system is high. When coupled with the relatively low SO<sub>2</sub> emission rates, a relatively small SO<sub>2</sub> concentration of around 1-20 ppmv will result in

the exhaust. The  $SO_2$  concentration will also vary widely over the EAF cycle which operate as a batch process. This will preclude efficient application of wet scrubbing.

Based on discussions with major wet scrubber vendors (i.e., Wheelabrator Air Pollution Control Inc., Bionomic Industries Inc., Beco Engineering Company, Ducon Technologies Inc.), it was clearly evident that there was a dearth of experience in applying wet scrubbing technology for an EAF application. This fact corroborated the findings from the review of the RBLC database and discussions with various individuals knowledgeable about steel mill operations that control technologies for SO<sub>2</sub> abatement have not been successfully implemented for EAFs. The possibility of water in the baghouse is a major operating problem, which would allow the dust to form into hard cement in the baghouse hoppers and cause the bags to blind with the caked dust. This would then lead to opacity problems and broken dust augers in the baghouse.

In general, the consensus of the major vendors was against applying wet scrubbing technology for the following reasons:

- Intrinsic nature of EAF operations on a batch basis;
- Inability to efficiently control SO<sub>2</sub> due to cyclic nature of process, timing of SO<sub>2</sub> evolution from the furnace, and duration of SO<sub>2</sub> emissions;
- Variability of SO<sub>2</sub> emissions and low SO<sub>2</sub> concentrations;
- Variability of gas flow and temperature with unpredictable thermal cycling; and
- Unable to provide credible and sustained SO<sub>2</sub> removal guarantees due to above reasons.

Thus, there are significant reservations regarding effective technical applicability of this control alternative for the EAF application. Due to the large gas flows, the equipment would have to be over-sized with care for corrosion resistance. Besides the issues pertaining to pollutant concentration cycling and lack of compensatory system response, there are concerns about handling, treatment and disposal of sludge-phase and liquid-phase wastes which have the potential of being classified as hazardous wastes. Moreover wet scrubbing has never been proposed nor successfully implemented for similar steel mill applications. In view of the above limitations, the wet scrubber option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(2b) Spray Dryer Absorption (SDA) -- An alternative to wet scrubbing is a process known as dry scrubbing, or spray-dryer absorption (SDA). As in wet scrubbing, the gas-phase SO<sub>2</sub> is removed by intimate contact with a suitable absorbing solution.

Typically, this may be a solution of sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>) or slaked lime  $[Ca(OH)_2]$ . In SDA systems the solution is pumped to rotary atomizers, which create a spray of very fine droplets. The droplets mix with the incoming SO<sub>2</sub>-laden exhaust gas in a very large chamber and subsequent absorption leads to the formation of sulfites and sulfates within the droplets. Almost simultaneously, the sensible heat of the exhaust gas which enters the chamber evaporates the water in the droplets, forming a dry powder before the gas leaves the spray dryer. The temperature of the desulfurized gas stream leaving the spray dryer is now approximately 30 - 50 °F above its dew point.

The exhaust gas from the SDA system contains a particulate mixture which includes reacted products. Typically, baghouses employing Teflon-coated fiberglass bags (to minimize bag corrosion) are utilized to collect the precipitated particulates.

The SDA process would not have many of the potential operating problems associated with the wet scrubbing systems. However, the volumetric exhaust gas flow rate from the melt shop(s) will be approximately 1,050,000 dscfm. When coupled with the relatively low SO<sub>2</sub> emission rates, a relatively small SO<sub>2</sub> concentration of around 1-20 ppmv in the exhaust will result. The SO<sub>2</sub> concentration will also vary widely over the EAF cycle. Based on discussions with a major SDA vendor (Wheelabrator Air Pollution Control Inc.), this control alternative has significant limitations for effective technical applicability for an EAF application:

- a. The very low SO<sub>2</sub> concentration of around 1 20 ppmv in the influent coupled with a relatively large gas flow of 1,050,000 dscfm would retard the adequate contact interface with the reagent. The vendor noted that the inlet SO<sub>2</sub> concentrations would be lower than the outlet concentrations that most SDAs are designed for;
- b. The variations in the SO<sub>2</sub> concentration during and between heats would severely impair the control system's capability to respond adequately. SDA systems are not designed for adept load-follow flexibility;
- c. The low temperature of the exhaust gas of around 210 °F and the low gas moisture would not allow sufficient thermal gradient for an appropriate approach to saturation which typically specifies that the temperature of the desulfurized gas stream leaving the spray dryer be around 30 50 °F above its dew point;
- d. Thermal cycling during the regular batch operation of the EAF in concert with the melting and refining heats could potentially result in less than desirable temperature approaches to saturation, thereby, raising the prospect of wet fouling. The system would be hard to control with attendant near-loss of SO<sub>2</sub> control efficiencies; and
- e. Unable to provide credible and sustained SO<sub>2</sub> removal guarantees due to above reasons.

