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BUREAU OF AIR REGULATION

BEST AVAILABLE CONTROL TECHNOLOGY (BACT) ANALYSIS UPDATE FOR THE GERDAU AMERISTEEL JACKSONVILLE STEEL MILL BALDWIN DUVAL COUNTY, FLORIDA

0310157-011-AC/PSD-FL-349C

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1.0 INTRODUCTION

On July 22, 2008, Gerdau Ameristeel (Gerdau) submitted to the Florida Department of Environmental Protection (the Department) a request for an 18-month extension of the expiration date of permit PSD-FL-349 and PSD-FL-349(A), Project No. 0310157-011-AC/PSD-FL-349(C). Subsequently, on August 19, 2008, the Department requested, pursuant to Rule 62-212.400(12)(a), F.A.C., that the Ladle Metallurgical Furnace (LMF), Billet Reheat Furnace, and Billet Reheat Furnace #2 undergo a Best Available Control Technology (BACT) determination review before construction is to resume. The Department's letter is included as Appendix A. The BACT determination review requested by the Department is contained herein.

2.0 BEST AVAILABLE CONTROL TECHNOLOGY ANALYSIS

2.1 Control Technology Review

The control technology review requirements of the federal and state PSD regulations require that all applicable federal and state emission-limiting standards be met, and that BACT be applied to control emissions from the source. The BACT requirements are applicable to all regulated pollutants for which the increase in emissions from the facility exceeds the significant emission rate: PM/PM_{10}, NO_x, CO, VOC, and SO_2 emissions

BACT is defined in 40 CFR 52.21 (b)(12), and Rule 62-210.200(38), F.A.C. as:

> An emissions limitation (including a visible emission standard) based on the maximum degree of reduction of each pollutant subject to regulation under the Act which would be emitted by 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 through application of production processes and 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 measurement methodology to a particular part of a source or facility would make the imposition of an emission standard infeasible, a design, equipment, work practice, operational standard or combination thereof, may be prescribed instead to satisfy the requirement for the application of BACT. Such standard shall, to the degree possible, set forth the emissions reductions achievable by implementation of such design, equipment, work practice, or operation and shall provide for compliance by means, which achieve equivalent results.

BACT was promulgated within the framework of the PSD requirements in the 1977 amendments of the CAA [Public Law 95-95; Part C, Section 165(a)(4)]. The primary purpose of BACT is to optimize consumption of PSD air quality increments and thereby enlarge the potential for future economic growth without significantly degrading air quality (EPA, 1978; 1980). Guidelines for the evaluation of BACT can be found in EPA's *Guidelines for Determining Best Available Control Technology (BACT)* (EPA, 1978) and in the *PSD Workshop Manual* (EPA, 1980). These guidelines were issued by EPA to provide a consistent approach to BACT and to ensure that the impacts of alternative emission control systems are measured by the same set of parameters. In addition, through implementation of these guidelines, BACT in one area may not be identical to BACT in another area.

According to EPA (1980), "BACT analyses for the same types of emissions unit and the same pollutants in different locations or situations may determine that different control strategies should be applied to the different sites, depending on site-specific factors. Therefore, BACT analyses must be conducted on a case-by-case basis."

The BACT requirements are intended to ensure that the control systems incorporated in the design of a proposed facility reflect the latest in control technologies used in a particular industry and take into consideration existing and future air quality in the vicinity of the proposed facility. BACT must, as a minimum, demonstrate compliance with new source performance standards (NSPS) for a source (if applicable). An evaluation of the air pollution control techniques and systems, including a cost-benefit analysis of alternative control technologies capable of achieving a higher degree of emission reduction than the proposed control technology, is required. The cost-benefit analysis requires the documentation of the materials, energy, and economic penalties associated with the proposed and alternative control systems, as well as the environmental benefits derived from these systems. A decision on BACT is to be based on sound judgment, balancing environmental benefits with energy, economic, and other impacts (EPA, 1978).

Historically, a "bottom-up" approach consistent with the BACT Guidelines and PSD Workshop Manual was used. With this approach, an initial control level, which is usually NSPS, is evaluated against successively more stringent controls until a BACT level is selected. However, EPA developed a concern that the bottom-up approach was not providing the level of BACT decisions originally intended. As a result, in December 1987, the EPA Assistant Administrator for Air and Radiation mandated changes in the implementation of the PSD program, including the adoption of a new "top-down" approach to BACT decision making.

The top-down BACT approach essentially starts with the most stringent (or top) technology and emissions limits that have been applied elsewhere to the same or a similar source category. The applicant must next provide a basis for rejecting this technology in favor of the next most stringent technology or propose to use it. Rejection of control alternatives may be based on technical or economic infeasibility. Such decisions are made on the basis of physical differences (e.g., fuel type), locational differences (e.g., availability of water), or significant differences that may exist in the environmental, economic, or energy impacts. The differences between the proposed facility and the facility on which the control technique was applied previously must be justified.

EPA has issued a draft guidance document on the top-down approach titled *Top-Down Best Available Control Technology Guidance Document* (EPA, 1990). This document has not yet been issued as final guidance or as rule. EPA has also published the document titled *OAQPS Cost Control Manual* (EPA, 1996) to assist industry and regulators in estimating capital and annual costs of pollution control equipment.

2.2 Requirements and BACT Summary

The 1977 CAA Amendments established requirements for the approval of pre-construction permit applications under the PSD program. One of these requirements is that BACT be installed for those pollutants requiring PSD review. BACT determinations must be made on a case-by-case basis considering technical, economic, energy, and environmental impacts for various BACT alternatives. To bring consistency to the BACT process, the EPA developed the "top-down" approach to BACT determination that is followed by FDEP.

The first step in a top-down BACT analysis is to determine, for each applicable pollutant, the most stringent control alternative available for a similar source or source category. If it can be shown that this level of control is not feasible on the basis of technical, economic, energy, or environmental impacts for the source in question, then the next most stringent level of control is identified and similarly evaluated. This process continues until the BACT level under consideration cannot be eliminated by any technical, economic, energy, or environmental consideration.

As requested by the Department, and in support of an extension of permits PSD-FL-349 and PSD-FL-349(A), an updated BACT analysis for the LMF, Billet Reheat Furnace, and Billet Reheat Furnace #2 is provided for , PM/PM_{10}, NO_x, CO, VOC, and SO_2 emissions.

2.2.1 Ladle Metallurgic Furnace (LMF)

The Electric Arc Furnace (EAF) and LMF make up one process and one emission unit (Emission Unit No. 008) and exhaust to a common baghouse. The EAF has been constructed and successfully compliance tested. The operation of the EAF and LMF are interconnected. Without the LMF, the refinement operations are performed in the EAF, and the emissions per ton of steel are assumed to be equal with or without the LMF. The EAF and LMF work together to produce liquid steel from scrap steel and, as such, serve as one emission unit. The addition of a LMF reduces the heat time of the

EAF by moving the refining operation to the LMF. While molten steel is being refined in the LMF, the EAF can be charged with scrap and melted, thus increasing the production rate of the facility. Based on this arrangement, the BACT limits applicable to the common EAF/LMF Baghouse encompass the limits for the EAF and LMF combined.

As stated above the construction of the EAF has been completed and the emission unit has successfully completed compliance testing. The emission limits for the EAF/LMF are based on a per ton of steel basis and the emissions from the EAF alone and EAF/LMF combined are assumed equal as described above. Therefore the compliance test results from the EAF are also representative of emissions for the EAF/LMF.

Due to the interconnected operation of the LMF with the EAF, the updated BACT analysis also includes the EAF. However, it should be noted that BACT for the EAF is not subject to the review because the EAF has been successfully constructed and test within the requirements of permits PSD-FL-349.

2.2.2 Billet Reheat Furnaces

The facility processes steel billets into steel rebar, wire, and rod. This is accomplished by reheating the steel billets produced by the continuous caster in the Billet Reheat Furnace (BRF) and processing them through various rolling and wire machines in the rolling and wire mills. Two new BRFs are authorized by permits PSD-FL-349 and PSD-FL-349(A). The BRFs being constructed as part of the project include the Rebar Mill BRF (Emission Unit No. 009) and the Wire/Rod Mill BRF (Emissions Unit No. 011).

A summary of the updated BACT determination analysis for the LMF and BRFs is provided in Table 2-1.

2.3 LMF BACT Analysis

2.3.1 Particulate Matter (PM/PM_{10}) and Lead

2.3.1.1 Previous BACT Determinations

As part of the updated BACT analysis, a review was performed of previous BACT determinations for PM/PM_{10} from EAF/LMFs listed in the RACT/BACT/LAER Clearinghouse on EPA's web page and recent permitting activity. A summary of BACT determinations from this review are presented in Table 2-2. Determinations for similar sources issued during from years 1998 through 2008 are shown in Table 2-2.

From the review of previous BACT determinations, it is evident that PM/PM_{10} BACT determinations for EAF/LMFs remain to be exclusively been based on baghouse technology. BACT determinations have been in the range of 0.0015 to 0.0052 gr/dscf for PM/PM_{10} emissions. Therefore, no change in the EAF/LMF current BACT PM/PM_{10} emission limit of 0.0018 gr/dscf is justified.

2.3.1.2 Control Technology Feasibility

The possible PM/PM_{10} controls for the EAF/LMFs are listed in Table 2-3. As shown, there are five primary types of PM/PM_{10} abatement methods, with various techniques within each method. Each available technique is listed with its associated efficiency estimate, identified as feasible or infeasible, and ranked based on control efficiency.

2.3.1.3 Potential Control Method Descriptions

Fuel Techniques

Fuel substitution, or fuel switching, is a common means of reducing emissions from combustion sources, such as electric utilities and industrial boilers. It involves replacing the current fuel with a fuel that emits less of a given pollutant when burned. PM/PM_{10} emissions are primarily generated by electric arcing.

Fuel substitution is not feasible for the EAF/LMF because the primary source of heat is achieved through electrical arcing of AC power.

Pretreatment Devices

The performance of particulate control devices can often be improved through pretreatment of the gas stream. For PM control devices, pretreatment consists of the following techniques:

- Settling Chambers;
- Elutriators;
- Momentum Separators;
- Mechanically-Aided Separators; and
- Cyclones.

Of these five techniques, cyclones offer the most control efficiency, typically in the range of 60 to 90 percent. All of the other techniques have control efficiencies less than 30 percent.

Cyclones use inertia to remove particles from a spinning gas stream. Within a cyclone, the gas stream is forced to spin within a usually conical-shaped chamber. The gas spirals down the cyclone near the inner surface of the cyclone tube. At the bottom of the cyclone the gas turns and spirals up through the center of the tube and out the top of the cyclone.

