

New Galvanization Line Project

Prevention of Significant Deterioration and Title V Permits Major Modification Application

Prepared for:

Nucor Steel Decatur, LLC

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This document has been prepared by SLR International Corporation. The material and data in this report were prepared under the supervision and direction of the undersigned.



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CONTENTS

1.	Introduction	1
1.1	Background.....	1
1.2	Process Description	2
1.2.1	Electric Arc Furnaces	2
1.2.2	Ladle Metallurgy Furnaces	3
1.2.3	Continuous Casters	4
1.2.4	New Galvanization Line.....	4
1.3	Air Emissions Summary	5
2.	Regulatory Applicability	7
2.1	Prevention of Significant Deterioration (PSD)	7
2.2	Non-Attainment New Source Review (NNSR)	8
2.3	New Source Performance Standards (NSPS)	8
2.3.1	Subpart AAa - Standards of Performance for Steel Plants: Electric Arc Furnaces and Argon - Oxygen Decarburization Vessels Constructed After August 7, 1983	8
2.3.2	Subpart Db - Standards of Performance for Industrial-Commercial- Institutional Steam Generating Units	8
2.4	National Emission Standards for Hazardous Air Pollutants (NESHAP)	9
2.4.1	Subpart EEEEE - NESHAP for Iron and Steel Foundries	9
2.4.2	Subpart FFFFF - NESHAP for Integrated Iron and Steel Manufacturing Facilities	9
2.4.3	Subpart YYYYY - National Emission Standards for Hazardous Air Pollutants for Area Sources: Electric Arc Furnace Steelmaking Facilities.....	9
2.5	Alabama Air Quality Regulations.....	9
2.5.1	ADEM Particulate Emission Rules	10
2.5.2	ADEM Sulfur Dioxide Rules	10
2.5.3	ADEM NO _x and CO Rules.....	11
3.	Best Available Control Technology (BACT) Review	12
3.1	BACT Definition and Applicability.....	12
3.2	BACT Analysis for Electric Arc Furnace	15
3.2.1	BACT Control of Oxides of Nitrogen (NO _x) Emissions	15
3.2.2	BACT Control of Carbon Monoxide (CO) Emissions	27
3.2.3	BACT Control of Particulate Matter Emissions	31
3.2.4	BACT Control of Sulfur Dioxide (SO ₂) Emissions.....	32
3.2.5	BACT Control of Volatile Organic Compound Emissions.....	39
3.2.6	BACT Control of Lead Emissions.....	40
3.2.7	BACT Control of Greenhouse Gas Emissions.....	41
3.3	BACT Analysis For Galvanizing Line (Natural Gas-Fired Burners)	42
3.3.1	BACT Control of Oxides of Nitrogen (NO _x) Emissions	42
3.3.2	BACT Control of Particulate Matter Emissions	43

CONTENTS (CONTINUED)

3.3.3	BACT Control of Sulfur Dioxide (SO ₂) Emissions.....	44
3.3.4	BACT Control of Carbon Monoxide (CO) Emissions	44
3.3.5	BACT Control of Volatile Organic Compound Emissions.....	44
3.3.6	BACT Control of Lead Emissions.....	45
3.3.7	BACT Control of Greenhouse Gas Emissions.....	45

TABLES

Table 1-1 Summary of the Decatur Steel Mill Project Emissions Totals and PSD Triggers

Table 4-1 Summary of BACT/LAER Emission Rates for Steel Mills

Table 4-2 Summary of Proposed BACT Limits

APPENDICES

Appendix A Plot Plans and Process Flow Diagrams

Appendix B ADEM Application Forms

Appendix C Emissions Calculations

Appendix D Class I Modeling Report

Appendix E Class II Modeling Report

1. INTRODUCTION

1.1 BACKGROUND

Nucor Steel Decatur, LLC, a subsidiary of Nucor Corporation (collectively Nucor), owns and operates a steel recycling mill in Trinity, Morgan County, Alabama (the Decatur Steel Mill). The mill is categorized under the Standard Industrial Classification (SIC) code 3312: Steel Works, Blast Furnaces (including Coke Ovens), and Rolling Mills. The mill is a major stationary source under the Title V Operating Permit Program administered by the Alabama Department of Environmental Management (ADEM) under Air Pollution Control Program, Chapter 335-3-10. The mill currently operates under Title V Permit No. 712-0037 which expires September 5, 2021.

In this permit application, Nucor and the Decatur Steel Mill will expand the facility by adding a new galvanization line and debottlenecking the existing meltshop. The project includes the following changes at the facility:

- A new 500,000 metric tonnes per year (TPY) Galvanizing Line with a natural gas ceiling of 120 MMBtu/hour;
- A third Ladle Metallurgical Furnace (LMF) Station;
- Four new Electric Arc Furnace (EAF) transformers (two per furnace), upgrading from the current rating of 75 megavolt-ampere (MVA) to 90 MVA;
- Increase in the slab width to 68 inches;
- The addition of an eighth casting segment on both casters;
- Upgrade to the existing charge crane; and
- An increase in the annual liquid metal limit production from 3.2 million tons per year (MM tpy) to 3.6 MM tpy and an increase in the hourly limit increased from 440 tons per hour (tph) to 540 tph.

Nucor is pleased to announce that the project will include a \$200 million investment and will result in the addition of 35 additional Nucor Team Mates.

Nucor is the leading steel producer and scrap steel recycler in North America, and is based in Charlotte, North Carolina. Nucor's goal is to take care of its customers by working to be the safest, highest quality, lowest cost, most productive and most profitable steel company in the world. They are committed to doing this while being cultural and environmental stewards in the communities where they live and work.

Nucor has a strong desire to strengthen American manufacturing, the American steel industry, and empower the American worker by providing high-quality products, high-paying jobs, and a strong sense of environmental and community stewardship in all of its steel mills and facilities. An important ingredient in Nucor's success is its commitment to locate its diverse facilities in rural locations across America. Nucor has traditionally avoided building manufacturing sites in urban areas. By selecting rural locations, Nucor has been able to establish strong ties to its local communities and its work force. In

each of the current locations, Nucor is typically one of the largest and highest-paying employers, providing rewarding careers to employees in their own local communities.

Nucor has never laid off an employee due to lack of work, takes an egalitarian approach in providing benefits to its employees, and is frequently the largest contributor to local philanthropic and civic efforts. This “good neighbor” behavior helps Nucor attract the hard-working, dedicated employees with the “can-do” spirit that makes Nucor one of the world’s most productive and respected manufacturers. Nucor’s Decatur Steel Mill is no exception. Nucor takes great pride in the positive impact it brings to the communities in which it operates, and hopes to continue to bring these benefits to the people of Morgan County, and operate a profitable American manufacturing business in the State of Alabama.

1.2 PROCESS DESCRIPTION

The Decatur Steel Mill produces steel coils primarily from steel scrap and scrap substitutes using the EAF process. In general, raw materials, including: various grades of scrap steel, direct reduced iron (DRI), hot briquetted iron (HBI), pig iron, iron carbide, lime, dolomitic lime, pebble lime, carbon (coal and coke), alloy materials, dropout chamber contents, slag conditioners, pour-back heats, and roll grinding swarf are brought to the facility by barge, rail, or truck, or produced internally. Scrap and scrap substitutes, alloys, carbon, fluxes, and other materials are charged to two EAFs and melted by application of electric current through the mixture. Molten metal is tapped to ladles and is transferred to one of three ladle metallurgical furnaces (LMFs), where the metallurgy and temperature of the steel is adjusted. From the LMFs, the molten metal is transferred to one of two continuous casters, which cast continuous slabs of steel.

After casting, the slabs proceed through one of two roller hearth furnaces and then to the rolling mill, where they are rolled to the desired dimensions and coiled. Steel coils may then be further processed in the cold rolling mill to meet customer order specification. The coils may first be cleaned with hydrochloric acid in the pickle line. Cleaned steel can then be reduced in thickness in the cold reversing mill/ temper mill. Some coils may then be galvanized in the galvanizing line. Some material may be annealed in the annealing furnaces.