Thus, there are significant reservations regarding effective technical applicability of this control alternative for the EAF application. In addition to the above issues, there are significant concerns about handling, treatment and disposal of large amounts of dry solid wastes which have the potential of being classified as hazardous wastes. Moreover SDA has never been proposed nor successfully implemented for similar steel mill applications. In view of the above limitations, the SDA dry scrubbing option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

**(2c)** *Dry Sorbent Injection (DSI)* -- This control option typically involves the injection of dry powders into either the furnace or post-furnace region of utility-sized boilers. This process was developed as a lower cost option to conventional FGD technology. Since the sorbent is injected directly into the exhaust gas stream, the mixing offered by the dry scrubber tower is not realized. The maximum efficiency realized for this SO<sub>2</sub> control technology is estimated to be fairly nominal. It is felt that if sufficient amounts of reactants are introduced into the flue gas, there is a possibility of some degree of mixing and reaction. The science is inexact and the coupling of reactant dosage and influe mixing which impacts the SO<sub>2</sub> control efficiency is susceptible to variability in SO<sub>2</sub> concentrations.

The dry sorbent injection process would not have many of the potential operating problems associated with the wet scrubbing systems. However, the volumetric exhaust gas flow rate from the EAF will be approximately 1,050,000 dscfm. When coupled with the relatively low SO<sub>2</sub> emission rates, a relatively small SO<sub>2</sub> concentration of 1 - 20 ppmv will result in the exhaust. The SO<sub>2</sub> concentration will also vary widely over the EAF cycle. The injection dose of sorbent materials would be hard to control in order to match variability in SO<sub>2</sub> concentrations. Similar control systems are fraught with chronic operational problems with the sensors requiring frequent maintenance and calibration.

Based on discussions with a major scrubbing vendor (Wheelabrator Air Pollution Control Inc.), this control alternative has significant limitations for effective technical applicability for an EAF application which were discussed earlier in the context of a dry scrubbing (SDA) system:

- a. The very low SO<sub>2</sub> concentration of around 1 20 ppmv in the influent coupled with a relatively large gas flow of 1,050,000 dscfm would retard the adequate contact interface with the reagent. The vendor noted that the inlet SO<sub>2</sub> concentrations would be lower than the outlet concentrations that most DSIs are designed for:
- b. The variations in the SO<sub>2</sub> concentration during and between heats would severely impair the control system's capability to respond adequately. DSI systems are not

designed for adept load-follow flexibility and variable reactant dose control with fast response times comparable to anticipated process conditions;

- c. Due to the anomalies of mixing afforded by the process, the reaction kinetics are not very flexible and rather time-dependent. Unlike the SDA system, the mixing uncertainty can potentially reduce DSI technology to a sheer brute-force proposition resulting in unstable and unpredictable performance;
- d. In a DSI-fabric filter coupled system configuration, whereby most of the reaction takes place on the filter cake on the bags, the vendor felt that adequate residence time simply would not be available since the attendant higher particulate load would necessitate a higher cleaning frequency of the fabric filter; and
- e. Unable to provide credible and sustained  $SO_2$  removal guarantees due to above reasons.

Thus, there are significant reservations regarding effective technical applicability of this control alternative for the EAF application. In addition to the above issues, similar to the SDA, there are significant concerns about handling, treatment and disposal of large amounts of dry solid wastes which have the potential of being classified as hazardous wastes. Moreover DSI has never been proposed nor successfully implemented for similar steel mill applications. In view of the above limitations, the DSI dry scrubbing option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

#### Evaluation of Most Effective SO2 Controls for EAF

Various control alternatives were reviewed for technical feasibility in controlling SO<sub>2</sub> emissions from the EAF. All potential control options were determined to be technically infeasible. Based on a review of the information resources referenced earlier, it is revealed that these control alternatives have not been successfully implemented to reduce SO<sub>2</sub> emissions from EAFs. Thus, the projected use of any of these technologies would be considered a "technology transfer."

A review of the RBLC database revealed only that other steel mills have a similar emission limit. None of the steel mills reviewed in this analysis have proposed or successfully implemented any controls. The other control options have been shown to be technically infeasible.

Based on a review of similar EAF melt shop applications, the existing controls and the emission limit represent the best available control technology for the EAF melt shop application.

## Proposal for SO2 BACT for EAF

BACT for controlling  $SO_2$  emissions from the EAF is the use of a scrap management program and variable charge and injection carbon materials to meet the maximum  $SO_2$  emission rates.