Particles in the gas stream are forced toward the cyclone walls by centrifugal forces. For particles that are large, typically greater than 10 microns, inertial momentum overcomes the fluid drag forces so that the particles reach the cyclone walls and are collected. For smaller particles, the fluid drag forces are greater than the momentum forces and the particles follow the gas out of the cyclone. Inside the cyclone gravity forces the large particles down the sidewalls of the cyclone to a hopper where they are collected. Some pretreatment devices are technically feasible for application to the EAF/LMF. However, while pretreatment devices are feasible, they do not offer any additional control than the proposed baghouse. Because of the high flow rate, up to 1,000,000 ACFM, the flow would have to be divided and sent to several elutriators, momentum separators, mechanically-aided separators or cyclones and then merged again to enter the baghouse. In addition, while pretreatment devices are generally good at removing large particle size particulate, they do not effectively remove smaller particle sizes. The proposed baghouse is effective at removing large and small particle size PM. Therefore, use of a pretreatment device before the baghouse would be considered redundant and not afford any additional PM removal.

Electrostatic Precipitators (ESPs)

Collection of PM by electrostatic precipitators involves the ionization of the gas stream passing through the ESP, the charging, migration, and collection of particles on oppositely charged surfaces, and the removal of particles from the collection surfaces. There are two basic types of ESPs: dry and wet. In dry ESPs, the particulate is removed by rappers, which vibrate the collection surface, dislodging the material and allowing it to fall into the collection hoppers. Wet ESPs use water to rinse the particulates off of the collection surfaces.

Electrostatic precipitators have several advantages when compared with other control devices. They are very efficient collectors, even for small particles, with greater than 97-percent control efficiency. ESPs can also treat large volumes of gas with a low-pressure drop. ESPs can operate over a wide range of temperatures and generally have low operating cost. However, they have been proven unsuitable for applications involving PM with high concentrations of iron compounds such as those for the Project. A strong adhesion to the ESP plates results due to the properties of the iron particles. This strong adhesion results in an inability to clean the plates and ineffective ESP performance. Other issues of fouling of the ESP electrodes from high zinc content of PM. For these reasons ESPs are considered technically infeasible for the EAF/LMF.

Fabric Filters (Baghouses)

Baghouses, or fabric filters, utilize porous fabric to clean an airstream. They include types such as reverse-air, shaker, and pulsejet baghouses. The dust that accumulates on the surface of the filter aids in the filtering of fine dust particles. PM/PM_{10} control efficiencies for fabric filters are typically greater than 99 percent.

During fabric filtration, flue gas is sent through the fabric by forced-draft fans. The fabric is responsible for some filtration, but more significantly it acts as support for the dust layer that accumulates. The layer of dust, also known as the filter cake, is a highly efficient filter, even for submicron particles. Woven fabrics rely on the filtration of the dust cake much more than felted fabrics.

Fabric filters offer high efficiencies, and are flexible to treat many types of dusts and a wide range of volumetric gas flow rates. In addition, fabric filters can be operated with low-pressure drop. Some potential disadvantages are:

- High moisture gas streams and sticky particles can plug the fabric and blind the filter, requiring bag replacement;
- High temperatures can damage fabric bags; and
- Fabric filters have a potential for fire or explosion.

Fabric filters can be categorized by type of cleaning, including shaker, reverse-air, and pulse jet:

- Shaker cleaning transfers energy to the fabric by suspending the bag from a motor-driven hook or framework that oscillates. Motion may be imparted to the bag in several ways, but the general effect is to create a sine wave along the fabric.
- In reverse air cleaning, gas flow to the bags is stopped in the compartment being cleaned and reverse air flow is directed through the bags. This reversal of gas flow gently collapses the bags, which causes the filter cake to detach.
- Pulse jet uses compressed air to force a burst of air down through the bag and expand it violently, releasing the filter cake.

Baghouses have been used exclusively as the PM control device for EAF/LMFs and are considered technically feasible for the Project. The Project has constructed the EAF/LMF baghouse with a BACT grain loading limit not to exceed 0.0018 gr/dscf. As discussed previously, based on an updated review of previous BACT determinations, it is evident that PM/PM_{10} BACT determinations for EAF/LMFs remain to be exclusively been based on baghouse technology. BACT determinations have been in the range of 0.0015 to 0.0052 gr/dscf for PM/PM_{10} emissions. Therefore, no change in the EAF/LMF current BACT PM/PM_{10} emission limit of 0.0018 gr/dscf is justified.

Wet Scrubbers

Wet scrubbers are systems that involve particle collection by contacting the particles to a liquid, usually water. The aerosol particles are transferred from the gaseous airstream to the surface of the liquid by several different mechanisms. Wet scrubbers create a liquid waste that must be treated prior to disposal. In this case, the water will contain the hazardous waste EAF/LMF baghouse dust (RCRA Hazardous Waste K061). Typical gas flow rates for scrubbers are 500 to 100,000 scfm. The proposed project would require that the flow out of the baghouse be split into 10 separate scrubber units. PM/PM_{10} control efficiencies for wet scrubbing systems range from about 50 to 95 percent, depending on the type of scrubbing system used. Typical types of wet scrubbers are as follows:

- Spray Chamber;
- Packed-Bed;
- Impingement Plate;
- Mechanically-Aided;
- Venturi;

- Orifice; and
- Condensation.

The advantages of wet scrubbers compared to other PM collection devices are that they can collect flammable and explosive dusts safely, absorb gaseous pollutants, and collect mists. Scrubbers can also cool hot gas streams. The disadvantages are the potential for corrosion and freezing, the potential of water and solid waste pollution problems, and high energy costs.

As provided in the original application, EPA's Air Pollution Control Technology Fact Sheet estimates the capital cost from \$2.5 to \$21 per scfm. Given the constituents of EAF baghouse dust, the scrubbers would likely need to be constructed of stainless steel and would likely be near the upper range of capital cost. Therefore the capital cost would be approaching \$20,000,000.00. EPA states that the annualized cost range from \$5.7 to \$193 per scfm. Even at the low end of the range would result in nearly \$6,000,000.00 annual cost for operating the scrubbers. Therefore wet scrubbers are not cost effective for the project.

2.3.1.4 Economic Analysis

Gerdau has constructed a 1,000,000-acfm baghouse, to control PM/PM_{10} emissions from the EAF/LMF. This control equipment results in the highest control efficiency determined to be feasible, demonstrated and economical for the Project. Because Gerdau is proposing and constructed the control technology that offers the highest control efficiency feasible, an economic analysis comparing less efficient control devices is not applicable.

2.3.1.5 Environmental Impacts

The maximum predicted PM impacts for the proposed Project are below AAQS and Class II increment allowable impact levels. (Refer to Section 6, Table 6-8 of the original PSD application.) Additional PM controls would result in an insignificant reduction of ambient impacts that are already below AAQS and PSD increment levels for both Class I and Class II areas.

2.3.1.6 PM/PM_{10} BACT Selection

In conclusion, Gerdau's current PM/PM_{10} control technology (baghouse) and BACT emission limit equal to 0.0018 gr/dscf represents current BACT based on the latest control technologies and previous

BACT determinations for similar sources. Baghouses have been utilized exclusively for PM control from EAFs and provide the highest level of control of all feasible controls. The two most recent BACT determinations for EAF/LMFs resulted in a PM emission limit of 0.0018 gr/dscf. Similar to those projects, additional or different add-on PM/PM_{10} control equipment remains inappropriate for the EAF/LMF.

PM emissions from primarily occur during charging and melting stages of the heat which occur in the EAF compared to the refining stages planned for the LMF. The EAF has been constructed and compliance tested. The focus of this BACT analysis is the LMF.

2.3.2 Nitrogen Oxides

2.3.2.1 Previous BACT Determinations

As part of the updated BACT analysis, a review was performed of previous NO_x BACT determinations for EAF/LMFs listed in the RACT/BACT/LAER Clearinghouse on EPA's web page and recent permitting activity. A summary of BACT determinations from this review are presented in Table 2-2. Determinations for similar sources issued during from years 1998 through 2008 are shown in Table 2-2.

From the review of previous BACT determinations, it is evident that NO_x BACT determinations for EAF/LMFs have exclusively been based on combustion practice. BACT determinations have been in the range of 0.3 to 0.89 lb NO_x per ton of steel.

2.3.2.2 Control Technology Feasibility

The possible NO_x controls for EAF/LMF are shown in Table 2-4. As shown in the table, there are five primary types of NO_x abatement methods, with various techniques within each method. Each available technique was listed with its associated efficiency estimate, identified as feasible or infeasible, and ranked based on control efficiency.

2.3.2.3 Potential Control Method Descriptions

Removal of Nitrogen

EAF/LMFs primary source of heat is achieved through electrical arcing of AC power. Removal of nitrogen in the air flow is not an option. The primary source of nitrogen is from ambient air pulled into the furnace by the direct evacuation system (DES). Control of the DES results in control of furnace pressure and control of high temperature NO_x formation. Gerdau will utilize furnace pressure control (combustion practice) to control excess air infiltration into the EAF/LMF and subsequent formation of high temperature NO_x.

Oxidation of NO_x with Subsequent Absorption

Inject Oxidant -- The oxidation of nitrogen to its higher valence states makes NO_x soluble in water. When this is done a gas absorber can be effective. Oxidants that have been injected into the gas stream are ozone, ionized oxygen, or hydrogen peroxide. This NO_x reduction technique has not been demonstrated on EAF/LMFs, and as such is not considered a demonstrated control technology.

Non-Thermal Plasma Reactor (NTPR) -- This technique generates electron energies in the gas stream that generate gas-phased radicals, such as hydroxyl (OH) and atomic oxygen (O) through collision of electrons with water and oxygen molecules present in the flue gas stream. In the flue gas stream, these radicals oxidize NO_x to form nitric acid (HNO_3), which can then be condensed out through a wet condensing precipitator. NTPR has not been demonstrated on EAF/LMFs, and as such is not considered a demonstrated control technology for the Project.

Chemical Reduction of NO_x

Selective Catalytic Reduction (SCR) -- SCR uses a catalyst to react injected ammonia to chemically reduce NO_x. The catalyst has a finite life in flue gas and some ammonia slips through without being reacted. SCR has historically used precious metal catalysts, but can now also use base metal and zeolite catalyst materials. In order for a SCR system to effectively reduce NO_x emissions, the exhaust stream should have relatively stable gas flow, and temperature. EAF/LMFs are highly transient operations due to their batch nature. The temperature and flow rate of the EAF/LMF exhaust stream will vary greatly over the heat cycle and as such are not suited for SCR control.

Other technical difficulties associated with applying SCR include no operating experience on EAF/LMFs, and likely premature catalyst deactivation due to chemical poisoning of the catalyst resulting from the EAF/LMF PM constituents of phosphorous and zinc. The high levels of reactive compounds in EAF/LMF PM emissions would lead to rapid catalyst deactivation, and SCR would not be feasible unless the SCR system is placed after a highly effective PM control device, such as a baghouse. In addition, SCR catalyst require moderately high temperature gas stream [600 to 750 degrees Fahrenheit (°F)]; thus, the gas stream 1,000,000 acfm would have to be reheated from approximately 200 °F to the proper temperature. This would require significant energy and result in additional NO_x and CO emissions. Additional energy would also be needed to compensate for the additional back pressure created by the SCR. While SCR is an available control for NO_x, it is not feasible on EAF/LMFs. Additionally expected high cost of reheating the gas stream and uncertainty of catalyst poisoning and catalyst replacement would make SCR economically unreasonable.