Steel may pass through none, one, or any combination of these processes. The maximum steel production rate after the project will be 540 tph, and the maximum annual steel production will be 3.6MM tpy.

1.2.1 ELECTRIC ARC FURNACES

Nucor receives scrap iron and steel by barge, rail, and truck. After unloading, the scrap is either stored in stockpiles or loaded into furnace charging buckets. The scrap, lime, alloys, and injection carbon are charged into one of two electric arc furnaces. Flux materials such as lime and carbon are handled and stored in bulk form.

After charging, graphite electrodes are positioned just above the scrap in the furnace shells. An electrical charge is applied to the electrodes, causing an arc to jump from the end of the electrode to the steel. The heat generated from this arc, combined with the heat from the injection carbon and auxiliary

burners, melts the scrap into molten steel. As the steel melts, injection carbon is added. The heavier steel sinks to the bottom, causing the fluxed slag to float to the top of the furnace. Hot gases are captured in a "fourth hole" duct (direct evacuation control, or DEC)) and via a canopy hood located in the overhead roof exhaust system. The exhaust is then ducted to two baghouses.

This project will seek to debottleneck the EAF by making the following changes:

- Add a third LMF Station;
- Add four new Electric Arc Furnace (EAF) transformers (two per furnace), upgrading from the current rating of 75 MVA to 90 MVA);
- Increase in the slab width to 68 inches;
- Add an eighth casting segment on both casters; and
- Upgrade the existing charge crane.

The result of these changes will allow the Decatur Steel Mill to increase the annual liquid metal production limit from 3.2 million MM tpy to 3.6 MM tpy and an increase in the hourly limit increased from 440 tph to 540 tph. Emissions from the EAF are calculated using these increased production rates and the emission factors determined in the Best Available Control Technology (BACT) analyses. In addition, there are emissions increases at the baghouse dust silo and from fugitive road dust. Each of these emissions increases are calculated based on the increased production rate of the EAFs and previously established emission factors.

1.2.2 LADLE METALLURGY FURNACES

Molten metal is tapped into a ladle and transported from the EAFs to the LMFs. The LMFs are used primarily to adjust the composition and temperature of the steel prior to continuous casting. The processes conducted at an LMF include the following:

- Injection / addition of alloys, fluxes, non-ferrous metals, and gases;
- Argon stirring;
- Desulfurization; and
- Reheating with electrodes to continuous casting temperature.

Emissions from the LMFs can be either in gaseous or particulate form. Particulate emissions are generally attributed to dust associated with fluxes, slag, and various additives. Gaseous emissions are generally associated with the oxidation of metals. The EAF is equipped with a side draft fume collection hood system for local collection of emissions from the EAF as well as a canopy hood system located above the furnace for collection of secondary emissions generated during EAF operations. Ninety-nine percent of the generated emissions are captured these hood systems and ducted to the EAF baghouses. The remaining 1% is uncaptured emissions and the Decatur Steel Mill conservatively assumes that 50% settles within the melt shop building, the remainder is emitted from the melt shop roof monitor.

To estimate fugitive PM emissions from the LMFs, an uncontrolled emission factor of 0.6 lb of PM/ton of steel (AP-42, Table 12.5-1 for uncontrolled emissions from basic oxygen furnace charging) was used in conjunction with the requested increase in steel production to 540 tph and 3.6 MM tpy.

1.2.3 CONTINUOUS CASTERS

After the temperature and composition of the molten steel is adjusted at the LMFs, the ladle of molten steel is transferred to one of two continuous casters. The molten steel is poured from the ladle into a tundish, which funnels the molten steel into a mold. The steel solidifies as it passes through the water-cooled mold, providing immediate cooling of the outer skin. At this point, the center of the steel is still molten. Two casters produce continuous steel slabs.

Emissions from the continuous casters are assumed to consist of particulates. Lids are in place over the tundish that are directly above the caster. The canopy hood also captures emissions from this process to be ducted to the baghouses. It is estimated that this represents a capture of approximately 99% of emissions generated at the casters. The remaining 1% is uncaptured emissions, and the Decatur Steel Mill conservatively assumes that 50% settles within the melt shop building, the remainder is emitted from the melt shop roof monitor.

To estimate particulate emissions from the roof monitor, an uncontrolled emission factor of 0.07 lbs of PM / ton of steel (AP-42, Table 12.5-1 for uncontrolled teeming of unleaded steel) was used in conjunction with the requested increase in steel production to 540 tph and 3.6 MM tpy.

1.2.4 NEW GALVANIZATION LINE

Nucor plans to add to the existing galvanization capacity of the Decatur Steel Mill by adding an additional galvanization line with a rated natural gas burner capacity of 120 MMBtu/hr. The purpose of the galvanization process is to apply a coat of zinc onto the surface of steel sheets in an effort to increase their corrosion resistance. There is a wide range of control of zinc coat thickness, and the galvanized steel sheets are used for a broad range of purposes, including construction materials, automobiles and electrical appliances.

In the continuous hot dip galvanizing line, each strip will be coated with zinc as an anticorrosive coating. The process begins by welding coils together into one long strip. The strip will be cleaned using a detergent to remove oil and scale, followed by electrolytic cleaning to remove residual particles of oil and dirt trapped in the pores of the strip. A hot water rinsing section will remove residual cleaning liquid from the strip. After cleaning and rinsing, the remaining moisture will be dried off the strip by a forced air dryer. Only moisture and small amounts of hydrogen (from electrolysis) will be released to the atmosphere.

The strip then will be fed to a continuous annealing furnace, where it will enter an inert atmosphere (a mixture of nitrogen and hydrogen). In the furnace, the strip will be exposed to radiant tube heating, which is indirect heat generated from low-NO_x burners (LNBs) rated at 120.0 MMBtu/hr. After annealing, the strip will enter the cooling section, followed by an inductive heating unit for reheating the strip to zinc pot temperature. The galvanizing process will consist of passing the strip through pots filled

with a molten bath of zinc. These pots will contain the molten metals that will adhere to the strip as it passes through the baths. The thickness of the coating layer will be adjusted by an air knife as the strip emerges from the molten bath. The galvanized strip will travel upward through the galvanneal soak and afterpot cooling equipment.

1.3 AIR EMISSIONS SUMMARY

Based on maximum potential emissions minus actual emissions (2013-2015), the proposed modification will be subject to Prevention of Significant Deterioration (PSD) review for sulfur dioxide (SO_2), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($\text{PM}_{2.5}$), nitrogen dioxide (NO_2), volatile organic compounds (VOC), lead (Pb), carbon monoxide (CO), and greenhouse gases (CO_2 e). Emissions increases associated with the proposed modification are below PSD significance levels for emissions of asbestos, beryllium, mercury, vinyl chloride, fluorides, sulfuric acid mist, hydrogen sulfide, total reduced sulfur, and reduced sulfur compounds. A summary of the pollutant emission rates for the proposed modification in comparison with the significant emission rates is provided in Table 1-1. Calculations of pollutant emission rates are presented in Appendix C. Baseline actual emissions for this comparison are based on July 2013 – June 2015 for each pollutant.

Emissions rate calculations are based on AP-42 emission factors and methods, vendor provided emission factors, and best engineering judgment. Specific calculation details are included as Appendix C of this application.