#### BACT Analysis for Caster and Caster Steam Vent

The caster forms a solid continuous slab as molten steel passes through a water-cooled mold. Fugitive PM emissions may be generated during the casting of hot metal; however, the emissions are evacuated to the melt shop baghouse, which is BACT for PM emissions. A small amount of fugitive PM emissions is included with the emissions from the melt shop building. The steel billets are water-sprayed to cool the steel. The steam generated from this process is vented through a vent to the atmosphere. A small amount of PM emissions are associated with the steam. PM emissions tested at the caster steam vent at the Nucor Crawfordsville, Indiana steel mill were used to represent PM emissions for the Utah caster steam vent. There are no feasible controls for these PM emissions.

## BACT Analysis for Caster Area Roof Emissions

The caster emissions include emissions from the tundish and ladle preheating, skull lancing, ladle stirring, and other caster operations. The preheating of the ladle and tundish is done with natural gas fired burners. The use of natural gas is BACT as use of other fuels represent higher emission rates. The skull lancing is an operation that removes excess steel from the tundish and ladles through the use of cutting torches. This process takes place inside the caster building and the some of the emissions are assumed to escape the building. This source is not in continuous operation, thus, no further controls are justified. Ladle stirring and caster operations can occur at the caster and involve the additions of alloy and stirring the molten steel with a nitrogen lance. The molten steel is then poured and cast into billets. Emissions are fugitive in nature and a portion of the emissions are assumed to escape the building. There are no feasible control methods for the small emissions associated with this operation.

#### BACT Analysis for Billet Reheat Furnaces

Nucor has two reheat furnaces. Reheat furnace No. 1 is rated at a maximum of 160 MMBtu/hr; limited to 1,320,000,000 ft<sup>3</sup> natural gas/year and has a NO<sub>x</sub> emission rate of 0.09375 lb/MMBtu. Reheat furnace No. 2 is rated at a maximum of 134 MMBtu/hr; limited to 980,000,000 ft<sup>3</sup> natural gas /year and has a NO<sub>x</sub> emission rate of 0.0597 lb/MMBtu. Both reheat furnace can use propane but this is during emergency conditions. The table below provides a list of reheat, tunnel, roller hearth and reheat furnaces at other steel mills with their NO<sub>x</sub> emission limit.

STEEL MILL	HEAT INPUT RATE (MMBtu/hr)	NOx EMISSION RATE (lb/MMBtu)
Nucor Steel – Tuscaloosa, AL	400	0.075
Nucor Steel – Auburn, NY	179	0.075
Nucor Steel – Hickman, AR	250.5	0.18
Nucor-Yamato Steel- Blytheville, AR	300	0.171
Nucor Gallatin – Ghent, Kentucky	124 (No.1)	0.09
	80.7 (No.2)	
MacSteel – Fort Smith, AR	45	0.14
Nucor Steel - Darlington, SC	140 (No.1)	0.104
	125 (No.2)	0.104
	185 (proposed)	0.092
Nucor Steel - Huger, SC	125 (No. 1)	0.19
	85 (No. 2)	0.17
	185 (reheat furnace)	0.15
Nucor Steel - Cofield, NC	309	0.128
Nucor Steel – Crawfordsville, IN	174	0.19
	26 (shuttle furnaces)	0.10
Nucor Steel – Birmingham, AL	203	0.174
Nucor Steel – Kankakee, IL	160	0.07
Charter Steel – Saukville, WI	115	0.09
Chaparral Steel	276	0.21
IPSCO Steel		0.23
Republic Technologies -	196.2	0.112
Canton, OH		
Ameristeel - Baldwin		0.19

As indicated in the above table, the  $NO_x$  emissions rates range from 0.07 to 0.23 lb/MMBtu. The lowest  $NO_x$  emission rates are for the Nucor Kankakee, IL ; Nucor Tuscaloosa, AL; and Nucor Auburn, NY are 0.07 0.075, and 0.075 lb/MMBtu, respectively. Nucor's present NOx emissions are 0.09375 and 0.0597 lb/MMBtu, for reheat furnace no. 1 and reheat furnace No.2, respectively.

#### 2.2.5.1 BACT Control of Oxides of Nitrogen (NO<sub>x</sub>) Emissions

 $NO_x$  emissions from the reheat furnace primarily result from combustion by-product of the fuel. The reheat furnaces have ultra-Low  $NO_x$  burners to minimize  $NO_x$  emissions. The use of ultra-Low  $NO_x$  burners ( $NO_x$  emissions of 0.075 lb/MMBtu) was accepted as BACT technology. As a result, since this represents BACT, it is not necessary to address lesser control technologies. As part of Nucor's Consent Decree, a detailed investigation was undertaken for  $NO_x$  emission controls from the reheat furnace. The conclusions

were that ultra low  $NO_x$  burners to meet a limit of 0.075 lb  $NO_x/MMBtu$  can be applied to new reheat furnaces. Existing reheat furnaces retrofitted with new burners should meet an emission limit of 0.09 lb  $NO_x/MMBtu$ . This investigation looked at other add-on controls such as SCR.