Selective Non-Catalytic Reduction (SNCR) -- In SNCR, ammonia or urea is injected within the ducts in a region where temperature is between 1,600 and 2,000°F. This technology is based on temperature ionizing the ammonia or urea instead of using a catalyst or non-thermal plasma. The temperature window for SNCR is very important because outside of it either more ammonia slips through the system or more NO_x is generated than is being chemically reduced.

As stated previously the EAF/LMF operation is highly transient throughout the heat cycle and the required temperature and residence time required for SNCR is not achieved in the EAF/LMF DES duct work. Therefore, SNCR is considered technically feasible for the proposed EAF/LMF.

Additionally, information from the Institute of Clean Air Companies' White Paper titled; "Selective Non-Catalytic Reduction for Controlling NO_x Emissions," dated May 2000, was reviewed. However, the document shows that none of the sources of the listed steel facilities utilize SNCR for EAFs or LMFs. The sources identified are natural gas-fired furnaces including annealing furnaces, tube furnaces, rotary hearths, etc. This document does not address the application of SNCR on electric arc furnaces and, as such, cannot be used as a basis for the determination that SNCR is a feasible and demonstrated technology for EAF/LMFs. Furthermore, not related to the White Paper, in 2000, Nucor Steel was required to evaluate the feasibility of SNCR on an EAF as part of an EPA Consent Decree, and determined that the technology is not technically feasible.

Reducing Residence Time at Peak Temperature

Air Staging of Combustion -- Combustion air is divided into two streams. The first stream is mixed with fuel in a ratio that produces a reducing flame. The second stream is injected downstream of the flame and creates an oxygen-rich zone.

Fuel Staging of Combustion -- This is staging of combustion using fuel instead of air. Fuel is divided into two streams. The first stream feeds primary combustion that operates in a reducing fuel-to-air ratio. The second stream is injected downstream of primary combustion, causing the net fuel to air ratio to be slightly oxidizing. Excess fuel in the primary combustion zone dilutes heat to reduce temperature. The second stream oxidizes the fuel while reducing the NO_x to N_2.

Inject Steam -- Injection of steam causes the stoichiometry of the mixture to be changed and dilutes calories generated by combustion. These actions cause combustion temperature to be lower, and in-turn reduces the amount of thermal NO_x formed.

Each of these techniques is designed for fuel combustion equipment and they are not technically feasible for an EAF/LMF.

Reducing Peak Temperature

This group of combustion controls is primarily designed to reduce the combustion temperature and such conditions in an EAF/LMF result in inefficient scrap melting and increases in tap-to-tap time lowering the efficiency of the EAF/LMF. A short description of each technique follows:

Flue Gas Recirculation (FGR) -- Recirculation of cooled flue gas reduces combustion temperature by diluting the oxygen content of the combustion air and by causing heat to be diluted in a greater mass of flue gas. Heat in the flue gas can be recovered by a heat exchanger. This reduction of temperature lowers the thermal NO_x concentration that is generated.

Reburn -- In reburn technology, a set of natural gas burners are installed above the primary combustion zone. Natural gas is injected to form a fuel-rich, oxygen-deficient combustion zone above the main firing zone. Nitrogen oxides, created by the combustion process in the main portion of the boiler, drift upward into the reburn zone and are converted to molecular nitrogen. The technology requires no catalysts, chemical reagents, or changes to any existing burners. Reburn is designed for fossil fuel combustion units and is not known to have ever been utilized on an EAF/LMF.

Over-Fire Air (OFA) -- When primary combustion uses a fuel-rich mixture, use of OFA completes the combustion. Because the mixture is always off-stoichiometric when combustion is occurring, the temperature is reduced. After all other stages of combustion, the remainder of the fuel is oxidized in the OFA.

Less Excess Air (LEA) -- Excess airflow combustion has been correlated to the amount of NO_x generated. Limiting the net excess airflow can limit NO_x content of the flue gas. The EAF/LMF will utilize furnace pressure control (combustion practice) to control the formation of high temperature NO_x.

Combustion Optimization -- Combustion optimization refers to the active control of combustion. The active combustion control measures seek to find optimum combustion efficiency and to control combustion at that efficiency.

Low NO_x/Oxy-fuel Burners (LNB) -- A LNB provides a stable flame that has several different zones. For example, the first zone can be primary combustion. The second zone can be Fuel Reburning (FR) with fuel added to chemically reduce NO_x. The third zone can be the final combustion in low excess air to limit the temperature.

In summary, FGR, Reburn, OFA, LEA, and Combustion Optimization are designed to reduce combustion temperature and as such are not feasible for EAF/LMFs.

2.3.2.4 Economic Analysis

Gerdau is proposing to utilize furnace pressure control and LNB in the EAF to control NO_x emissions from the EAF/LMF. This control equipment will result in the highest control efficiency determined to be feasible, demonstrated and economical for the Project. Because Gerdau is proposing the control technology that offers the highest control efficiency feasible, an economic analysis comparing less efficient control devices is not applicable.

2.3.2.5 Environmental Impacts

The maximum predicted annual NO_2 impacts for the proposed Project are below AAQS and PSD Class II increment allowable impact levels. (Refer to Section 6 of the original PSD application). Additional NO_x controls would result in an insignificant reduction of ambient impacts that are already below AAQS PSD increment levels for both Class I and II areas.

2.3.2.6 Energy Impacts

There are no significant energy penalties associated with furnace pressure control for the EAF/LMF and LNB for the EAF sidewall burners.

2.3.2.7 NO_x BACT Selection

In conclusion, Gerdau's current NO_x control technology of furnace pressure control for the EAF/LMF and LNB for the EAF burners and BACT emission limit equal to 0.33 lb/ton represents current BACT based on the latest control technologies and previous BACT determinations for similar sources. The two most recent BACT determinations for EAF/LMFs resulted in a NO_x emission limit of 0.3 lb/ton and 0.42 lb/ton. Similar to those projects, additional or different add-on NO_x control equipment is not technically feasible or appropriate for the EAF/LMF.

2.3.3 Carbon Monoxide

2.3.3.1 Previous BACT Determinations

As part of the updated BACT analysis, a review was performed of previous CO BACT determinations for EAF/LMFs listed in the RACT/BACT/LAER Clearinghouse on EPA's web page and recent permitting activity. A summary of BACT determinations from this review are presented in Table 2-2. Determinations for similar sources issued during from years 1998 through 2008 are shown in Table 2-2.

From the review of previous BACT determinations, it is evident that CO BACT determinations for EAF/LMFs remains exclusively based on combustion practice. BACT determinations have been in the range of 1.34 to 7.5 lb CO per ton of steel.

2.3.3.2 Control Technology Feasibility

The possible CO controls for EAF/LMFs are shown in Table 2-5. As shown in the table, there are four primary types of CO abatement methods. Each available technique was listed with its associated efficiency estimate, identified as feasible or infeasible, and ranked based on control efficiency.

2.3.3.3 Potential Control Method Descriptions

Good Operating Practices

CO is formed from incomplete combustion in the EAF/LMF. The sources of carbon monoxide are as follows:

- Charge carbon, which is carbon added to the scrap steel prior to initiation of melting;
- Injection carbon; and
- Small amounts of hydrocarbon compounds on steel scrap.

The EAF utilizes sidewall injectors similar to those currently operating on the old EAF to allow for injection of carbon below the slag level of the steel bath resulting in a more homogeneous steel bath, less carbon combusted above the steel bath and in forth-hole duct work, and as a result less incomplete combustion.

Post Combustion Reaction Chamber

Post combustion chambers are a form of thermal oxidation. Post combustion chambers are capable of achieving up to 99 percent reduction of CO emissions given enough residence time at high temperature. There are three known installations of post combustion chambers on EAFs:

- IPSCO Steel, IA was issued a PSD permit on April 1996 which required installation of a post combustion chamber. IPSCO was initially limited to 0.91 lb CO per ton of steel. However, in 2002, the IPSCO permit limit for CO was increased to 1.93 lb per ton steel.
- Tuscaloosa Steel, AL although not required by BACT, installed a post combustion chamber with oxyfuel burners on a trial basis to determine a means to meet their BACT limit of 2.0 lb CO per ton steel. Tuscaloosa has since removed the burners in the chamber due to continual maintenance because of particulate plugging. Tuscaloosa's current limit is equal to 2.2 lb/ton, permit issued in year 2006.
- Gallatin Steel initially installed a post combustion chamber with burner to meet its proposed minor source status. Operation of the post combustion chamber resulted in CO reductions less than expected and increased NO_x emissions. Maintenance was also an issue

from particulate plugging. As a result Gallatin Steel discontinued use of the post combustion chamber.

Post combustion chambers are technically feasible for EAF/LMFs, however they have not been proven successful in controlling CO emissions from EAF/LMFs. Due to the high particulate loading of EAF exhaust gases, it would be necessary to operate a baghouse prior to the combustion chamber. Exhaust gas exiting the baghouse would have to be reheated to bring the gas stream back up to the required thermal oxidation temperature, 1200°F. The reheating of 1,000,000 acfm would result in significant natural gas consumption and secondary NO_x emissions and is therefore not considered appropriate for the Project.

Incinerators

The two basic types of incinerators are thermal and catalytic. Thermal systems may be direct flame incinerators with no energy recovery (post combustion chambers), flame incinerators with a recuperative heat exchanger, or regenerative systems, which operate in a cyclic mode to achieve high-energy recovery. Catalytic systems include fixed bed (packed bed or monolith) systems and fluid-bed systems, both of which provide for energy recovery. Catalytic systems are not an option for EAF/LMFs due to catalyst poisoning. Thermal oxidation systems are an available technology, however have not been proven in EAF/LMF, a discussion of the feasibility of thermal systems was presented previously in the discussion of post combustion chambers.

Direct Shell Evacuation Control (Fourth Hole)

The primary CO control method for EAFs is the direct shell evacuation otherwise referred to as the fourth-hole evacuation. The DSE consists of water-cooled duct connected to the EAF through the furnace roof. The connection is referred to as the "fourth-hole." The fourth-hole is connected to the baghouse and during the melting and refining stages of a heat, a negative pressure is maintained in the EAF. At the point where the DSE duct meets the EAF there is an adjustable gap that allows combustion air to enter, providing oxygen to oxidize CO. The EAF utilizes a fourth-hole evacuation system for control of CO combustion.

2.3.3.4 CO BACT Selection

The CO BACT emission limit for the EAF/LMF remains equal to 2.0 lb/ton steel. The EAF/LMF will minimize CO emissions through proper EAF/LMF design, use of DSE, and good operating practices. This level of control is consistent with previous determinations. The two most recent BACT determinations for EAF/LMFs resulted in a CO emission limit of 2.0 lb/ton and 2.3 lb/ton.

2.3.4 Volatile Organic Compounds (VOC)

2.3.4.1 Previous BACT Determinations

VOC emissions from the EAF/LMF are generated due to the volatilization of organic compounds present in the scrap metal. As part of the BACT analysis, a review was performed of previous VOC BACT determinations for EAF/LMFs listed in the RACT/BACT/LAER Clearinghouse on EPA's web page and recent permitting activity. A summary of BACT determinations from this review are presented in Table 2-2. Determinations for similar sources issued during from years 1998 through 2008 are shown in Table 2-2.