Table 1-1 Summary of the Decatur Steel Mill Project Emissions Totals and PSD Triggers

EMISSION SOURCES	ESTIMATED POLLUTANT EMISSION RATES (tons per year)								
	TSP	PM ₁₀	PM _{2.5}	NO _x	SO ₂	CO	VOC	Lead	CO ₂ e
Melt Shop Baghouses (max. potential emissions based on 3.6MM TPY of steel)	429	429	429	756	630	4,140	234	3.60	504,000
Melt Shop Baghouses (actual average emissions based on 2,565,135 TPY of steel)	385	385	385	333	105	2,437	95	0.07	359,119
SUBTOTAL	44.7	44.7	44.7	423	525	1,703	139.1	3.53	144,881
New Galvanizing Line (120 MMBtu/hr)	3.92	3.92	3.92	35.22	0.31	4.33	0.28	--	61,842
EAF Fugitive Emissions Increase	7.24	4.20	3.11	--	--	--	--	--	--
LMF Fugitive Emissions Increase	1.55	0.900	0.667	--	--	--	--	--	--
Caster Fugitive Emissions Increase	0.181	0.105	0.078	--	--	--	--	--	--
Baghouse Dust Silo Emissions Increase	0.060	0.060	0.060	--	--	--	--	--	--
Unpaved Road Emissions Increase	2.69	0.285	0.029	--	--	--	--	--	--
Paved Road Emissions Increase	3.91	0.782	0.192	--	--	--	--	--	--
TOTAL	64.2	54.9	52.7	458	525	1,707	139.4	3.529	206,723
Significant Emission Rate (SER)	25	15	10	40	40	100	40	0.6	75,000
Subject to PSD Review	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

2. REGULATORY APPLICABILITY

The following sections describe the state and federal regulatory applicability for the proposed modifications.

2.1 PREVENTION OF SIGNIFICANT DETERIORATION (PSD)

The Decatur Steel Mill is defined as a major source under the PSD regulations. These regulations, amended by the U.S. Environmental Protection Agency (USEPA) on August 7, 1980 (45 FR 52675) and December 31, 2002 (67 FR 80186), specify that any major new stationary source or major modification to an existing major source within an air quality attainment area must undergo a PSD review and obtain all applicable federal and state preconstruction permits prior to commencement of construction. A new source is considered major and subject to these regulations if they meet the following:

1. Any source type in any of 28 designated industrial source categories having potential emissions of 100 tons per year or more of any pollutant regulated under the Clean Air Act; and
2. Any other source having potential emissions of 250 tons per year or more of any pollutant regulated under the Clean Air Act.

"Potential emissions" are defined as the emissions of any pollutant at maximum design capacity (or less than maximum design capacity if specified as a federally-enforceable permit condition), including the control efficiency of air pollution control equipment. A modification of existing sources is considered to be major, and therefore subject to the regulations, if the existing source is major (as defined above) for any criteria pollutant and the modification results in increased emissions of any criteria pollutant exceeding the PSD significant emission limits presented in Table 1. A PSD review generally consists of:

1. A case-by-case Best Available Control Technology (BACT) demonstration, taking into account energy, environmental and economic impacts as well as technical feasibility;
2. An ambient air quality impact analysis to determine whether the allowable emissions from the proposed modification, in conjunction with all other applicable emission increases or reductions, would cause or contribute to a violation of the applicable PSD increments and National Ambient Air Quality Standards (NAAQS);
3. An ambient air quality monitoring program for up to 1 year;
4. An assessment of the direct and indirect effects of the modification on general growth, soil vegetation, and visibility; and
5. Public comments, including an opportunity for a public hearing.

2.2 NON-ATTAINMENT NEW SOURCE REVIEW (NNSR)

Nucor Steel Decatur is located in Morgan County, an area designated as attainment for all NAAQS. Therefore, an NNSR analysis is not required.

2.3 NEW SOURCE PERFORMANCE STANDARDS (NSPS)

New Source Performance Standards (NSPS) require new, modified, or reconstructed sources to control emissions to the level achievable by the best demonstrated technology as specified in the applicable provisions. An applicability analysis of potentially applicable NSPS subparts is presented below.

2.3.1 SUBPART AAA - STANDARDS OF PERFORMANCE FOR STEEL PLANTS: ELECTRIC ARC FURNACES AND ARGON - OXYGEN DECARBURIZATION VESSELS CONSTRUCTED AFTER AUGUST 7, 1983

The existing electric arc furnaces, control devices, and dust handling system at the Decatur Steel Mill are subject to New Source Performance Standards (NSPS), 40 CFR Part 60, Subpart AAa - Standards of Performance for Steel Plants: Electric Arc Furnaces and Argon - Oxygen Decarburization Vessels Constructed After August 7, 1983. The NSPS specifically regulates filterable particulate matter emissions to 0.0052 grains/dscf and 3% opacity at the control device, 6% opacity from the shop due solely to the operations of the electric arc furnace, and 10% opacity from the dust handling system. The Decatur Steel Mill will continue to comply with the applicable requirements of 40 CFR 60 Subpart AAa.

2.3.2 SUBPART DB - STANDARDS OF PERFORMANCE FOR INDUSTRIAL-COMMERCIAL-INSTITUTIONAL STEAM GENERATING UNITS

The NSPS - Standards of Performance for Industrial-Commercial-Institutional Steam Generating Units, 40 CFR 60 Subpart Db (60.40b- 49b), regulates air emissions from steam generating units with a rated heat input capacity greater than 100 MMBtu/hr. The rule defines a steam generating unit as not just a unit that produces steam, but any unit that combusts fuel to heat all other transfer mediums. The definition of a steam generating unit excludes process heaters: .

Steam generating unit means a device that combusts any fuel or byproduct/waste and produces steam or heats water or heats any heat transfer medium. This term includes any municipal-type solid waste incinerator with a heat recovery steam generating unit or any steam generating unit that combusts fuel and is part of a cogeneration system or a combined cycle system. This term does not include process heaters as they are defined in this subpart.

The definition of a process heater is defined as follows:

Process heater means a device that is primarily used to heat a material to initiate or promote a chemical reaction in which the material participates as a reactant or catalyst.

The new galvanizing line will have a nameplate heat input capacity of greater than 100 MMBtu/hr; however, this emission source is considered a process heater as there is no intervening heat transfer medium between the fuel combustion and the material being heated.

2.4 NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS (NESHAP)

National Emission Standards for Hazardous Air Pollutants (NESHAP) are emission standards for hazardous air pollutants (HAP) that are generally applicable to major sources of HAPs, but also apply to certain area sources of HAPs. A HAP major source is defined as having potential emissions in excess of 10 tpy for any individual HAP and/or 25 tpy for total HAPs. NESHAP apply to specific pollutant sources (40 CFR 61), or to sources in specifically regulated industrial source categories (CAA Section 112(d)) or on a case-by-case basis (Section 112(g) or 112G)) for facilities not regulated as a specific industrial source type (40 CFR 63). The Decatur Steel Mill is an area source for HAPs. An applicability analysis of potentially applicable NESHAP (Part 63) subparts is presented below.

2.4.1 SUBPART EEEEE - NESHAP FOR IRON AND STEEL FOUNDRIES

The provisions of 40 CFR 63 Subpart EEEEE - NESHAP for Iron and Steel Foundries (40 CFR 63.7680 - 40 CFR 63.7765) regulate existing and new iron and steel foundries. As per 40 CFR 63.7681, the rule applies to owners and operators of iron and steel foundries that are (or are part of) a major source of HAP emissions. The Decatur Steel Mill is not a major source of HAP emissions and therefore is not subject to this NESHAP.

2.4.2 SUBPART FFFFF - NESHAP FOR INTEGRATED IRON AND STEEL MANUFACTURING FACILITIES

The provisions of 40 CFR 63, Subpart FFFFF - National Emission Standards for Hazardous Air Pollutants for Integrated Iron and Steel Manufacturing Facilities apply to integrated iron and steel manufacturing facilities. As per 40 CFR 63.7781, this rule applies to owners and operators of integrated iron and steel manufacturing facilities that are (or are part of) a major source HAP emissions. The Decatur Steel Mill is not a major source of HAP emissions and therefore is not subject to this NESHAP.