### BACT Control of Volatile Organic Compound Emissions

The reheat furnaces have ultra-low NO<sub>x</sub> burners. The VOC emissions for the reheat furnace were calculated using the latest AP-42 emissions factors (Table 1.4-2, July 1998). The emission factor was 5.5 lbs/million cubic foot and represents low NO<sub>x</sub> burners. The natural gas combustion factors were derived based on tests for various boilers. These factors have generally been applied to other industrial emission sources that combust natural gas (e.g. reheat furnace, dryers and burners).

VOC emissions from the reheat furnace primarily result from combustion by-product of the fuel. Due to the relatively small emissions from natural gas combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for VOC control from similar sized natural gas-fired reheat furnaces. In conclusion, for the existing reheat furnaces, BACT for controlling VOC emissions is proposed as the use of natural gas-fired burners employing good combustion practices per manufacturer's guidance to meet a VOC emission rate of 0.0055 lbs/MMBtu.

#### BACT Control for PM<sub>2.5</sub> Emissions

 $PM_{2.5}$  emissions from the reheat furnace primarily result from combustion by-product of the fuel. Due to the relatively small emissions from natural gas combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT/LAER analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for  $PM_{2.5}$  from similar sized natural gas-fired reheat furnaces. BACT for controlling  $PM_{2.5}$  emissions is proposed as the use of natural gas-fired burners employing good combustion practices per manufacturer's guidance to meet a  $PM_{2.5}$  emission rate of 0.0076 lb/MMBtu.

## BACT Control of Sulfur Dioxide (SO2) Emissions

SO<sub>2</sub> emissions from the reheat furnace primarily result from combustion by-product of the fuel. Due to the relatively small emissions from natural gas combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for SO<sub>2</sub> control from similar sized natural gas-fired reheat furnaces. BACT for controlling SO<sub>2</sub> emissions is the use of

natural gas-fired burners employing good combustion practices per manufacturer's guidance to meet a  $SO_2$  emission rate of 0.0006 lb/MMBtu.

## BACT Analysis for Natural Gas-Fired Preheaters and Dryers

Nucor's natural gas fired preheaters and dryers are located and exhaust in the melt shop building.

## BACT Control of Oxides of Nitrogen (NO<sub>x</sub>) Emissions

NO<sub>x</sub> emissions from these small preheaters and dryers primarily result from combustion by-product of the fuel. Due to the relatively small emissions from natural gas combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for NO<sub>x</sub> control from similar sized natural gas-fired combustion equipment in other industries. Based on a review of similar natural gas-fired applications, the proposed emission limit represents the best available control technology for the burners and dryers.

In conclusion, for the preheaters and dryers, BACT for controlling NO<sub>x</sub> emissions is proposed as the use of natural gas-fired burners employing good combustion practices per manufacturer's guidance to meet a NO<sub>x</sub> emission rate of 0.1 lb/MMBtu.

## BACT Control of PM<sub>2.5</sub> Emissions

Particulate matter emissions from the small preheaters and dryers primarily result from carryover of non-combustible trace constituents in the fuel. Typically, particulates are hard to detect with natural gas firing due to the low ash content. The USEPA reference AP-42 recommends that all particulate emissions from natural gas combustion are less than 1 micron in aerodynamic diameter.

Based on a review of the previously listed information resources including the RBLC database, it was revealed that with the exception of natural gas as fuel and good combustion practices, no other control technologies for particulate abatement have been successfully implemented for small preheaters and dryers emissions. In addition, the RBLC database did not reveal any add-on control technologies for similar sized natural gas-fired combustion equipment in other industries.

Based on a review of similar natural gas-fired applications, the proposed emission limit represents the best available control technology for the small preheaters and dryers.

BACT for controlling  $PM_{2.5}$  emissions from the small preheaters and dryers is proposed as the use of natural gas combustion with good combustion practices per manufacturer's guidance to meet a TSP/PM<sub>10</sub> emission rate of 0.0076 lb/MMBtu.

## BACT Control of Sulfur Dioxide (SO2) Emissions

SO<sub>2</sub> emissions from these small preheaters and dryers primarily result from combustion by-product of the fuel. Due to the relatively small emissions from natural gas combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for SO<sub>2</sub> control from similar sized natural gas-fired combustion equipment in other industries. Based on a review of similar natural gas-fired applications, the current emission limit represents the best available control technology for the proposed burners and dryers.

BACT for controlling  $SO_2$  emissions from preheaters and dryers the use of natural gasfired burners employing good combustion practices per manufacturer's guidance to meet an  $SO_2$  emission rate of 0.0006 lb/MMBtu.

## BACT Control of Volatile Organic Compound Emissions

VOC emissions from these small preheaters and dryers primarily result from combustion by-product of the fuel. Due to the relatively small emissions from natural gas combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for VOC control from similar sized natural gas-fired combustion equipment in other industries. Based on a review of similar natural gas-fired applications, the proposed emission limit represents the best available control technology for the burners and dryers.