From the review of previous BACT determinations, it is evident that VOC BACT determinations for EAF/LMFs remain exclusively based on good operational practices. BACT determinations have been in the range of 0.1 to 0.42 lb VOC per ton of steel.

2.3.4.2 Control Technology Feasibility

The technically feasible add-on VOC controls for EAF/LMFs are shown in Table 2-6. As shown, there are four types of add-on VOC abatement methods. Each available technique was listed with its associated efficiency estimate, identified as feasible or infeasible, and ranked based on control efficiency.

2.3.4.3 Potential Control Method Descriptions

Refrigerated Condensers

The most common types of condensers used are surface and contact condensers. In surface condensers, the coolant does not contact the gas stream. Most surface condensers in refrigerated systems are shell and tube type. Shell and tube condensers circulate the coolant through tubes. The VOC condenses on the outside surface of the tube. Plate and frame type heat exchangers are also used as condensers in refrigerated systems. In these condensers, the coolant and the vapor flow separately over thin plates. In either design, the condensed VOC vapors drain away to a collection tank for storage, reuse, or disposal.

Contact condensers cool the vapor stream by spraying either a liquid at ambient temperature or a chilled liquid directly into the gas stream.

Refrigerated condensers are used as air pollution control devices for treating emissions with high VOC concentrations [>5,000 parts per million by volume (ppmv)], in applications involving gasoline bulk terminals, storage, etc. Refrigerated condensers are not technically feasible for reduction of VOC from industrial EAF/LMFs, and as such are not technically feasible for the Project.

Carbon Adsorbers

Adsorption is employed to remove VOC compounds from low to medium concentration gas streams. Adsorption is a phenomenon where gas molecules passing through a bed of solid particles are selectively held there by attractive forces, which are weaker and less specific than those of chemical bonds. During adsorption, a gas molecule migrates from the gas stream to the surface of the solid where it is held by physical attraction releasing energy, the heat of adsorption, which typically equals or exceeds the heat of condensation. Adsorption capacity of the solid for the gas tends to increase with the gas phase concentration, molecular weight, diffusivity, polarity, and boiling point. Gases form actual chemical bonds with the adsorbent surface groups. There are five types of adsorption techniques.

Of the five techniques, fixed bed units are typically utilized for controlling continuous VOC containing streams from flow rates ranging from several hundred to several thousand cubic feet per minute. Based on the gas flow rate of EAF/LMF, carbon adsorption is not technically feasible for this project.

Flare

Flaring is a VOC control process in which the VOCs are piped to a remote, usually elevated, location and burned in an open flame in the open air using a specially designed burner tip and auxiliary fuel. Flares are not technically feasible for the EAF/LMF due to the large gas volume and low Btu value of the gas stream.

Incinerators

The two basic types of incinerators are thermal and catalytic. Thermal systems may be direct flame incinerators with no energy recovery, flame incinerators with a recuperative heat exchanger, or regenerative systems, which operate in a cyclic mode to achieve high-energy recovery. Catalytic systems include fixed bed (packed bed or monolith) systems and fluid-bed systems, both of which provide for energy recovery. Catalytic systems are not an option for EAF/LMFs due to catalyst poisoning.

Thermal incinerators are not considered technically feasible for EAF/LMFs, because of the high flue gas volume and low concentration of VOCs. In addition, the combustion of natural gas would result in increased NO_x emissions.

2.3.4.4 VOC BACT Selection

The BACT VOC emission limit for the EAF/LMF remains equal to 0.13 lb/ton steel. The EAF/LMF will minimize VOC emissions through proper EAF/LMF design, use of DSE, and good operating practices. This level of control is consistent with previous determinations. The two most recent BACT determinations for EAF/LMFs resulted in a VOC emission limit of 0.13 lb/ton.

As stated previously, VOC emissions from the EAF/LMF are generated due to the volatilization of organic compounds present in the scrap metal. This occurs primarily early in the heat cycle in the EAF, which has been constructed and compliance tested. The focus of this BACT analysis is the LMF.

2.3.5 Sulfur Dioxide

2.3.5.1 Previous BACT Determinations

As part of the updated BACT analysis, a review was performed of previous SO2 BACT determinations for EAF/LMFs listed in the RACT/BACT/LAER Clearinghouse on EPA's web page and recent permitting activity. A summary of BACT determinations from this review are presented in Table 2-2. Determinations for similar sources issued during from years 1998 through 2008 are shown in Table 2-2.

From the review of previous BACT determinations, it is evident that SO2 BACT determinations for EAF/LMFs have exclusively been based on good operational practices. BACT determinations have been in the range of 0.15 to 1.8 lb SO2 per ton of steel.

2.3.5.2 Control Technology Feasibility

The technically feasible add-on SO_2 controls for EAF/LMFs are shown in Table 2-7. As shown, there are four types of add-on SO_2 abatement methods. Each available technique was listed with its associated efficiency estimate, identified as feasible or infeasible, and ranked based on control efficiency.

2.3.5.3 Potential Control Method Descriptions

Charge Management

Sulfur dioxide emissions from EAF/LMFs are directly related to the amount of sulfur charged into the furnace. Sources of sulfur are as follows:

- Scrap metal
- Direct reduced iron (DRI)
- Pig iron
- Charge carbon; and
- Injection carbon

Gerdau operates scrap management which includes iron and steel scrap specifications; see Appendix C of the original PSD application. Gerdau will utilize scrap management to minimize the amount of sulfur charged in the EAF and, as a result, minimize the amount of SO_2 emissions.

Sorbent Injection

Sorbent Injection involves the injection of a dry sorbent into the flue gas duct where the temperature is about 750 to 1,250 degrees Celsius (°C). In sorbent injection, a finely grained sorbent, limestone ($CaCO_3$) or hydrated lime [$Ca(OH)_2$] is distributed quickly and evenly over the entire cross section in the duct work in a location where the temperature is in the range of 750 to 1,250 °C. The sorbent reacts with SO_2 and O_2 to form $CaSO_4$. $CaSO_4$ is then captured in a particulate control device together with unused sorbent and fly ash. Temperatures over 1,250 °C result in sintering of the surface on the sorbent, destroying the structure of the pores and reducing the active surface area.

There are many factors, which influence the performance of a duct sorbent injection process. These include sorbent reactivity, quantity of injected sorbent, relative humidity of the flue gas, gas and solids residence time in the duct, and quantity of recycled, unreacted sorbent from the particulate control device. The most efficient way of achieving good conditions is to establish a dedicated reaction chamber. EAF/LMFs are highly transient operations due to their batch nature. The temperature and flow rate of the EAF/LMF exhaust stream will vary greatly over the heat cycle and contain high particulate matter and low SO_2 concentrations, and as such are not ideal for sorbent injection. In addition there is no known installation of sorbent injection for EAF/LMFs.

Wet Scrubbers

Devices that are based on absorption principles include packed towers, plate, columns, venturi scrubbers, and spray chambers. Absorption is a mass transfer operation in which one or more soluble components of a gas mixture are dissolved in a liquid that has low volatility under the process conditions. The pollutant diffuses from the gas into the liquid when the liquid contains less than the equilibrium concentration of the gaseous component. The difference between the actual and the equilibrium concentration provides the driving force for absorption.

Wet FGD includes technologies such as lime, limestone forced or inhibited oxidation, and magnesium-enhanced lime FGD. These systems create solid and liquid waste streams, which must be treated before disposal. SO_2 control efficiencies for wet limestone FGD range from 50 to 98 percent, depending on the type of device and design, with an average of 90 percent

Wet scrubbers are not considered technically feasibility due to the presence of high particulate loading in the EAF exhaust gas. High particulates plug spray nozzles, packing, plates, and trays. Wet scrubbers are technically feasible if located downstream of a particulate control device. However wet scrubbers are typically designed for gas streams containing SO_2 concentrations ranging from 250 to 10,000 ppmv. This is at least 100 times greater than the SO_2 concentrations expected from the EAF/LMF. In addition there is no known installation of wet scrubbers on EAF/LMFs.

Spray Dry Scrubbers

Dry FGD systems include lime spray drying, dry lime furnace injection, and dry lime duct injection. These systems must be followed by a highly efficient PM control device, which is typically a fabric filter, although an electrostatic precipitator could also be used. Lime spray drying efficiency ranges from 70 to 96 percent, with an average of 90 percent.

The lime slurry, also called lime milk, is atomized/sprayed into a reactor vessel in a cloud of fine droplets where the water is evaporated by the heat of the flue gas. The typical residence time of about 10 seconds in the reactor is sufficient to allow for the SO_2 and other acid gases such as SO_3 and HCL to react simultaneously with the hydrated lime to form a dry mixture of calcium sulphate/sulphite. Waste water treatment is not needed in spray dry scrubbers because the water is completely evaporated in the system. Factors affecting the absorption chemistry include flue gas temperature, SO_2 concentration in the flue gas and the size of the atomized slurry droplets.

Spray dry scrubbers are not considered technically feasibility due to the presence of high particulate loading in the EAF exhaust gas. Spray dry scrubbers are technically feasible if located downstream of a particulate control device. However, an additional particulate control device would be required downstream of the scrubber to collect the calcium sulphate/sulphite. Given the expected low concentration of SO_2 in the exhaust stream, and the additional particulate control device required, spray dry scrubbers would be economically infeasible. Like wet scrubbers, spray dry scrubbers are typically designed for gas streams containing SO_2 concentrations ranging from 250 to 10,000 ppmv. In addition there is no known installation of wet scrubbers on EAF/LMFs.

FGD systems have not been demonstrated as feasible control technologies for EAF/LMFs. There are no known installations of FGD on EAF/LMFs and as such FGD is not feasible for the Project.

2.3.5.4 SO_2 BACT Selection

The current BACT SO_2 emission limit for the EAF/LMF remains equal to 0.20 lb/ton steel. The EAF/LMF will minimize SO_2 emissions through scrap management. This level of control is consistent with previous determinations. The two most recent BACT determinations for EAF/LMFs resulted in a SO_2 emission limit of 0.15 lb/ton and 0.63 lb/ton.

As stated previously, Sulfur dioxide emissions from EAF/LMFs are directly related to the amount of sulfur charged into the furnace. SO2 emissions occur primarily in the charging and melting stages of the heat which occur in the EAF compared to the refining stages planned for the LMF. The EAF has been constructed and compliance tested. The focus of this BACT analysis is the LMF.

2.4 Reheat Furnace BACT Analysis (Rebar and Wire/Rod BRFs)

2.4.1 Particulate Matter (PM/PM_{10})

2.4.1.1 Previous BACT Determinations

As part of the updated BACT analysis, a review was performed of previous PM/PM_{10} BACT determinations for Reheat Furnaces listed in the RACT/BACT/LAER Clearinghouse on EPA's web page. A summary of BACT determinations from this review are presented in Table 2-8. Determinations for similar sources issued during from years 1998 through 2008 are shown in Table 2-8.

From the review of previous BACT determinations, it is evident that PM/PM_{10} BACT determinations for Reheat Furnaces have exclusively been based on good combustion practice. BACT determinations have been in the range of 0.002 to 0.08 lb PM/PM_{10} per MMBtu. The most recent determinations are based on natural gas consumption without specific permit limits.