2.4.3 SUBPART YYYYY - NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS FOR AREA SOURCES: ELECTRIC ARC FURNACE STEELMAKING FACILITIES

The Decatur Steel Mill is subject to NESHAP regulations for area sources of HAP, such as 40 CFR 63 Subpart YYYYY - National Emission Standards for Hazardous Air Pollutants for Area Sources: Electric Arc Furnace Steelmaking Facilities. The Decatur Steel Mill will continue to comply with the applicable requirements of 40 CFR 63 Subpart YYYYY.

2.5 ALABAMA AIR QUALITY REGULATIONS

The State of Alabama has promulgated standards governing the emission of particulate matter, SO₂, volatile organic compounds (VOC), CO, and NO_x.

2.5.1 ADEM PARTICULATE EMISSION RULES

Chapter 335-3-4, Control of Particulate Emissions, regulates particulate emissions in Alabama.

335-3-4-.04 Visible Emissions

(1) Visible Emissions Restrictions for Stationary Sources.

All process vents will be limited to 20% opacity, as determined by a 6-minute average.

335-3-4-.03 Fuel Burning Equipment.

For the galvanizing line, particulate emissions will be limited for heat input ratings between 10 MMBtu/hr and 250 MMBtu/hr by the equation:

$$E = 1.38H^{-0.44}$$

where: E = Emissions in lbs/MMBtu

H = Heat input in MMBtu/hr

335-3-4-.04 Process Industries: General.

All other process vents will have particulate limits based on the following equation. For the process, weight per hour values up to 60,000 lbs/hour shall be accomplished by use of the equation:

$$E = 3.59P^{0.62}$$

Interpolation and extrapolation of the data for process weight per hour values equal to or more than 60,000 lbs/hour shall be accomplished by use of the equation:

$$E = 17.31P^{0.16}$$

where: E = Emissions in pounds per hour

P = Process weight per hour in tons per hour

Compliance with all these particulate matter standards will be demonstrated by meeting more stringent federal requirements. In addition, the galvanization line will combust only natural gas.

2.5.2 ADEM SULFUR DIOXIDE RULES

Chapter 335-3-5, Control of Sulfur Compound Emissions, regulates sulfur compound emissions in Alabama. The only section that applies to this expansion is the section on fuel combustion:

335-3-5-.01 Fuel Combustion

For Category I counties, such as Morgan County, the sulfur dioxide emissions are limited to 1.8 lbs/MMBtu, which will be easily achieved because the only fuel burned will be pipeline-quality natural gas.

2.5.3 ADEM NO_x AND CO RULES

Chapter 7 of ADEM regulations apply to CO emissions, but only one rule refers to metal production. It identifies cupolas, blast furnaces, and basic oxygen steel furnaces as the regulated units, which are not present at the Decatur Steel Mill.

Chapter 8 of ADEM regulations apply to NO_x emissions, but the Decatur Steel Mill does not have any units regulated by these rules. The only potentially applicable rule is 335-3-8-.14 New Combustion Sources; however, this rule applies only to boilers with a capacity greater than 250 MMBtu/hr, which are not present at the Decatur Steel Mill.

3. BEST AVAILABLE CONTROL TECHNOLOGY (BACT) REVIEW

As previously discussed, the Decatur Steel Mill is subject to PSD regulation for emissions of SO₂, NO₂, VOC, PM, PM₁₀, PM_{2.5}, lead, greenhouse gases, and CO, which mandate that a case-by-case Best Available Control Technology (BACT) analysis be performed.

3.1 BACT DEFINITION AND APPLICABILITY

The definition of BACT may be found in Section 165(a)(4) of the Clean Air Act or in the PSD regulations under 40 CFR 52.210. BACT is defined as:

"...an emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under the Clean Air Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant. In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR Parts 60 and 61. If the Administrator determines that technological or economic limitations on the application of the measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof may be prescribed instead to satisfy the requirement for the application of best available control technology. Such standard shall, to the degree possible, set forth the emissions reduction achievable by the implementation of such design, equipment, work practice or operation, and shall provide for compliance by means which achieve equivalent results."

The present BACT analysis follows the USEPA's top-down approach. In the top-down approach, progressively less stringent control technologies are analyzed until a level of control considered BACT is reached on the basis of environmental, energy, and economic impacts. The key steps in the top-down process are:

- Identify viable options;
- Eliminate technically infeasible options;
- Rank remaining alternatives by control effectiveness;
- Evaluate most effective controls considering environmental, energy and economic impacts; and
- Select BACT.

The sources of information on control alternatives vary for the emission sources being analyzed. The following information resources may be consulted in searching for control alternatives:

- 1) USEPA RACT/BACT /LAER Clearinghouse (RBLC) System;
- 2) USEPA/State/Local Air Quality Permits;
- 3) Federal/State/Local Permit Engineers;
- 4) Control Technology Vendors; and
- 5) Inspection/Performance Test Reports.

Once the technically feasible control alternatives have been identified, they should be ranked in order of control effectiveness, with the most effective control alternative at the top. The ranked alternatives are reviewed with respect to environmental, energy, and economic considerations specific to the modified steel mill. However, an applicant proposing the top-rated control alternative need not provide costs and other economic information relative to the other control options¹. If the analysis determines that the examined alternative is not appropriate as BACT due to any of these considerations, then the next most stringent alternative is subjected to the same review. This process is repeated until a control alternative is justified to represent BACT. The proposed BACT must provide emission limitations which are at least as stringent as the applicable federally-approved State Implementation Plan (SIP) or the federal NSPS and National Emission Standards for Hazardous Air Pollutants (NESHAP) emission standards.

The impact analysis of the BACT review focuses on environmental, energy, and economic impacts. The net environmental impact associated with the control alternative should be reviewed. This is generally satisfied with dispersion modeling, which is performed as a part of PSD review. The dispersion modeling normally considers a "worst-case" scenario, thus constituting an assessment of the maximum environmental impacts. The energy impact analysis estimates the direct energy impacts of the control alternatives in units of energy consumption. If possible, the energy requirements of the control option is assessed in terms of total and incremental (units of energy per ton of reduction) energy costs. The economic impact of a control option is typically assessed in terms of cost-effectiveness and ultimately whether the option is economically reasonable. Normally, the economic impacts are reviewed on a cost per ton of pollutant removed basis.

Several sources were consulted regarding recent steel mill operations and the associated control implemented. These sources included the RBLC database, recent permit applications, USEPA air permitting authorities, and equipment vendors.

Table 4-1 presents a summary of the BACT determinations for recent applications for new and modified electric arc furnaces. This list separates EAFs that use the CONSTEEL® process versus those using the traditional batch process. The CONSTEEL® process consists of loading scrap onto a conveyor that continuously feeds the EAF. Lime and carbon are continuously added to the scrap prior to entering the EAF. Other alloys are added to the EAF using a conveyor from the alloy bin storage area. After initial charging by a charge bucket to develop a molten heel, the EAF will continuously receive scrap metal and other scrap substitutes, lime, carbon, and carbon units by the CONSTEEL® process, where the raw materials are melted into molten steel. The CONSTEEL® process is a unique method of charging steel,

¹ New Source Review Workshop Manual", USEPA, October 1990

where the scrap steel is conveyed into the EAF while the hot off-gases from the furnace are sent counter currently, thus preheating the scrap. The EAF at the Decatur Steel Mill is a traditional bucket-charged EAF.