BACT for controlling VOC emissions from preheaters and dryers is the use of natural gas-fired burners employing good combustion practices per manufacturer's guidance to meet a VOC emission rate of 0.0055 lb/MMBtu.

## BACT/LAER Analysis for Proposed Heat Retention Boxes

While not installed, Nucor has permits to add natural gas combustion equipment that will include a two heat retention boxes (each rated at 5 MMBtu/hr). These would be located in the rolling mill building.

### BACT Control of Oxides of Nitrogen (NO<sub>x</sub>) Emissions

NO<sub>x</sub> emissions from these small burners primarily result from combustion by-product of the fuel. Due to the relatively small emissions from natural gas combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for NO<sub>x</sub> control from similar sized natural gas-fired combustion equipment in other industries. Based on a review of similar natural gas-fired applications, the proposed emission limit represents the best available control technology for the burners.

BACT for controlling NO<sub>x</sub> emissions is the use of natural gas-fired burners employing good combustion practices per manufacturer's guidance to meet a NO<sub>x</sub> emission rate of 0.05 lb/MMBtu.

### BACT Control PM<sub>2.5</sub> Emissions

Particulate matter emissions from the small burners primarily result from carryover of non-combustible trace constituents in the fuel. Typically, particulates are hard to detect with natural gas firing due to the low ash content. The USEPA reference AP-42 recommends that all particulate emissions from natural gas combustion are less than 1 micron in aerodynamic diameter.

Based on a review of the previously listed information resources including the RBLC database, it was revealed that with the exception of natural gas as fuel and good combustion practices, no other control technologies for particulate abatement have been successfully implemented for natural gas fired burners.. In addition, the RBLC database did not reveal any add-on control technologies for similar sized natural gas-fired combustion equipment in other industries.

BACT for controlling  $PM_{2.5}$  emissions from the small preheaters and dryers is the use of natural gas combustion with good combustion practices per manufacturer's guidance to meet a  $PM_{2.5}$  emission rate of 0.0076 lbs/MMBtu.

## BACT Control of Sulfur Dioxide (SO2) Emissions

SO<sub>2</sub> emissions from these small preheaters and dryers primarily result from combustion by-product of the fuel. Due to the relatively small emissions from natural gas combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for SO<sub>2</sub> control from similar sized natural gas-fired combustion equipment in other industries. Based on a review of similar natural gas-fired applications BACT for controlling  $SO_2$  emissions is the use of natural gas-fired burners employing good combustion practices per manufacturer's guidance to meet an  $SO_2$  emission rate of 0.0006 lb/MMBtu.

### BACT Control of Volatile Organic Compound Emissions

VOC emissions from these small burners primarily result from combustion by-product of the fuel. Due to the relatively small emissions from natural gas combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for VOC control from similar sized natural gas-fired combustion equipment in other industries. Based on a review of similar natural gas-fired applications, the use of natural gas burners represents the best available control technology for the burners.

## BACT Analysis for Plant Wide Torches and Lancing

Nucor conducts various torching and lancing throughout the mill utilizing either acetylene or natural gas as a fuel.

## BACT Control of Oxides of Nitrogen (NO<sub>x</sub>) Emissions

 $NO_x$  emissions from these torches primarily result from combustion by-product of the fuels. Due to the relatively small emissions from combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis.

#### BACT Control of PM<sub>2.5</sub> Emissions

Particulate matter emissions from these torches primarily result from carryover of noncombustible trace constituents in the fuel and particulate from the burning of steel.

Based on a review of the previously listed information resources including the RBLC database, no other control technologies for particulate abatement have been successfully implemented for small torches. In addition, the RBLC database did not reveal any add-on control technologies tor similar torching operations.

Torching operations are conducted plant wide both within large buildings and outdoors. Mostly the torching operations are intermittent at various locations where capturing these emissions are not practical, and even if they were at specific locatons only, the amounts are very small where add on capture devices are not warranted for BACT. Torches utilized at the caster at a permanent location and located below a ventilation system where much of the emissions are captured and passed through the EAF baghouse which controls particulate emissions.

## BACT Control of Sulfur Dioxide (SO<sub>2</sub>) Emissions

 $SO_2$  emissions from these torches primarily result from combustion by-product of the fuel. Due to the relatively small emissions from combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for  $SO_2$  control for torches.

## BACT Control of Volatile Organic Compound Emissions

VOC emissions from these torches primarily result from combustion by-product of the fuel. Due to the relatively small emissions from combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis.