2.4.1.2 Control Technology Feasibility

The technically feasible PM/PM_{10} controls for the Reheat Furnace are listed in Table 2-9. As shown, there are four primary types of PM/PM_{10} abatement methods, with various techniques within each method. Each available technique is listed with its associated efficiency estimate, identified as feasible or infeasible, and ranked based on control efficiency.

2.4.1.3 Potential Control Methods

There are three potential sources of particulate emissions from combustion processes: mineral matter found in the fuel, solids or dust in the ambient air used for combustion, and unburned carbon formed by incomplete combustion of the fuel. Due to the fact that natural gas is a gaseous fuel, PM emissions are typically low. Particulate matter from natural gas combustion has both filterable and condensable fractions. The particulate matter generated from natural gas combustion is usually larger molecular weight hydrocarbons that are not fully combusted. Increased PM emissions may result from poor air/fuel mixing or maintenance problems.

All control options are basically technically feasible however the reheat furnace will fire natural gas exclusively, which has little to no ash that would contribute to the formation of PM/PM_{10}. Add-on controls have never been applied to reheat furnace or commercial natural gas fired boilers, therefore add-on PM controls are not considered for the proposed reheat furnace.

Fuel Techniques

Fuel Substitution, or fuel switching, is a common means of reducing emissions from combustion sources, such as electric utilities and industrial boilers. It involves replacing the current fuel with a fuel that emits less of a given pollutant when burned.

The proposed reheat furnaces will be fired exclusively with clean burning natural gas and therefore no fuel substitution will result in lower PM emissions.

Pretreatment Devices, Electrostatic Precipitators (ESPs), and Baghouses

As stated previously all control options are basically technically feasible, however the reheat furnaces will fire natural gas exclusively, which has little to no ash that would contribute to the formation of PM/PM_{10}.

Pretreatment devices, ESPs, and baghouse as described in EAF/LMF BACT analysis are typically utilized for combustion of ash producing fuels such as coal, oil, biomass, refuse, etc. Theses add-on controls have never been applied to commercial natural gas fired boilers, therefore add-on PM controls are not considered for the proposed reheat furnaces.

2.4.1.4 PM/PM_{10} BACT Selection

The updated BACT PM/PM_{10} emission limit for the reheat furnaces remains equal to good combustion practice control technology and the exclusive use of natural gas. This limit is consistent with the most recent determinations, based on natural gas consumption without specific permit emission limits.

2.4.2 Nitrogen Oxides

2.4.2.1 Previous BACT Determinations

As part of the BACT analysis, a review was performed of previous BACT determinations for similar reheat furnaces listed in the RACT/BACT/LAER Clearinghouse on EPA's web page. A summary of these BACT determinations is presented in Table 2-9. Determinations for similar sources issued during from years 1998 through 2008 are shown in Table 2-9.

From the review of previous BACT determinations, it is evident that NO_x BACT determinations for Reheat Furnaces remain based on good combustion practice. BACT determinations have been in the range of 0.08 to 0.269 lb PM/PM_{10} per MMBtu. The two most recent BACT determinations for reheat furnaces resulted in a NO_x emission limit of 0.10 and 0.08 lb/MMBtu.

2.4.2.2 Control Technology Feasibility

The technically feasible NO_x controls for reheat furnaces are shown in Table 2-10. As shown in the table, there are two primary types of NO_x abatement methods, with various techniques within each method. Each available technique was listed with its associated efficiency estimate, identified as feasible or infeasible, and ranked based on control efficiency.

2.4.2.3 Potential Control Method Descriptions

The principal mechanism of NO_x formation in natural gas combustion is thermal NO_x. The thermal NO_x mechanism occurs through the thermal dissociation and subsequent reaction of nitrogen and oxygen molecules in the combustion air. Most NO_x formed through the thermal NO_x is affected by three factors:

1. oxygen concentration;
2. peak temperature; and
3. time of exposure at peak temperature.

As these factors increase, NO_x emissions increase. The emission trends due to changes in these factors are fairly consistent for all types of natural gas fired boilers and furnaces. Emission levels vary considerably with the type and size of combustor and with operating conditions.

The second mechanism of NO_x formation is prompt NO_x, which occurs through early reactions of nitrogen molecules in the combustion air and hydrocarbon radicals from the fuel. Prompt NO_x reactions occur within the flame and are usually negligible.

The last mechanism of NO_x formation, fuel NO_x, stems from the evolution and reaction of fuel-bonded nitrogen compounds with oxygen. Due to the characteristically low fuel nitrogen content of natural gas, NO_x formation through the fuel NO_x mechanism is insignificant.

A description of NO_x reduction methods follows.

Chemical Reduction of NO_x

Selective Catalytic Reduction (SCR) -- SCR uses a catalyst to react injected ammonia to chemically reduce NO_x. The catalyst has a finite life in flue gas and some ammonia slips through without being reacted. SCR has historically used precious metal catalysts, but can now also use base metal and zeolite catalyst materials. SCR is technically feasible for reheat furnaces; however there is only one know installation, Beta Steel in Portage Indiana. It should be noted that Beta Steel's current NO_x permit limit of 0.077 lb/MMBtu with SCR is essentially equivalent to the proposed BRFs NO_x limit of 0.08 lb/MMBtu.

Beta Steel, Portage Indiana – Reheat Furnace Permit History -- Beta Steel's reheat furnace was originally limited to 14.7 pounds per million standard cubic feet (lb/MMSCF) or 0.014 lb/MMBtu with SCR control. Subsequent stack testing showed that Beta Steel could not meet this limit with test results ranging from 17.7 to 77.1 lb/MMSCF. As a result, on May 30, 2003, Beta Steel requested and received a revised permit limit equal to 0.077 lb/MMbtu (IDEM Construction Permit 127-9642-00036, May 30, 2003), equal to the highest of the three test results. The Indiana Department of Environmental Management (IDEM) conducted an investigation to determine the appropriate limits. IDEM concluded that the 0.077 permit limit was still more stringent than any other BACT determination and granted the request.

In IDEM's Notice of Approval, May, 20, 2003, it is stated that "Beta Steel has demonstrated that due to the non-steady state nature of the reheat furnace process, it is not possible to maintain a consistent level of performance from SCR control. This results in lowered efficiency of control of NO_x emissions." In order for a SCR system to effectively reduce NOx emissions, the exhaust stream must have relatively stable gas flow and temperature. As stated, the reheat furnace is a non-steady state operation, and as such the flue gas emission concentration and temperature are highly variable depending upon the heat input rate and the material being heated.

The following factors contribute to reduction in SCR control efficiency:

1. The reheat furnace operation is a non-steady state operation where emission rates vary depending upon heat input rate and material being heated;
2. Varying flue gas temperature at the inlet of SCR causes fluctuations in the Catalyst performance.
3. The catalyst performance is affected due to deposition of particulate matter from the flue gas stream. As it is not possible to run the gas through any kind of add-on control before the SCR, this factor is inherent to this application of SCR."

SCR is typically assumed to have a reduction efficiency of 80 to 90 percent with ideal conditions. Based on Beta Steel's current permit limit of 0.077 lb/MMBtu and original permit limit of 0.014 lb/MMBtu, the SCR system's efficiency was over estimated by 82 percent. Based on this information the SCR is at best only reducing NO_x emission by 10 percent.

In conclusion, while Beta Steel operates the only SCR controlled reheat furnace, the NO_x BACT permit limit of 0.077 lb/MMBtu is consistent with recently permitted furnaces with low NO_x burners and good combustion practice (see recent BACT determinations in Table 2-8). Based on Beta Steel's experience, and IDEM's conclusions, SCR is not considered a proven technology for control of NOx emissions from reheat furnaces.

Selective Non-Catalytic Reduction (SNCR) -- In SNCR, ammonia or urea is injected within the boiler or in ducts in a region where temperature is between 1,600 and 2,000°F. This technology is based on temperature ionizing the ammonia or urea instead of using a catalyst or non-thermal plasma. The temperature window for SNCR is very important because outside of it either more ammonia slips through the system or more NO_x is generated than is being chemically reduced. The temperature requirement for SNCR is greater than the temperature available exiting the reheat furnace and therefore SNCR is determined to be technically infeasible for the reheat furnace. There are no known installations of SNCR on billet reheat furnaces.

Reducing Peak Temperature

Flue Gas Recirculation (FGR) -- Recirculation of cooled flue gas reduces combustion temperature by diluting the oxygen content of the combustion air and by causing heat to be diluted in a greater mass of flue gas. Heat in the flue gas can be recovered by a heat exchanger. This reduction of temperature lowers the thermal NO_x concentration that is generated. FGR has been utilized in boilers; however, it has not been demonstrated in reheat furnaces and therefore is not considered for the Project

Reburn -- In a boiler outfitted with reburn technology, a set of natural gas burners are installed above the primary combustion zone. Natural gas is injected to form a fuel-rich, oxygen-deficient combustion zone above the main firing zone. Nitrogen oxides, created by the combustion process in the main portion of the boiler, drift upward into the reburn zone and are converted to molecular nitrogen. The technology requires no catalysts, chemical reagents, or changes to any existing burners. Typical reburn systems also incorporate redesign of the combustion air system along with the water-cooled, pinhole grate to provide less excess air (LEA). LEA has been utilized in boilers; however, it has not been demonstrated in reheat furnaces and therefore is not considered for the Project

Over-Fire Air (OFA) -- When primary combustion uses a fuel-rich mixture, use of OFA completes the combustion. Because the mixture is always off-stoichiometric when combustion is occurring, the temperature is reduced. After all other stages of combustion, the remainder of the fuel is oxidized in the OFA. OFA has been utilized in boilers; however, it has not been demonstrated in reheat furnaces and therefore is not considered for the Project.

Less Excess Air (LEA) -- Excess airflow combustion has been correlated to the amount of NO_x generated. Limiting the net excess airflow can limit NO_x content of the flue gas. The reheat furnace will utilize a combustion system that minimizes the amount of excess air in the furnace.

Combustion Optimization -- Combustion optimization refers to the active control of combustion. The active combustion control measures seek to find optimum combustion efficiency and to control combustion at that efficiency. The reheat furnace will be optimized for maximum combustion efficiency.

Low NO_x Burners (LNB) -- A LNB provides a stable flame that has several different zones. For example, the first zone can be primary combustion. The second zone can be Fuel Reburning (FR) with fuel added to chemically reduce NO_x. The third zone can be the final combustion in low excess air to limit the temperature. The reheat furnace will utilize LNB technology to reduce NO_x emissions.

2.4.2.4 Economic Analysis

SCR

An updated SCR cost analysis was performed in support of the updated BACT analysis. This updated cost analysis included scaling the year 2005 vendor provided equipment cost based on ratio of ENR's construction cost index for years 2005 and 2008. This results in an increase equipment cost of 8.7 percent from year 2005. For this analysis the uncontrolled NOx emissions are based on an annual average heat input rate of 90 MMBtu/hr, based on past actual operating experience (AOR data). The cost analysis also assumes 40 percent reduction of NOx as guaranteed by Haldor Topsoe. The resulting capital and annual costs and cost effectiveness of SCR applied to the reheat furnace are as follows:

- Capital Cost – $1,021,934
- Annual Cost – $171,251
- Cost Effectiveness - $13,991 per ton of NOx removed per reheat furnace.