Table 4-1 Summary of BACT/LAER Emission Rates for Steel Mills

STEEL MILL	EMISSION RATE (lbs/ton steel)					
	PM/PM ₁₀ /PM _{2.5}	SO ₂ ^a	NO _x	CO	VOC	Lead
STEEL MILLS WITH THE CONSTEEL PROCESS						
Nucor Steel - Hertford County, NC	0.0018 gr/dscf	0.35	0.36	2.3	0.13	--
Nucor Steel - Darlington, SC	0.0015 gr/dscf	0.35/0.675 ^a	0.35/0.41 ^a	2.76/3.13 ^b	0.35/1.11 ^c	--
Ameristeel - Charlotte, NC	0.0052 gr/dscf	0.23	0.51	6	0.5	--
New Jersey Steel - Sayreville, NJ	--	--	0.54	5.8	0.46	--
Gerdau Ameristeel - NC	--	--	--	4.4	--	--
Gerdau AmeriSteel - Knoxville, TN	0.004 gr/dscf	0.2	0.25	6	0.3	--
OTHER STEEL MILLS						
Big River Steel - Osceola, AR	0.0018 gr/dscf (filt.) 0.0024 gr/dscf (f+c)	0.2	0.35	2.02	0.093	--
Osceola Steel - GA	0.18	0.18	0.35	2	--	--
Timken - Harrison Plant - OH	0.15	0.15	0.2	4.8	0.1	--
Timken - Faircrest Plant - OH	0.0017 gr/dscf	0.52 (with tire burning)	0.2	3.5	0.17	--
SeverCorr - Columbus, MS	0.0018 gr/dscf	0.2	0.35	2	0.13	--
Ellwood National Steel - PA	0.0050 gr/dscf	0.55	--	6	0.28	--
Nucor Steel - Marion, OH	0.0052 gr/dscf	0.5	0.43	2.23	0.13	0.0036
V&MStar-OH	0.0018 gr/dscf	0.25	0.4	4	0.18	0.0017
Mid-American Steel & Wire -- OK	0.0018 gr/dscf	0.3	0.3	3	0.3	--
New Steel International- OH	0.0014 gr/dscf	0.1	0.31	2	0.07	--
Minnesota Steel - MN	0.0030 gr/dscf	0.15	0.3	2	0.13	--
Thyssenkrupp, AL	0.0018 gr/dscf	0.375	0.6	2	0.03	--
Nucor Steel - Memphis, TN	0.0018 gr/dscf	0.35/1.75 ^a	0.27(LAER)	2	0.09(LAER)	--
Nucor Steel - Berkeley County, SC	0.0035 gr/dscf	0.2	0.35	2	0.13	--
Nucor Steel - Crawfordsville, IN	0.0018 gr/dscf	0.33	0.35	2	0.09	--
Nucor Steel - Hickman, AR	0.0018 gr/dscf	0.33	0.52	2	0.093	--
Nucor Steel - Jewett, TX	0.0052 gr/dscf	1.06	0.4314	5.02	0.2906	--
Nucor Steel - Norfolk, NE	0.0052 gr/dscf	2.25	0.54	4.74	0.17	--
Nucor-Yamato Steel - Blytheville, AR	0.0018 gr/dscf	0.15	0.38	2	0.13	--
Nucor Steel Tuscaloosa, Inc.	0.0018 gr/dscf	0.46 ^a	0.35	2.2	0.13	--
Nucor Steel Gallatin - Ghent, KY	0.0018 gr/dscf	0.49	0.51	2	0.13	--
SSAB - Montpelier, IA	0.0033 gr/dscf	0.7	0.8	1.93	0.18	--
SSAB - Axis, AL	0.0033 gr/dscf	0.7	0.4	2	0.35	--
SDI - Butler, IN	0.0032 gr/dscf	0.2	0.51	2	0.13	--
SDI - Columbia City, IN	0.0018 gr/dscf	0.25	0.35	2	0.09	--
SDI - Pittsboro	0.0018 gr/dscf	0.25/1.5/1.8	0.35	2	0.13	--
MacSteel - Fort Smith, AR	0.0018 gr/dscf	1.05	0.51	4.9	0.13	--
Beta Steel - IN	0.0052 gr/dscf	0.33	0.35	5.4	0.13	--
Chaparral Steel - Petersburg, VA	0.0018 gr/dscf	0.7	0.7	4	0.35	--
Arkansas Steel - Newport, AR	0.0052 gr/dscf	0.7	1	6	0.35	0.008
Roanoke Electric Steel - Roanoke, VA	0.0034 gr/dscf	0.23	0.51	2.88	0.35	0.0034
Charter Steel - Saukville, WI	0.0052 gr/dscf	--	0.51	3.83	--	0.005
Gerdau AmeriSteel - Duval County, FL	0.0018 gr/dscf	0.2	0.33	2	0.13	0.0085

- a) resulfurized steel
- b) low carbon steel and use of waste oil filters
- c) waste oil filters
- d) There are no currently operating facilities with a verified GHG BACT emission rate.

Table 4-2 provides the BACT selection for each pollutant and operating unit, including emission/operating limits and the projected compliance method.

Table 4-2 Summary of Proposed BACT Limits

Unit	Pollutant	Selected BACT	Emission/ Operating Limit	Compliance Method
Electric Arc Furnace and Meltshop Baghouses	PM/PM ₁₀ /PM _{2.5}	Fabric Filtration	0.0018 gr/dscf (filt.) 0.0052 gr/dscf (f+c)	Stack Test
	SO ₂	Good Operating Practices	0.35 lb/ton steel	Stack Test
	NO _x	Oxy-fuel Fired Burners	0.42 lb/ton steel	Stack Test
	CO	Direct Evacuation Control	2.3 lb/ton steel	Stack Test
	VOC	Scrap Management Program	0.13 lb/ton steel	Stack Test
	Lead	Fabric Filtration	0.002 lb/ton steel	Stack Test
	GHG	Good Operating Practices	504,000 TPY	Production
New Galvanizing Line	PM/PM ₁₀ /PM _{2.5}	Natural Gas Combustion	7.6 lb/MMscf	Fuel Monitoring
	SO ₂	Natural Gas Combustion	0.6 lb/MMscf	Fuel Monitoring
	NO _x	SCR	0.067 lb/MMBtu	Stack Test
	CO	SCR	8.4 lb/MMscf	Stack Test
	VOC	SCR	0.006 lb/MMscf	Stack Test
	Lead	Natural Gas Combustion	0.0003 lb/MMscf	Fuel Monitoring
	GHG	Good Operating Practices	61,842 TPY	Fuel Monitoring

3.2 BACT ANALYSIS FOR ELECTRIC ARC FURNACE

The existing EAFs operate in a batch mode whereby the scrap steel and scrap substitutes are charged, melted, and tapped. During normal operation, cold scrap metal and scrap substitutes, carbon, and fluxing agents are charged into the EAF shell, powered by a high-powered transformer. A large electrical potential is applied to the carbon electrodes. The combination of the heat from the arcing process and natural gas burner jets melts the scrap and scrap substitutes into molten steel. As the scrap begins to melt, the temperature of the exhaust gas from the EAF increases appreciably. As melting progresses, oxygen lancing and carbon injection are performed and alloy injection may occur; thus, the temperature of the exhaust gas stream can approach 3,000°F, which is approximately the temperature of molten steel. Batch cycles typically vary from 40 to 50 minutes, but may run shorter or longer depending on operational conditions.

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

The dust collection equipment for the EAFs consists of two baghouses. Each baghouse has a design volume flow rate of 1,500,000 acfm (1,100,000 dscfm).

3.2.1 BACT CONTROL OF OXIDES OF NITROGEN (NO_x) EMISSIONS

NO_x is formed from the chemical reaction between nitrogen and oxygen at high temperatures. NO_x formation occurs by different mechanisms. In the case of an EAF, NO_x predominantly forms from thermal dissociation and subsequent reaction of nitrogen and oxygen molecules in the combustion air. This mechanism of NO_x formation is referred to as thermal NO_x. The other mechanisms of NO_x formation such as fuel NO_x (due to the evolution and reaction of fuel-bound nitrogen compounds with

oxygen) and prompt NO_x (due to the formation of HCN followed by oxidation to NO_x), are thought to have lesser contributions to NO_x emissions from EAFs. The present NO_x emission limit is 0.42 lb/ ton of steel produced.