## BACT Analysis for Rolling Mill

Fumes in roll mill are associated with the hot steel rolling process. The steel is spray with water to reduce its temperature and minimize PM<sub>2.5</sub> emissions. A high level of control is assumed (99.9%) due to continuous water spray and because the operation is contained within a building. Because oils are lost to the water and the water contacts hot steel, some VOC emissions result from the vaporization of the heavy oils. These VOC emissions are addressed through a mass balance quantification methods by studies conducted by Nucor Corporation.

Because of the large area of the emission source within the building and the large volume of air to be evacuated, it is not practical to capture particulate and VOC emissions from the rolling operations to meet BACT.

## BACT Analysis for Roll Mill 1 Saw Shack Baghouse

Fumes in the mill associated with abrasive saw cutting are exhausted by a fan having a flow rate of 15,000 cfm and an outlet grain loading of 0.01 grain/dscf. Based on a review of the RBLC database, fabric filtration is the only add-on control of choice for similar process applications. As a consequence, the baghouse is BACT for  $PM_{2.5}$  emissions from the abrasive saw.

## BACT Analysis for Roll Mill 1 Jump Mill Baghouse

Nucor has obtained a permit, but does not currently operate, a baghouse to capture fumes from a hot rolling mill stand which makes several passes. These fumes currently are emitted within the building, but if installed, could be exhausted by a fan having a flow rate of 8,000 cfm and an baghouse having an outlet grain loading of 0.01 grain/dscf. The baghouse would have a stack to vent outdoors. Based on a review of the RBLC database, fabric filtration is the only add-on control of choice for similar process applications. As a consequence, the baghouse is BACT for for PM<sub>2.5</sub> emissions from the roll mill building.

## BACT Analysis for Scrap Steel Handling

Scrap Steel handling can cause emissions of PM2.5 resulting from dirt and rust on the steel. Existing BACT controls are in place that consists of the following with estimated control: direct from railcar (70 percent control); handled from covered truck dump (50 percent control); handled to and from stockpiles, watered as necessary (50 percent control); and handled from uncovered truck dump, watered as necessary (50 percent control). BACT controls in place and opacity restrictions are contained in permits.

### BACT Analysis for Storage Silos

Nucor has 4 carbon silos with three baghouses, one of which exhausts inside the melt shop, and the meltshop is evacuated to the EAF baghouse. There are two lime silos which are served with one baghouse. The silos have a small baghouse to prevent the material from escaping during filling operations. Each baghouse has an estimated flow rate of 1,020 cfm and an outlet grain loading of 0.01 grain/dscf. Based on a review of the RBLC database, fabric filtration is the only add-on control of choice for similar process applications. As a consequence, baghouse control is considered as BACT for  $PM_{2.5}$  emissions from the storage silos.

#### BACT Analysis for Paved/Unpaved Roads

The mill has paved and unpaved roads for the transportation of raw materials and slag, in addition to other miscellaneous vehicle travel. Nucor dramatically reduces PM<sub>2.5</sub> emissions associated with vehicular traffic on paved roadways by periodically sweeping or water flushing (as conditions warrant). Nucor dramatically reduces PM<sub>2.5</sub> emissions associated with vehicular traffic on unpaved roadways by water spray and/or chemical treatment in sufficient frequency to minimize emissions. The present controls applied to paved and unpaved roads are BACT for PM<sub>2.5</sub>.

## BACT Analysis for Material Handling and Stockpiles

Material handling consists of the following with estimated control: alloy/lime stockpiles (3-sided roofed bin, 90 percent control); alloy handling railcar unloading NE (Water sprays); alloy handling railcar unloading melt shop belly dump (90 percent control within building); small slag storage pile for truck bed lining (controlled by size); slag transfer to truck transfer below grade (90 percent control); and belly dump lime unloading at melt shop (90 percent control). The resulting small emissions with the controls in place are BACT.

## **BACT Analysis for Cooling Towers**

Nucor has the following cooling towers set installations: roll mill contact (8,000 gpm); roll mill and melt shop non contact (4,600 gpm); DEC (10,000 gpm); and the caster system (4,000 gpm). The cooling towers are equipped with drift mist eliminators have a drift rate of 0.0006 percent, except for the DEC system which has a drift rate of 0.001 percent. The maximum PM emissions associated with the towers are 1.57 tpy and assumed all PM2.5. PM emissions were calculated using the factor of 0.16 presented in the technical paper "Calculating Realistic PM<sub>10</sub> Emissions from Cooling Towers" (Reisman and Frisbie). The use of drift eliminators for cooling towers is BACT.

# BACT Analysis for Emergency Generators

Nucor is permitted diesel-fueled, gasoline powered, and natural gas fired generators. As emergency generators, they are seldom used with periodic maintenance firing and occasional use with loss of power. The majority are hand carry sized used backup UPS systems for computers in the event of extended loss of power. Some larger generators are installed in stationary locations to handle critical operations such as emergency equipment or molten steel. All stationary generators meet the applicable requirements for generators contained in EPA's NESHAP or NSPS, which is BACT for generators. These federal regulations address NOX, organic emissions, and particulates.