In addition the storage of ammonia for the SCR would trigger the requirement of a Risk Management Plan (RMP). Implementation of RMP would incur additional annual costs not included in above cost analysis.

SCR is not considered to be cost effective for the Project (Table 2-11).

2.4.2.5 Environmental Impacts

The maximum predicted annual NO_2 impacts for the proposed Project are below the allocable AAQS and PSD Class II increment levels (See original PSD application). Additional NO_x controls would result in an insignificant reduction of ambient impacts that are already below AAQS and PSD levels for both Class I and II areas.

2.4.2.6 Energy Impacts

Energy penalties occur with SCR. SCR will require inputs of energy, water, and ammonia. The energy requirement is estimated at approximately $12,600 per year and the annual ammonia cost is estimated at $21,000.

2.4.2.7 NO_x BACT Selection

For the reheat furnace the combination of good combustion practices; low excess air; and low NO_x burners can achieve the maximum amount of emissions reduction that is technically and economically feasible, and is demonstrated in practice. Additional controls should be rejected as BACT for the reheat furnace for the following reasons:

- The current BACT emission limit of 0.08 lb/MMBtu is as low as any previous BACT determination made on similar units;
- Although there is one installation of SCR on a reheat furnace, the permit limit is consistent with existing BACT determinations with LNB technology.
- SCR, has a capital and annual operating cost of $1.02 million and $171,251, respectively, resulting in a cost effectiveness of at approximately $14,000 per ton of NO_x removed; and
- SCR has not been demonstrated successfully in practice.

Therefore, the proposed NO_x BACT limit for the reheat furnace remains based on good combustion low excess air, and low NO_x burners with a maximum emission rate of 0.08 lb/MMBtu.

2.4.3 <u>Carbon Monoxide</u>

2.4.3.1 Previous BACT Determinations

As part of the updated BACT analysis, a review was performed of previous CO BACT determinations for reheat furnaces listed in the RACT/BACT/LAER Clearinghouse on EPA's web page. A summary of the BACT determinations for reheat furnaces from this review is presented in Table 2-8.

The CO emission limits for reheat furnaces range from 0.011 to 0.084 lb/MMBtu. This rather large range of emissions is due to differences in reheat furnace design and operation. From the review of previous determinations, it is evident that CO BACT determinations for reheat furnaces remain based on good combustion practices.

2.4.3.2 Control Technology Feasibility

The technically feasible add-on CO controls for reheat furnaces are shown in Table 2-12. As shown, there are two types of add-on CO abatement methods. Each available technique was listed with its associated efficiency estimate, identified as feasible or infeasible, and ranked based on control efficiency.

2.4.3.3 Potential Control Method Descriptions

Good Combustion Practices

The reheat furnace design generally provides a moderately high temperature with sufficient turbulence and residence time at that temperature to complete combustion of the fuel. GCPs maintain efficient combustion and minimize products of incomplete combustion. To assure good combustion, process monitors can be used to monitor the O_2 content of the reheat furnace flue gas. Real time data is fed to the boiler control room. The boiler operator uses the real time data to adjust the boiler operation to ensure sufficient excess air levels. The proposed reheat furnaces will utilize GCPs to control CO emissions.

Incinerators

The two basic types of incinerators are thermal and catalytic. Thermal systems may be direct flame incinerators with no energy recovery, flame incinerators with a recuperative heat exchanger, or regenerative systems, which operate in a cyclic mode to achieve high-energy recovery. Catalytic systems include fixed bed (packed bed or monolith) systems and fluid-bed systems, both of which provide for energy recovery.

Theses add-on controls have typically not applied to commercial natural gas fired boilers or reheat furnaces, therefore incinerators are not considered for the proposed reheat furnace.

2.4.3.4 CO BACT Selection

The proposed BACT CO emission limit for the billet reheat furnaces remains equal to 0.035 lb/MMBtu. Gerdau will minimize CO emissions through proper furnace design and good combustion practices, including: control of combustion air and combustion temperature. This level of control is consistent with previous determinations. The two most recent BACT determinations for reheat furnaces other than this facilities resulted in CO emission limits of 0.084 lb/MMBtu.

2.4.4 Volatile Organic Compounds (VOC)

2.4.4.1 Previous BACT Determinations

As part of the BACT analysis, a review was performed of previous VOC BACT determinations for reheat furnaces listed in the RACT/BACT/LAER Clearinghouse on EPA's web page. A summary of the BACT determinations for reheat furnaces from this review is presented in Table 2-8.

The VOC emission limits for reheat furnaces range from 0.0014 to 0.006 lb/MMBtu. This range of emissions is due to differences in reheat furnace design and operation. From the review of previous determinations, it is evident that VOC BACT determinations for reheat furnaces remain exclusively based on good combustion practices and boiler design.

2.4.4.2 Control Technology Feasibility

The technically feasible add-on VOC controls for reheat furnaces are shown in Table 2-13. As shown, there are four types of add-on VOC abatement methods. Each available technique was listed with its associated efficiency estimate, identified as feasible or infeasible, and ranked based on control efficiency.

2.4.4.3 Potential Control Method Descriptions

VOC emissions from natural gas fired sources are primarily the result of incomplete combustion. Complete combustion is a function of three variables; time, temperature and turbulence. Once the combustion process begins, there must be enough residence time at the required temperature to complete the process, and during combustion there must be enough turbulence or mixing to ensure that the fuel gets enough oxygen for the combustion air. Combustion systems with poor control of the fuel to air ratio, poor mixing, and insufficient residence time at combustion temperature have higher VOC emission than do those with good controls.

Refrigerated Condensers

The most common types of condensers used are surface and contact condensers. In surface condensers, the coolant does not contact the gas stream. Most surface condensers in refrigerated systems are shell and tube type. Shell and tube condensers circulate the coolant through tubes. The VOC condenses on the outside surface of the tube. Plate and frame type heat exchangers are also used as condensers in refrigerated systems. In these condensers, the coolant and the vapor flow separately over thin plates. In either design, the condensed VOC vapors drain away to a collection tank for storage, reuse, or disposal.

Contact condensers cool the vapor stream by spraying either a liquid at ambient temperature or a chilled liquid directly into the gas stream.

Refrigerated condensers are used as air pollution control devices for treating emissions with high VOC concentrations [>5,000 parts per million by volume (ppmv)], in applications involving gasoline bulk terminals, storage, etc. Refrigerated condensers are not technically feasible for reduction of VOC from reheat furnaces, and as such are not technically feasible for the Project.

Carbon Adsorbers

Adsorption is employed to remove VOC compounds from low to medium concentration gas streams. Adsorption is a phenomenon where gas molecules passing through a bed of solid particles are selectively held there by attractive forces, which are weaker and less specific than those of chemical bonds. During adsorption, a gas molecule migrates from the gas stream to the surface of the solid where it is held by physical attraction releasing energy, the heat of adsorption, which typically equals or exceeds the heat of condensation. Adsorption capacity of the solid for the gas tends to increase with the gas phase concentration, molecular weight, diffusivity, polarity, and boiling point. Gases form actual chemical bonds with the adsorbent surface groups. There are five types of adsorption techniques.

Of the five techniques, fixed bed units are typically utilized for controlling continuous VOC containing streams from flow rates ranging from several hundred to several thousand cubic feet per minute. Based on the gas flow rate of the reheat furnace and low VOC content of the exhaust stream, carbon adsorption is not technically feasible for this project.

Destruction Controls (Flares)

Flaring is a VOC control process in which the VOCs are piped to a remote, usually elevated, location and burned in an open flame in the open air using a specially designed burner tip and auxiliary fuel. Flares are not technically feasible for the reheat furnace due to the large gas volume and low Btu value of the gas stream.

Incinerators

The two basic types of incinerators are thermal and catalytic. Thermal systems may be direct flame incinerators with no energy recovery, flame incinerators with a recuperative heat exchanger, or regenerative systems, which operate in a cyclic mode to achieve high-energy recovery. Catalytic systems include fixed bed (packed bed or monolith) systems and fluid-bed systems, both of which provide for energy recovery.

These add-on controls have typically not applied to commercial natural gas fired boilers or reheat furnaces, therefore incinerators are not considered for the proposed reheat furnace

2.4.4.4 VOC BACT Selection

The updated BACT VOC emission limit for the reheat furnaces remains equal to good combustion practice control technology and the exclusive use of natural gas. This limit is consistent with the most recent determinations, based on natural gas consumption without specific permit emission limits.

2.4.5 Sulfur Dioxide

2.4.5.1 Previous BACT Determinations

As part of the BACT analysis, a review was performed of previous SO_2 BACT determinations for reheat furnaces listed in the RACT/BACT/LAER Clearinghouse on EPA's web page. A summary of the BACT determinations for reheat furnaces from this review is presented in Table 2-8.

The SO_2 emission limits for reheat furnaces are all equivalent to 0.0006 lb/MMBtu. From the review of previous determinations, it is evident that SO_2 BACT determinations for reheat furnaces remain exclusively based on combustion of natural gas.

2.4.5.2 Control Technology Feasibility

Control technologies to reduce SO2 emissions are described in Section 1.4. There are no known installations of SO_2 controls on any existing natural gas fired reheat furnace. Based on low sulfur content of natural gas, additional controls such sorbent injection, wet scrubbers and spray dry scrubbers are not considered economically feasible for the project.

2.4.5.3 SO_2 BACT Selection

The updated BACT SO_2 emission limit for the reheat furnaces remains equal to good combustion practice control technology and the exclusive use of natural gas. This limit is consistent with the most recent determinations, based on natural gas consumption without specific permit emission limits.

TABLES

Table 2-1. Proposed Updated BACT Emission Levels.