Review of the RBLC data shows limits established for EAFs ranging from 0.13 lb/ton to 1.0 lb/ton, with most facilities higher than 0.35 lb/ton. One facility has a NO_x limit at 0.13 lb/ ton, which is an older limit not followed in any subsequent BACT determination and is considered to be unrealistically low. Two facilities have NO_x limits at 0.20 lb/ton. The RBLC database and discussions with various individuals knowledgeable about steel mill operations, it was revealed that control technologies for NO_x abatement have not been successfully implemented for EAF emissions. However, NO_x control technologies are currently available for fossil-fuel boilers, stationary combustion engines, and turbines. Thus, these control alternatives are potentially available to control NO_x from an EAF. These control options have been reviewed for technical feasibility in this BACT analysis. Due to the lack of successful application of such controls to an EAF, they are considered a "technology transfer".

Step 1: Identify All Control Technologies

The alternatives available to control NO_x emissions from the existing EAF include the following:

1. Combustion Controls;
2. Selective Catalytic Reduction (SCR);
3. Non-Selective Catalytic Reduction (NSCR);
4. SCONox Catalytic Oxidation/ Absorption;
5. Shell DeNOx System (modified SCR);
6. Selective Non-Catalytic Reduction (SNCR) options -
 - Exxon's Thermal DeNOx®
 - Nalco Fuel Tech's NOxOUT®
 - Low Temperature Oxidation(LTO)

Step 2: Eliminate Technical Infeasible Options

The test for technical feasibility of any control option is whether it is both available and applicable to reducing NO_x emissions from the existing EAF. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

(1) Combustion Controls -- There is an entire family of combustion controls for NO_x reduction from various combustion units as follows:

- a. Low Excess Air (LEA);
- b. Oxyfuel Burner;
- c. Overfire Air (OFA);
- d. Burners Out Of Service (BOOS);
- e. Reduced Combustion Air Temperature;
- f. Load Reduction; and
- g. Flue Gas Recirculation (FGR)

The LEA option is typically used in conjunction with some of the other options. The use of this option will result in the generation of additional CO emissions, which is another pollutant under BACT review. In addition, LEA is not very effective for implementation in electric arc furnaces which do not operate with combustion air feeds, since the combustion process is not modulated with the near-atmospheric furnace conditions. Thus, this option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

The existing EAF system does employ natural gas-fired oxyfuel burners; thus, this option will be included for further consideration in this BACT analysis.

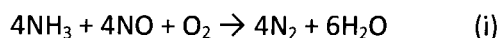
The OFA option is geared primarily for fuel NO_x reduction, which is not the major NO_x formation mechanism from EAFs. Further, this option is associated with potential operational problems due to low primary air, creating incomplete combustion conditions. Such conditions can result in inefficient scrap melting and unacceptable increases in tap-to-tap times. Thus, this option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

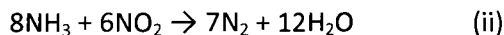
The BOOS and Load Reduction (or Deration) options incorporate a reduction in furnace load, thereby, potentially reducing NO_x formation. This reduction must be balanced, however, against a longer period of NO_x generation resulting from the furnace's inability to efficiently melt scrap and scrap substitutes. The inefficient melt would result in longer melt times and an increase in lb/ton NO_x emissions. Accordingly, these options are judged technically infeasible for this particular application and will not be considered any further in this BACT analysis.

The Reduced Combustion Air Temperature option inhibits thermal NO_x production. However, the option is limited to equipment with combustion air preheaters which are not applicable to EAFs. Thus, this option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

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

(2) Selective Catalytic Reduction (SCR) -- In this process, ammonia (NH₃), usually diluted with air or steam, is injected through a grid system into the exhaust gas upstream of a catalyst bed. On the catalyst surface the NH₃ reacts with NO_x to form molecular nitrogen and water. The basic reactions are as follows:





The reactions take place on the surface of the catalyst. Usually, a fixed bed catalytic reactor is used for SCR systems. The function of the catalyst is to effectively lower the activation energy of the NO_x decomposition reactions. Technical factors related to this technology include the catalyst reactor design, optimum operating temperature, sulfur content of the charge, catalyst deactivation due to aging, ammonia slip emissions and design of the ammonia injection system.

Three types of catalyst bed configurations have been successfully applied to commercial sources: the moving bed reactor, the parallel flow reactor and the fixed bed reactor. The fixed bed reactor is applicable to sources with little or no particulate present in the flue gas. In this reactor design, the catalyst bed is oriented perpendicular to the flue gas flow and transport of the reactants to the active catalyst sites occurs through a combination of diffusion and convection.

Depending on system design, NO_x removal of 80% - 90% may be achievable under optimum conditions². The reaction of NH_3 and NO_x is favored by the presence of excess oxygen. Another variable affecting NO_x reduction is exhaust gas temperature. The greatest NO_x reduction occurs within a reaction window at catalyst bed temperatures between 600 °F - 750 °F for conventional (vanadium or titanium-based) catalyst types, and 470 °F - 510 °F for platinum-based catalysts.

Performance for a given catalyst depends largely on the temperature of the exhaust gas stream being treated. A given catalyst exhibits optimum performance when the temperature of the exhaust gas stream is at the midpoint of the reaction temperature window for applications where exhaust gas oxygen concentrations are greater than 1%. Below the optimum temperature range, the catalyst activity is greatly reduced, potentially allowing unreacted ammonia (referred to as "ammonia slip") to be emitted directly to the atmosphere.

The SCR system may also be subject to catalyst deactivation over time. Catalyst deactivation occurs through two primary mechanisms - physical deactivation and chemical poisoning. Physical deactivation is generally the result of either continual exposure to thermal cycling or masking of the catalyst due to entrainment of particulates or internal contaminants. Catalytic poisoning is caused by the irreversible reaction of the catalyst with a contaminant in the gas stream. Catalyst suppliers typically guarantee a 3-year catalyst lifetime for a sustainable emission limit.

In order for an SCR system to effectively reduce NO_x emissions, the exhaust gas stream should have relatively stable gas flow rates, NO_x concentrations, and temperature. In addition, certain elements such as iron, nickel, chrome, and zinc can react with platinum catalysts to form compounds or alloys which are not catalytically active. These reactions are termed "catalytic poisoning", and can result in premature replacement of the catalyst. An EAF flue gas may contain a number of these catalytic poisons. In addition, any solid material in the gas stream can form deposits and result in fouling or masking of the catalytic surface. Fouling occurs when solids obstruct the cell openings within the catalyst. Masking occurs when a film forms on the surface of catalyst over time. The film prevents contact between the catalytic surface and the flue gas. Both of these conditions can result in frequent

² USEPA "ACT Document - NO_x Emissions from Iron and Steel Mills", Sept., 1994.

cleaning and/or replacement requirements. Due to the above effective technical applicability constraints, SCR technology has never been applied to EAF operations.

In addition to the above reservations regarding effective applicability of potential SCR application to EAFs, the technology is also associated with the following environmental impacts:

1. Unreacted ammonia (around 5-10 ppmv) would be emitted to the environment as ammonia slip. Based on conservative estimates of a 7 ppmv ammonia slip, approximately 85 tons/yr of ammonia could be potentially emitted from the existing EAF;
2. Formation of ammonium salts can readily foul the catalyst section, resulting in reduced efficiency and increase back pressure;
3. Small amounts of ammonium salts would be emitted as PM_{10} ;
4. Safety issues associated with the transportation, handling and storage of aqueous ammonia; and,
5. Potentially hazardous waste handling and disposal of spent catalyst.