## BACT Analysis for Miscellaneous Painting and Solvent Cleaning

Nucor has miscellaneous painting and solvent use. Painting is conducted plant wide on buildings, equipment, for safety markings, and to identify products. Present VOC emissions are included in plantwide permit limitations for the amounts that can be purchased or used. Typically, a BACT analysis for painting operations identifies that a paint booth with particulate filters is necessary to meet BACT. VOC emissions control are not considered feasible, due to the small emissions levels from the miscellaneous painting. Because painting is conducted plant wide a specific paint booth with add-on control is not possible for miscellaneous painting operations. However, spray most painting is performed inside a building which greatly limits the PM emissions to the

atmosphere. Similarly, miscellaneous solvent use is utilized plant wide. Miscellaneous solvent use is distinguished from the utilization of parts washers in that solvents are used at the location of the repair. The majority of these solvents used are in aerosol cans which are sprayed on the equipment part at the operating location where it may be repaired on-line or at a designated repair location. The equipment is typically too large to be placed in a parts washer with a closing lid.

Nucor does have a painting process at the operation for providing painted product to customers. As part of the process, this painting operation is limited to the types of paint that can be used to limit VOC emissions. The rule is applicable in nonattainment areas and is 2.3 lbs/VOC per gallon of paint. Nucor utilizes a water based paint to comply with this rule. Compliance with this rule meets VOC BACT for painting used in a process. The painting operation used at Nucor is a dip process. Therefore does not cause any particulate emissions where a BACT analysis is necessary.

# BACT Analysis for Sandblasting

Sandblasting can represent significant emissions of PM if substantial sandblasting is completed and the operations are uncontrolled. Nucor conducts sandblasting within a 3-sided building with a roof. Sand blasting is not part of Nucor's manufacturing process. Rather it is used for our own equipment maintenance or functionality. The amount of PM<sub>2.5</sub> is very limited due to the small utilization and containment within buildings. Control is achieved by limiting air movement around the operations so that PM settles in the immediate area. Nucor's controls meet the sandblasting requirements contained in R307-206, UAC and BACT.

## BACT Analysis for Volatile Organic Storage Tanks

There are 2 diesel storage tanks and one gasoline storage tank. Emissions associated with these tanks are calculated with the USEPA TANKS program. These tanks are equipped with pressure relief devices to reduce breathing losses. VOC emissions are very small. Due to the small emissions associated with the filling and evaporative losses due to these tanks, no further control is necessary to meet BACT.

## BACT Analysis for Vacuum Ladle Degasser

Nucor has permitted, but not yet installed, a vacuum ladle degasser that will process the molten steel in the melt shop. The vacuum degasser will be limited to 100,000 tons/year and approximately 1,500 hours/year. The exhaust gas will be ducted to a flare.

### BACT Control of Oxides of Nitrogen (NO<sub>x</sub>) Emissions

 $NO_x$  emissions from the vacuum degasser result from the degassing of the liquid steel and due to combustion by-product of the fuel in the flare (used for CO emissions control). Due to the relatively small emissions from natural gas combustion and the vacuum degassing process, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for  $NO_x$  control from vacuum degassers. Based on a review of similar applications, the proposed emission limit of 0.005 lb/ton represents the best available control technology for the vacuum degasser.

## BACT Control of Particulate Matter (PM/PM<sub>10</sub>) and LAER for PM<sub>2.5</sub> Emissions

Particulate matter emissions from the vacuum degasser result from the degassing of the liquid steel and due to combustion by-product of the fuel in the flare (used for CO emissions control). Due to the relatively small emissions from natural gas combustion and the vacuum degassing process, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for PM from vacuum degassers.

Based on a review of similar natural gas-fired applications, the proposed emission limit represents the best available control technology for the vacuum degasser.

In conclusion, BACT for  $PM/PM_{10}$  and LAER for  $PM_{2.5}$  emissions from the vacuum degasser is proposed as the use of natural gas combustion with good combustion practices per manufacturer's guidance to meet a  $PM/PM_{10}/PM_{2.5}$  emission rate of 0.008 grain/dscf.

## BACT Control of Sulfur Dioxide (SO2) Emissions

Sulfur dioxide emissions from the vacuum degasser result from the degassing of the liquid steel and due to the combustion by-product of the fuel in the flare (used for CO emissions control). Due to the relatively small emissions estimated from natural gas combustion and the vacuum degassing process, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for SO<sub>2</sub> control from the vacuum degasser.