Pollutant	EAF/LMF	Rebar Mill BRF & Wire/Rod Mill BRF (lb/MMBtu)
PM	0.0018 gr/dscf	Natural Gas Combustion
PM_{10}	0.0018 gr/dscf	Natural Gas Combustion
NO_x	0.33 lb/ton tapped steel	0.08
CO	2.0 lb/ton tapped steel	0.035
VOC	0.13 lb/ton tapped steel	Natural Gas Combustion
SO_2	0.2 lb/ton tapped steel	Natural Gas Combustion

Source: Golder, 2008

Table 2-2. BACT Determinations for Electric Arc Furnace (EAF), 1998 - 2008

Facility	State	Date	Throughput ton/hr	NOx lb/ton	CO lb/ton	VOC lb/ton	SO_2 lb/ton	PM/PM_{10} gr/dscf	PM gr/dscf	PM_{10} gr/dscf
Minnesota Steel Industries, LLC	Minnesota	9/7/2007	205	0.3	2	0.13	0.15	--	0.0018	0.003
Nucor Corporation/ Nucor Steel Decatur, LLC	Alabama	6/12/2007	440	0.42	2.3	0.13	0.62	0.0018	--	--
Elwood National Steel	Pennsylvania	8/18/2006	45	–	6	0.28**	0.55	--	–	0.005
Nucor Steel Tuscaloosa	Alabama	6/6/2006	300	0.35	2.2	0.13	0.46	–	–	0.0018
North Star BHP Steel, Ltd	Ohio	12/20/2005	315	0.57	7.5	–	0.25	–	46.9 TPY	167.2 TPY
Nucor Steel Marion Inc.	Ohio	8/18/2005	70	0.40	4.1	0.29	0.25	–	--	0.005
Wheeling Pittsburgh Steel Corporation	Ohio	1/6/2005	350	0.54**	4**	0.35	0.3**	–	0.0032**	0.044
Steelcorr, Inc. - Bluewater project	Arizona	7/22/2004	350	0.35	2	0.13	0.2	--	–	0.0018
Charter Manufacturing Co., Inc./Charter Steel	Ohio	6/10/2004	110	0.33	3.24	0.2	0.2	--	–	0.113
Steel Dynamics, Hendricks	Indiana	8/29/2003	135	0.35	2	0.13	0.25-1.8	–	0.0018	0.0052
Beta Steel[1]	Indiana	5/30/2003	151	0.45	5.41	0.15	0.33	0.0052	–	0.0052
Timken Company/Faircrest Plant[2]	Ohio	2/20/2003	200	0.2 (NO_2)	4.8	0.1	0.15	0.0032	--	--
Nucor Jewett Plant[3]	Texas	1/5/2003	240	0.898	2.2	0.43	1.76	–	55.5 lb/hr	34.2 lb/hr
Corus Tuscaloosa	Alabama	6/3/2003	160	0.35	2	0.13	0.62	0.2	--	--
Nucor Corp.	Texas	1/15/2003	--	0.3	2	0.427	0.35	0.0052	--	--
Nucor Steel Decatur, LLC (Trico Steel)	Alabama	7/11/2002	440	0.4	2.0	0.2	0.5	0.0032	--	--
Nucor Steel Corp	North Carolina	2002	--	0.51	4	0.13	0.22	0.0018	–	--
IPSCO Steel	Iowa	2002	--	0.8	1.93	0.18	0.7	0.0052	--	--
Ellwood Quality Steels Co.	Pennsylvania	4/30/2001	53 ton/batch	0.1**	5	0.3**	0.45**	--	--	0.15 lb/ton**
SMI Steel	South Carolina	2001	--	0.51	2	–	0.35	0.002	--	--
Nucor Yamato	Arkansas	2001	450	0.38	2	0.13	0.15	0.0018	--	--
Kestone Steel	Illinois	2000	--	0.51	1.34	0.13	0.2	0.0018	–	--
Charter Steel	Wisconsin	2000	--	0.51	3.5	0.06	0.176**	0.0015	6.05 lb/hr	5.56 lb/hr
Nucor Steel Corporation	Tennessee	11/6/2000	150	0.7	4	0.26	0.16	--	–	0.002
Republic Technologies Int.	Ohio	1/27/1999	165	0.35	4**	0.35**	0.07**	0.0032**	–	--
SDI Steel, Whitley	Indiana	1999	–	0.35	2	0.09	0.25	0.002	–	--
Gerdau-Ameristeel/Ameristeel Corporation	Florida	9/28/1999	100	0.33	3	0.295**	--	0.0034	–	--
IPSCO Steel Inc.	Alabama	10/16/1998	200	0.4	2	0.35	0.7	0.0033	–	--
Roanoke Electric	Virginia	1998	–	0.378	2.4	0.3	0.17	0.0034	–	--
Quanex Corporation - Macsteel Division	Arkansas	2/18/1998	86	0.51	4.9	0.13	1.05	0.0018	–	--
Chaparral Steel	Virginia	1998	--	0.7	4	0.35	0.7	0.0018	–	--

** Per EPA RBLC database, basis other than BACT.

Notes:

[1]Emissions from Meltshop (EAF(w/Cojet Burners), LMF, Caster, & Natural Gas Comb. Units.)

[2]NO_2 emission limit as reported in EPA RBLC Database.

[3]EAF, LMF, Caster, Meltshop

Source: Golder, 2008.

Table 2-3. PM/PM_{10} Control Technolgy Feasibility Analysis for EAF/LMFs

PM Abatement Method	Technique Now Available	Estimated Efficiency	Technically Feasible? (Y/N)	Demonstrated? (Y/N)	Rank Based on Control Efficiency	Proposed for Project? (Y/N)
1. Fuel Techniques	Fuel Substitution	NA	N	NA	NA	NA
2. Pretreatment	Settling Chambers	< 10%	Y	Y	2	N
	Elutriators	< 10%	Y	N	NA	NA
	Momentum Separators	10 - 20%	Y	N	NA	NA
	Mechanically-Aided Separators	20 - 30%	Y	N	NA	NA
	Cyclones	60 - 90%	Y	N	NA	NA
3. Electrostatic Precipitators(ESP)	Dry ESP	>99%	N	NA	NA	NA
	Wet ESP	>99%	N	NA	NA	NA
	Wire-Plate ESP	>99%	N	NA	NA	NA
	Wire-Pipe ESP	>99%	N	NA	NA	NA
4. Fabric Filters	Shaker-Cleaned	>99%	Y	Y	1	N
	Reverse-Air	>99%	Y	Y	1	Y
	Pulse-Jet	>99%	Y	Y	1	N
5. Wet Scrubbers	Spray Chambers	50 - 95 %	Y	N	NA	NA
	Packed-Bed	50 - 95 %	Y	N	NA	NA
	Impingement Plate	50 - 95 %	Y	N	NA	NA
	Mechanically-Aided	50 - 95 %	N	NA	NA	NA
	Venturi	50 - 95 %	Y	N	NA	NA
	Orifice	50 - 95 %	Y	N	NA	NA
	Condensation	50 - 95 %	Y	N	NA	NA

Note: NA = Not Applicable

Source: Golder, 2008.

Table 2-4. NO_x Control Technolgy Feasibility Analysis for EAF/LMFs

NO_x Abatement Method	Technique Now Available	Estimated Efficiency	Technically Feasible? (Y/N)	Demonstrated? (Y/N)	Rank Based on Control Efficiency	Proposed for Project? (Y/N)
1. Removal of nitrogen	Ultra-Low Nitrogen Fuel	No Data	N	NA	NA	NA
	Furnace Control (Minimization of Air Infiltration to EAF)	No Data	Y	Y	NA	Y
2. Oxidation of NO_x with subsequent absorption.	Inject Oxidant	60 - 80%	N	NA	NA	NA
	Non-Thermal Plasma Reactor (NTPR)	60 - 80%	N	NA	NA	NA
3. Chemical reduction of NO_x	Selective Catalytic Reduction (SCR)	35 - 80%	N	NA	NA	NA
	Selective Non-Catalytic Reduction (SNCR)	35 - 80%	N	NA	NA	NA
4. Reducing residence time at peak temperature	Air Staging of Combustion	50 - 65%	N	NA	NA	NA
	Fuel Staging of Combustion	50 - 65%	N	NA	NA	NA
	Inject Steam	50 - 65%	N	NA	NA	NA
5. Reducing peak temperature	Flue Gas Recirculation (FGR)	15 -25%	Y	Y	1	N
	Natural Gas Reburning (NGR)	15 -25%	N	N	NA	NA
	Over Fire Air (OFA)	15 -25%	Y	Y	1	N
	Less Excess Air (LEA)	15 -25%	Y	Y	1	Y
	Combustion Optimization	15 -25%	Y	Y	NA	NA
	Reduce Air Preheat	15 -25%	Y	Y	1	N
	Low NO_x /Oxyfuel Burners (LNB)	15 -25%	Y	Y	1	Y

Note: NA = Not Applicable

Source: Golder, 2008.

Table 2-5. Add-on CO Control Technology Feasibility Analysis for EAF/LMFs

VOC Abatement Method	Technique Now Available	Estimated Efficiency	Technically Feasible? (Y/N)	Demonstrated? (Y/N)	Rank Based on Control Efficiency	Proposed for Project? (Y/N)
1. Good Combustion Practice	Furnace Control	>50%	Y	Y	1	Y
2. Post Combustion	Post Combustion Chamber	>90%	Y	N	NA	N
3. Incinerators	Thermal	>80%	N	NA	NA	NA
	Catalytic	>80%	N	NA	NA	NA
4. Direct Evacuation System	Fourth Hole	NA	Y	Y	NA	Y

Note: NA = Not Applicable

Source: Golder, 2008.

Table 2-6. Add-on VOC Control Technology Feasibility Analysis for EAF/LMFs

VOC Abatement Method	Technique Now Available	Estimated Efficiency	Technically Feasible? (Y/N)	Bagasse Demonstrated? (Y/N)	Rank Based on Control Efficiency	Proposed for Project? (Y/N)
1. Good Combustion Practice	Furnace Control	>50%	Y	Y	1	Y
2. Refrigerated Condensors	Surface	Variable	N	NA	NA	NA
	Contact	Variable	N	NA	NA	NA
				NA	NA	NA
3. Carbon Adsorbers	Fixed Regenerative bed	Variable	N	NA	NA	NA
	Disposable/Rechargeable Cannisters	Variable	N	NA	NA	NA
	Traveling Bed Adsorbers	Variable	N	NA	NA	NA
	Fluid Bed Adsorbers	Variable	N	NA	NA	NA
	Chromatographic Baghouse	Variable	N	NA	NA	NA
				NA	NA	NA
4. Destruction Controls	Flares	Variable	N	NA	NA	NA
				NA	NA	NA
5. Incinerators	Thermal	>80%	N	NA	NA	NA
	Catalytic	>80%	N	NA	NA	NA

Note: NA = Not Applicable

Source: Golder, 2008.

Table 2-7. SO_2 Control Technolgy Feasibility Analysis for EAF/LMFs

PM Abatement Method	Technique Now Available	Estimated Efficiency	Technically Feasible? (Y/N)	Demonstrated? (Y/N)	Rank Based on Control Efficiency	Proposed for Project? (Y/N)
1. Charge Management	Scrap and Carbon Management	Unknown	Y	Y	1	Y
2. Sorbent Injection	Sorbent Duct Injection	80%	Y	N	NA	NA
3. Wet Scrubbers	Packed Tower	99.9%	Y	N	NA	NA
	Plate	>90%	Y	N	NA	NA
	Columns	>90%	Y	N	NA	NA
	Venturi	>90%	Y	N	NA	NA
	Spray Chamber	>90%	Y	N	NA	NA
4. Spray Dry Scrubbers	Lime or Calcium Oxide	90 - 95%	Y	N	NA	NA

NTF = Not Technically Feasible

Source: Golder, 2008.