Successful applications of SCR technology to control NO_x emissions from EAFs are not known. The analysis presented above discusses a number of effective technical applicability concerns regarding SCR. In order for the SCR system to effectively reduce NO_x emissions, the exhaust gas stream should have relatively stable gas flow rates, NO_x concentrations, and temperature. The temperature of the EAF exhaust gas will vary widely over the melt cycle, and the gas flow rates and NO_x concentrations will exhibit a wide amplitude. Moreover, the presence of particulates in the exhaust gas prior to the EAF baghouse may result in fouling of the catalyst, rendering it ineffective. Also, the SCR system cannot be installed after particulate removal in the EAF baghouse due to unacceptably low temperatures outside the effective operating range. Note that SCR technology has not been utilized to control NO_x emissions from EAFs. Any projected application of SCR to EAFs would be considered a "technology transfer." In view of the above limitations, the SCR option is considered technically infeasible with unresolved technical issues and significant environmental impacts. Thus, this option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(3) Non-Selective Catalytic Reduction (NSCR) -- The NSCR system is a post-combustion add-on exhaust gas treatment system. It is often referred to as a "three-way conversion" catalyst since it reduces NO_x , unburned hydrocarbons (UBH), and CO simultaneously. In order to operate properly, the combustion process must be at stoichiometric or near-stoichiometric conditions, which are not maintained in an EAF, and which vary widely under regular operation. Under stoichiometric conditions, in the presence of the catalyst, NO_x is reduced by CO, resulting in nitrogen and carbon dioxide. Currently, NSCR systems are limited to rich-burn internal combustion (IC) engines with fuel-rich ignition system applications. Moreover, potential problems with NSCR systems include catalyst poisoning by phosphorus and zinc (present in galvanized scrap steel charged in the EAF). In view of the above limitations, the NSCR option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(4) SCONOx-Catalytic Oxidation/Absorption -- This is a catalytic oxidation/ absorption technology that has been applied for reductions of NO_x, CO and VOC from an assortment of combustion applications that mostly include small turbines, boilers and lean-burn engines. However, this technology has never been applied for steel mill EAFs. SCONOx employs a single catalyst for converting NO_x, CO and VOC. The flue gas temperature should be preferably in the 300 – 700 °F range for optimal performance without deleterious effects on the catalyst assembly. The technology was developed as an alternative to traditional SCR applications which utilize ammonia resulting in additional operational safeguards, unfavorable environmental impacts and excessive costs. In the initial oxidation cycle, the CO is oxidized to CO₂, the NO gets converted to NO₂, and the VOC gets oxidized to CO₂ and water. The NO₂ is then absorbed on the potassium carbonate coated (K₂CO₃) catalyst surface, forming potassium nitrites and nitrates (KNO₂, KNO₃). Prior to saturation of the catalyst surface, the catalyst enters the regeneration cycle.

In the regeneration phase, the saturated catalyst section is isolated with the expedient of moving hinged louvers and then exposed to a dilute reducing gas (methane in natural gas) in the presence of a carrier gas (steam) in the absence of oxygen. The reductant in the regeneration gas reacts with the nitrites and nitrates to form water and elemental nitrogen. Carbon dioxide in the regeneration gas reacts with potassium nitrites and nitrates to recover the potassium carbonate, which is the absorber coating that was on the surface of the catalyst before the oxidation/ absorption cycle began. Water (as steam) and elemental nitrogen are exhausted up the stack and the re-deposited K₂CO₃ allows for another absorption cycle to begin.

SCONOx technology is a variation of traditional SCR technology and for optimal performance it makes similar demands, such as: stable gas flows, lack of thermal cycling, invariant pollutant concentrations, and residence times on the order of 1.0 – 1.5 seconds. However, the initial attractive feature of not using ammonia has been replaced by other potential operational problems that impair the effectiveness of the technology.

In summary, an effective SCONOx application to a steel mill EAF application has the following reservations:

1. The technology is not readily adaptable to high-temperature applications outside the 300-700 °F range and is susceptible to the thermal cycling that will be experienced in an EAF application;
2. Scale-up is an issue; the technology has not been demonstrated for larger applications;
3. Optimum SCONOx operation is predicated by stable gas flow rates, NO_x concentrations and temperature. As discussed earlier, the nature of EAF operations do not afford any of these conditions which will significantly impair the effective control efficiency of the SCONOx system;
4. The catalyst is susceptible to moisture interference and the vendor indicates negation of its warranties and performance guarantees if the catalyst is exposed to any quantity of liquid water. However, during certain atmospheric conditions, the catalyst could be potentially exposed to moisture following a unit shutdown or leakage from water cooled ducts;

5. The prospect of moving louvers that effect the isolation of the saturated catalyst readily lends itself to the possibility of thermal warp and in-duct malfunctions in general. The process is dependent on numerous hot-side dampers that must cycle every 10 – 15 minutes;
6. The K_2CO_3 coating on the catalyst surface is an active chemical reaction and reformulation site which makes it particularly vulnerable to fouling. On some field installations, the coating has been found to be friable and tends to foul in the harsh in-duct environment;
7. During the regeneration step, the addition of the flammable reducing gas (natural gas which contains 85% methane) into the hot flue gas generates the possibility of LEL exceedances and subsequently catastrophic failure in the event the catalyst isolation is not hermetic or there is a failure in the carrier steam flow. This is a major safety concern for the operation of the unit which could result in a devastating explosion; and
8. There is a possibility of some additional SO_2 emissions if the dry scrubber with the tandem "guard-bed" SCOSox unit experiences a malfunction.

Thus, there are significant reservations regarding effective technical applicability of this control alternative for a steel mill EAF application. Moreover SCONox technology has never been proposed nor successfully implemented for similar industry applications. In view of the above limitations, SCONox is considered technically infeasible for the present application and will not be considered any further in this BACT analysis.

(5) Shell DeNOx System (modified SCR) -- The Shell DeNOx system is a variant of traditional SCR technology which utilizes a high activity dedicated ammonia oxidation catalyst based on a combination of metal oxides. The system is comprised of a catalyst contained in a modular reactor housing where in the presence of ammonia NO_x in the exhaust gas it is converted to nitrogen and water. The catalyst is contained in a low pressure drop lateral flow reactor (LFR) which makes best use of the plot space available. Due to the intrinsically high activity of the catalyst, the technology is suited for NO_x conversions at lower temperatures with a typical operating range of 250 – 660 °F. The Shell DeNOx technology can operate at a lower temperature and has a lower pressure drop penalty of around 2 inches WG.

The low temperature operation is the only aspect of the Shell DeNOx technology that marks its variance from traditional SCR technology. From an EAF application standpoint, there are no additional differences between this technology and SCR technology.

In summary, an effective Shell DeNOx application to the EAF application has the following reservations:

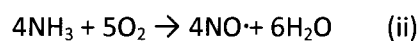
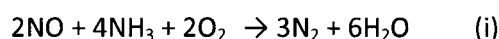
1. The Shell DeNOx system does not suffer from similar placement limitation considerations discussed earlier for SCRs. However, even a downstream of EAF baghouse placement of the system does not render it completely safe from the prospect of particulate fouling. The catalyst will still be exposed to particulates which can inflict a masking effect impairing the effective control efficiency of the system;

2. Optimum Shell DeNO_x operation is predicated by stable gas flow rates, NO_x concentrations and temperature. The nature of EAF operations do not afford any of these conditions which will significantly impair the effective control efficiency of the Shell DeNO_x system;
3. Since steel is produced from scrap, there is the possibility of the presence of catalytic poisons which can adversely affect the Shell DeNO_x catalyst resulting in impaired control efficiencies and frequent replacement of the catalyst;
4. The catalyst is particularly susceptible to thermal fluctuations. The threshold temperature for catalyst degradation is around 680 °F;
5. The use of relatively large amounts of ammonia, a regulated toxic chemical, will have the potential for accidental release and hazardous impact implications; and,
6. Ammonia slip from a 1,100,000 dscfm exhaust gas flow, from just one melt shop baghouse, even at just a 7 ppmv concentration, can result in the emission of approximately 20 tons/yr of ammonia, a toxic air pollutant with well documented health impacts.

Thus, there are significant reservations regarding effective technical applicability of this control alternative for an EAF application. Moreover Shell DeNO_x has never been proposed nor successfully implemented for similar steel mill applications. Any projected application of Shell DeNO_x to EAFs would be considered a "technology transfer." In view of the above limitations, the Shell DeNO_x option is considered technically infeasible with unresolved technical issues and significant environmental impacts for this application. Thus, it will not be considered any further in this BACT analysis.