#### BACT Control of Volatile Organic Compounds (VOC) Emissions

Volatile organic compound emissions from the vacuum degasser result from the degassing of the liquid steel and due to the combustion by-product of the fuel in the flare (used for CO emissions control). Due to the relatively small emissions estimated from natural gas combustion and the vacuum degassing process, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for VOC control from the vacuum degasser.
## TABLE 2-2

## SUMMARY OF BACT EMISSION RATES FOR STEEL MILLS

STEEL MILL	EMISSION RATE (lbs/ton of steel)				
	PM	SO <sub>2</sub>	NO <sub>X</sub>	СО	VOC
STEEL MILLS WITH THE CONSTEEL PROCESS					
Nucor Steel - Hertford County, NC	0.0018 gr/dscf	0.35	0.36	2.3	0.13
Nucor Steel – Darlington, SC	0.0015 gr/dscf	0.35/0.675ª	0.35/0.41ª	2.76/3.13 <sup>b</sup>	0.35/1.11°
Ameristeel - Charlotte, NC	0.0052 gr/dscf	0.23	0.51	6.0	0.5
New Jersey Steel - Sayreville, NJ			0.54	5.8	0.46
Gerdau Ameristeel - NC				4.4	
Gerdau AmeriSteel - Knoxville, TN	0.004 gr/dscf	0.2	0.25	6.0	0.3
OTHER STEEL MILLS					
Osceola Steel - GA	0.0018 gr/dscf	0.18	0.35	2.00	
Timken – Harrison Plant – OH	0.0003 gr/dscf	0.44	0.20	4.8	0.37
Timken – Faircrest Plant – OH	0.0017 gr/dscf	0.52	0.20	3.5	0.17
SeverCorr - Columbus, MS	0.0018 gr/dscf	0.2	0.35	2.0	0.13
Ellwood National Steel PA	0.0050 gr/dscf	0.55		6.0	0.28
Nucor Steel – Marion, OH	0.0052 gr/dscf	0.5	0.43	2.23	0.13
V&M Star – OH	0.0018 gr/dscf	0.25	0.40	4.0	0.18
Mid-American Steel & Wire OK	0.0018 gr/dscf	0.30	0.30	3.0	0.30
New Steel International – OH	0.0014 gr/dscf	0.10	0.31	2.0	0.07
Minnesota Steel – MN	0.0030 gr/dscf	0.15	0.3	2.0	0.13
Thyssenkrupp, AL	0.0018 gr/dscf	0.15	0.35	2.0	0.03
Nucor Steel – Memphis, TN	0.0018 gr/dsct	$0.35/1.75^{a}$	0.27(LAER)	2.0	0.09 LAER
Nucor Steel – Auburn, NY	0.0052  gr/dsct	0.25	0.27	2.0	0.14
Nucor Steel – Berkeley County, SC	0.0035  gr/dsct	0.2	0.35	2.0	0.13
Nucor Steel – Crawfordsville, IN	0.0018  gr/dscf	0.25	0.35	2.0	0.13
Nucor Steel – Hickman, AR	0.0018  gr/dscf	0.33	0.52	2.0	0.093
Nucor Steel – Jewett, 1X	0.0052  gr/dscf	1.06	0.4314	5.0214	0.2906
Nucor Verste Steel - Norioik, INE	0.0052  gr/dsci	2.25	0.34	4.74	0.17
Nucor Steel Tuggalogga Ing	0.0018  gr/dscf	0.15	0.36	2.0	0.13
Nucor Steel – Decatur AI	0.0010  gr/dscf	0.40	0.42	2.2	0.13
IPSCO – Montpelier IA	0.0032  gr/dscf	0.02	0.42	1.93	0.13
IPSCO - Axis, AL	0.0033  gr/dscf	0.7	0.4	2.0	0.35
SDL - Butler, IN	0.0032  gr/dscf	0.2	0.51	2.0	0.13
SDI – Columbia City, IN	0.0018  gr/dscf	0.25	0.35	2.0	0.09
SDI - Pittsboro	0.0018  gr/dscf	0.25/1.5/1.8	0.35	2.0	0.13
Gallatin – Ghent, KY	0.0018 gr/dscf	0.49	0.51	2.0	0.13
MacSteel – Fort Smith, AR	0.0018 gr/dscf	1.05	0.51	4.9	0.13
Beta Steel – IN	0.0052 gr/dscf	0.33	0.35	5.4	0.13
Chaparral Steel – Petersburg, VA	0.0018 gr/dscf	0.7	0.7	4.0	0.35
Arkansas Steel – Newport, AR	0.0052 gr/dscf	0.7	1.0	6.0	0.35
Roanoke Electric Steel – Roankoe, VA	0.0034 gr/dscf	0.23	0.51	2.88	0.35
Charter Steel – Saukville, WI	0.0052 gr/dscf		0.51	3.83	
Gerdau AmeriSteel - Duval County, FL	0.0018 gr/dscf	0.2	0.33	2.0	0.13

a resulfurized steel/ b low carbon steel and use of waste oil filters/ c waste oil filters