Table 2-8. **BACT Determinations for Reheat Furnaces, 1998 - 2008**

Facility	State	Date	(lb/MMBtu)				
			NO_x	CO	VOC	SO_2	PM/PM_{10}
Gerdau Ameristeel Wilton	Iowa	5/29/2007	110.23 lb/mmcf	84 lb/mmcf	--	--	--
Gerdau Ameristeel - Jacksonville Steel Mill	Florida	5/5/2006	0.08	0.035	--	--	--
Nucor-Yamato Steel Company - Blytheville Mill	Arizona	4/6/2005	0.17	--	--	--	--
IPSCO Steel Inc.	Alabama	2/7/2005	0.17	--	--	--	--
Nucor Steel	North Carolina	11/23/2004	0.13	0.084	0.006	0.00058	0.01
Nucor Steel Corp	Nevada	6/22/2004	0.64	0.066	0.0055	0.00060	--
Nucor Auburn Steel	New York	6/22/2004	--	0.084	--	0.00061	--
Structural Metals Inc./SMI Texas	Texas	1/28/2004	14.64 lb/hr	0.24 lb/hr	0.24 lb/hr	1.34 lb/hr	1.2 lb/hr
Nucor Steel Corp (Draft Determination)	Nebraska	6/22/2004	0.096	0.035	0.0055	0.0006	--
Steel Dynamics, Hendricks	Indiana	8/29/2003	0.08	0.084	0.0050	0.0006	0.0019
Beta Steel*	Indiana	5/30/2003	0.077	0.04	--	--	--
Nucor Steel	North Carolina	2002	0.128	0.084	0.005	0.00058	--
IPSCO Steel	Iowa	2002	0.269	--	--	--	--
Nucor Yamato	Arkansas	10/10/2001	0.094	0.0824	0.0054	0.0006	0.0168
Charter Steel	Wisconsin	2000	0.09	0.011	0.0014	0.00061	0.082
Republic Technologies Int.	Ohio	1/27/1999	0.112	0.039	--	--	0.005
SDI Steel, Whitley	Indiana	1999	0.11	0.03	0.0055	--	--
Gerdau-Ameristeel	Florida	1999	0.19	0.035	--	--	0.0108
IPSCO Steel Inc.	Alabama	10/16/1998	0.172	--	--	--	0.0058
Quanex Corporation - Macsteel Division	Arkansas	2/18/1998	0.14	0.035	--	--	0.0031
Chaparral Steel	Virginia	1998	0.21	0.075	0.0053	0.0006	--

Note: All measurements in lb/MMBtu.

Source: Golder, 2008.

Table 2-9. PM/PM_{10} Control Technolgy Feasibility Analysis for Reheat Furnaces

PM Abatement Method	Technique Now Available	Estimated Efficiency	Technically Feasible? (Y/N)	Demonstrated? (Y/N)	Rank Based on Control Efficiency	Proposed for Reheat Furnace? (Y/N)
1. Fuel Techniques	Fuel Substitution	NA	Y	Y	N	N
2. Pretreatment	Settling Chambers	< 10%	Y	N	NA	NA
	Elutriators	< 10%	Y	N	NA	NA
	Momentum Separators	10 - 20%	Y	N	NA	NA
	Mechanically-Aided Separators	20 - 30%	Y	N	NA	NA
	Cyclones	60 - 90%	Y	N	NA	NA
3. Electrostatic Precipitators(ESP)	Dry ESP	>99%	Y	N	NA	NA
	Wet ESP	>99%	Y	N	NA	NA
	Wire-Plate ESP	>99%	Y	N	NA	NA
	Wire-Pipe ESP	>99%	Y	N	NA	NA
4. Fabric Filters	Shaker-Cleaned	>99%	Y	N	NA	NA
	Reverse-Air	>99%	Y	N	NA	NA
	Pulse-Jet	>99%	Y	N	NA	NA

Note: NA = Not Applicable

Source: Golder, 2008.

Table 2-10. NO_x Control Technology Feasibility Analysis for Billet Reheat Furnaces

NO_x Abatement Method	Technique Now Available	Estimated Efficiency	Technically Feasible? (Y/N)	Demonstrated? (Y/N)	Rank Based on Control Efficiency	Proposed for Reheat Furnace? (Y/N)
1. Chemical reduction of NO_x	Selective Catalytic Reduction (SCR)	35 - 80%	Y	N	NA	NA
	Selective Non-Catalytic Reduction (SNCR)	35 - 80%	N	NA	NA	NA
2. Reducing peak temperature	Flue Gas Recirculation (FGR)	15 -25%	N	NA	NA	NA
	Natural Gas Reburning (NGR)	15 -25%	N	NA	NA	NA
	Over Fire Air (OFA)	15 -25%	N	NA	NA	NA
	Less Excess Air (LEA)	15 -25%	Y	Y	1	Y
	Combustion Optimization	15 -25%	Y	Y	1	Y
	Low NO_x Burners (LNB)	15 -25%	Y	Y	1	Y

Note: NA = Not Applicable

Source: Golder, 2008.

Table 2-11. Cost Effectiveness of SCR , Billet Reheat Furnace.

Cost Items	Cost Factors[a]	Cost ($)
DIRECT CAPITAL COSTS (DCC):		
SCR Installed System - Catalyst Cost	Based on Vendor quote[b]	765,078
Emission Monitoring	15% of SCR equipment cost	114,762
Ammonia Storage System	included	included
Foundation and Structure Support	8% of equipment cost	included
Control Room and Enclosures	4% of equipment cost, engineering estimate	included
Transition Ducts to and from SCR	4% of equipment cost, engineering estimate	included
Wiring and Conduit	2% of equipment cost, engineering estimate	included
Insulation	2% of equipment cost, engineering estimate	included
Motor Control and Motor Starters	4% of equipment cost, engineering estimate	included
SCR Bypass Duct	$127 per MMBtu/hr	included
Induced Draft Fan	5% of SCR equiment cost, engineering estimate	included
Taxes	Florida sales tax, 6%	included
Total DCC:		879,840
INDIRECT CAPITAL COSTS (ICC):		
General Facilities	5% of DCC	included
Engineering Fees	10% of DCC	included
Performance test	1% of DCC	8,798
Total ICC:		8,798
Project Contingencies:	15% of DCC and ICC	133,296
TOTAL CAPITAL INVESTMENT OF SCR (TCI):	DCC + ICC + Project Contingencies	1,021,934
TOTAL CAPITAL INVESTMENT		1,021,934
DIRECT OPERATING COSTS (DOC):		
(1) Operating Labor		
Operator	24 hrs/wk, $16/hr, 26 wks/yr	9,984
Supervisor	15% of operator cost	1,498
(2) Maintenance	Engineering estimate, 5% of catalyst replacement cost	1,417
(3) SCR Energy Requirement	163 Hp Blower, 16 Hp Ammonia Pump, 82kW/h for SCR @ $0.04/kWh	12,595
(4) Ammonia Cost	$800/ton NH3 19% Aqueous(Tanner,05)	20,951
(6) Catalyst Replacement and disposal	$85,008 per catalyst[c], 25,500 hrs or every 3 years	28,336
Total DOC:		74,781
CAPITAL RECOVERY COSTS (CRC):	CRF of 0.0944 times TCI (20 yrs @ 7%)	96,471
ANNUALIZED COSTS of SCR (AC):	DOC+ CRC	171,251
TOTAL ANNUALIZED COST		171,251
BASELINE NO_x EMISSIONS (TPY) :	Annual Avg. - 90 MMBtu/hr, 8500 hr/yr, 0.08 lb NOx/ MMBtu	30.6
MAXIMUM NO_x EMISSIONS (TPY) :	40% Control; Haldor Topsoe Quote	18.4
REDUCTION IN NO_x EMISSONS (TPY):		12.2
COST EFFECTIVENESS:	$ per ton of NO_x Removed	13,991

Footnotes:

[a] Unless otherwise specified, factors and cost estimates reflect OAQPS Cost Manual, Section 3, Sixth edition.

[b] 2005 Haldor Topsoe SCR Catalyst Quote scaled for year 2008 based ENR's Construction Cost Index (+8.7%). Catalyst estimated to be 10% of the total installed cost of the SCR.

[c] SCR catalyst replacement based on Haldor Topsoe catalyst quote and 3 year guarantee.

Source: Golder, 2008.

Table 2-12. Add-on CO Control Technology Feasibility Analysis for Billet Reheat Furnaces

VOC Abatement Method	Technique Now Available	Estimated Efficiency	Technically Feasible? (Y/N)	Demonstrated? (Y/N)	Rank Based on Control Efficiency	Proposed for Reheat Furnace? (Y/N)
1. Good Combustion Practice	Furnace Control	>50%	Y	Y	1	Y
2. Incinerators	Thermal	>80%	N	NA	NA	NA
	Catalytic	>80%	N	NA	NA	NA

Note: NA = Not Applicable

Source: Golder, 2008.

Table 2-13. Add-on VOC Control Technology Feasibility Analysis for Billet Reheat Furnaces

VOC Abatement Method	Technique Now Available	Estimated Efficiency	Technically Feasible? (Y/N)	Demonstrated? (Y/N)	Rank Based on Control Efficiency	Proposed for Reheat Furnace? (Y/N)
1. Good Combustion Practice	Furnace Control	>50%	Y	Y	1	Y
2. Refrigerated Condensors	Surface	Variable	N	NA	NA	NA
	Contact	Variable	N	NA	NA	NA
3. Carbon Adsorbers	Fixed Regenerative bed	Variable	N	NA	NA	NA
	Disposable/Rechargeable Cannisters	Variable	N	NA	NA	NA
	Traveling Bed Adsorbers	Variable	N	NA	NA	NA
	Fluid Bed Adsorbers	Variable	N	NA	NA	NA
	Chromatographic Baghouse	Variable	N	NA	NA	NA
4. Destruction Controls	Flares	Variable	N	NA	NA	NA
5. Incinerators	Thermal	>80%	N	NA	NA	NA
	Catalytic	>80%	N	NA	NA	NA

Note: NA = Not Applicable

Source: Golder, 2008.

APPENDIX A

FDEP BACT REQUEST LETTER

Florida Department of Environmental Protection

Bob Martinez Center
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

August 19, 2008

Electronically Sent – Received Receipt Requested

Mr. Carlos Zanoelo
Vice President and General Manager
Gerdau Ameristeel
Jacksonville Steel Mill
16770 Rebar Road
Baldwin, Florida 32234

RE: Request for an Extension of the Expiration Date for Permits PSD-FL-349 and PSD-FL-349(A)
Project No. 0310157-011-AC/PSD-FL-349(C)

Dear Mr. Zanoelo:

On July 22, 2008, the Department received a request for an 18-month extension of the expiration date of the above referenced permits. The expiration date is September 28, 2008. Based on our review of the proposed project, we have determined that the following additional information is needed in order to continue processing this application package. Please provide all assumptions, calculations, and reference material(s), that are used or reflected in any of your responses.

1. Pursuant to Rule 62-212.400(12)(a), F.A.C., Source Obligation, authorization to construct expires if construction is discontinued for a period of 18 months or more. Based on an e-mail received on August 5, 2008, the schedule for the Ladel Metallurgical Furnace, Billet Reheat Furnace and Billet Reheat Furnace #2 indicates that these emissions units will need to undergo a Best Available Control Technology (BACT) determination review before construction is to resume. Therefore, please complete and submit the appropriate application pages and associated documents to address BACT for these emissions units.

If you have any questions regarding this matter, please call Bruce Mitchell at (850)413-9198.

Sincerely,

Syed Arif, P.E.
New Source Review Section
Bureau of Air Regulation

SA/bm

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