(6) Selective Non-Catalytic Reduction (SNCR) -- The three commercially available SNCR systems are Exxon's Thermal DeNO_x® system, Nalco Fuel Tech1s NOxOUT® system and Low Temperature Oxidation (LTO). These technologies are reviewed below for technical feasibility in controlling EAF NO_x emissions.

Exxon's Thermal DeNO_x® - Exxon's Thermal DeNO_x® system is a non-catalytic process for NO_x reduction. The process involves the injection of gas-phase ammonia (NH₃) into the exhaust gas stream to react with NO_x. The ammonia and NO_x react according to the following competing reactions:



The temperature of the exhaust gas stream is the primary criterion controlling the above selective reaction. Reaction (i) dominates in the temperature window of 1,600 °F – 2,200 °F resulting in a reduction of NO_x. However above 2,200 °F, reaction (ii) begins to dominate, resulting in enhanced NO_x production. Below 1,600 °F, neither reaction has sufficient activity to produce or destroy NO_x. Thus, the optimum temperature window for the Thermal DeNO_x® process is approximately 1,600°F – 1,900°F. The above reaction temperature window can be shifted down to approximately 1,300°F – 1,500°F with the introduction of readily oxidizable hydrogen gas. In addition, the process also requires a minimum of 1.0 second residence time in the desired temperature window for any significant NO_x reduction.

In order for the Thermal DeNOx[®] system to effectively reduce NO_x emissions, the exhaust gas stream should have relatively stable gas flow rates; ensuring the required residence time and be within the prescribed temperature range.

Application of Thermal DeNOx[®] technology to control NO_x emissions from EAF operations are not known. Therefore, any projected application of the process to EAF operations would be considered a "technology transfer".

In summary, an effective Thermal DeNOx[®] application to the EAF application has the following reservations:

1. The placement of the Thermal DeNOx[®] system in an adequate temperature regime. In order to achieve optimum operational efficiency the system should be located in a temperature region of at least 1,300 °F, and preferably between 1,600 °F – 1,900 °F, which would put it upstream of the EAF baghouse. Such a placement configuration would not afford the desired temperature range which would be typically in the region of 300 °F – 400 °F, with an entry temperature of about 250 °F at the inlet to the EAF baghouse. The system cannot be placed further upstream for operational hazard reasons. Also, any injection mechanism upstream of the baghouse will be susceptible to prompt particulate fouling;
2. Optimum Thermal DeNOx[®] operation is predicated by stable gas flow rates, NO_x concentrations and temperature. The nature of EAF operations do not afford any of these conditions which will significantly impair the effective control efficiency of the Thermal DeNOx[®] system;
3. The use of relatively large amounts of ammonia, a regulated toxic chemical, will have accidental release and hazardous impact implications; and,
4. Even a 7 ppmv ammonia slip from a 1,100,000 dcfm exhaust gas flow can result in the emission of approximately 20 tons/yr of ammonia which is a toxic air pollutant with well documented health impacts.

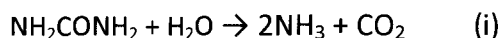
Depending on system design, NO_x removal of 40% – 70% may be achievable under optimum conditions³. In view of the concerns with the availability of steady gas flows and prescribed residence times, thermal cycling and the ability of the control option to load-follow varying pollutant concentrations and the fact that the source will be required to continually comply with an hourly emission rate, an effective NO_x control efficiency will be hard to maintain for an EAF application. It should be noted that if the required residence time or other optimum operation parameters are not available, unreacted ammonia will be released directly to the atmosphere.

There are significant reservations regarding effective technical applicability of this control alternative for an EAF application. In order for the Thermal DeNOx[®] system to effectively reduce NO_x emissions, the exhaust gas stream should have relatively stable gas flow rates, ensuring the requisite residence time requirements and temperature. The temperature of the EAF exhaust gas will vary widely over the melt cycle, and will not remain in the desired temperature window during all phases of operation. Similarly,

³ USEPA II ACT Document - NO_x Emissions From Iron and Steel Mills" Sept., 1994

the gas flow rates will not remain stable during furnace operation, precluding the possibility of adequate residence time. Moreover, Thermal DeNOx® technology has never been proposed nor successfully implemented to control NO_x emissions from EAFs. Any projected application of the process to the EAF would be considered a "technology transfer". In view of the above limitations, the Thermal DeNOx® option is considered technically infeasible with significant environmental impacts for this application and will not be considered any further in this BACT analysis.

Nalco Fuel Tech's NOxOUT® is a process very similar in principle to the Thermal DeNOx® process, except that it involves the injection of a liquid urea (NH₂CONH₂) compound (as opposed to NH₃) into the high temperature combustion zone to promote NO_x reduction. The chemical reaction proceeds as follows:



The reaction involves the decomposition of urea at temperatures of approximately 1,700 °F – 3,000 °F. Certain proprietary additive developments have allowed the operational temperature window to shift to approximately 1,400 °F - 2,000 °F. However, the process still has similar constraints as the Thermal DeNOx® system. The limitations are dictated by the reaction-controlling variables such as stable gas flow rates for a minimum residence time of 1.0 second in the desired temperature window to ensure proper mixing.

As with the Thermal DeNOx® system, the NOxOUT® system suffers from essentially similar limitations to effectively reduce NO_x emissions from EAF operations. Moreover, applications of the NOxOUT® technology to control NO_x emissions from steel mill EAF operations are not known. Therefore, any projected application of the process to the Nucor application would be considered a "technology transfer".

Similar to the Thermal DeNOx® application, an effective NOxOUT® application to the EAF application has the following reservations:

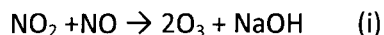
1. The placement of the NOxOUT® system in an adequate temperature regime. In order to achieve optimum operational efficiency the system should be located in a temperature region preferably between 1,400 °F – 2,000 °F, which would put it upstream of the EAF baghouse. Firstly, such a placement configuration would not afford the desired temperature range which would be typically in the region of 300 °F – 400 °F, with an entry temperature of about 250 °F at the inlet to the EAF baghouse. Also any injection mechanism upstream of the baghouse will be susceptible to prompt particulate fouling;
2. Optimum NOxOUT® operation is predicated by stable gas flow rates, NO_x concentrations and temperature. The nature of EAF operations do not afford any of these conditions which will significantly impair the effective control efficiency of the NOxOUT® system; and,
3. Although the NOxOUT® technology does not utilize ammonia directly, secondary chemical reactions under certain conditions (such as unreacted urea combining to form ammonia) can generate ammonia from the process. The vendor indicates 25 ppmv ammonia at the exhaust stack, which is higher than direct ammonia applications discussed earlier. Even a 7 ppmv ammonia slip from a 1,100,000 dscfm exhaust gas flow can result in the emission of

approximately 20 tons/yr of ammonia which is a toxic air pollutant with well documented health impacts.

Depending on system design, NO_x removal of 40% - 70% may be achievable under optimum conditions⁴. In view of the concerns with the availability of steady gas flows and prescribed residence times, thermal cycling and the ability of the control option to load-follow varying pollutant concentrations, and the fact that the source will be required to continually comply with an hourly emission rate, an effective NO_x control efficiency will be hard to maintain for an EAF application. It should be noted that if the required residence time or other optimum operation parameters are not available, secondary production ammonia will be released directly to the atmosphere. In some instances, it may even be higher than direct ammonia applications discussed earlier.

There are significant reservations regarding effective technical applicability of this control alternative for an EAF application. In order for the NOxOUT® system to effectively reduce NO_x emissions, the exhaust gas stream should have relatively stable gas flow rates, ensuring the requisite residence time requirements and temperature. The temperature of the EAF exhaust gas will vary widely over the melt cycle, and will not remain in the desired temperature window during all phases of operation. Similarly, the gas flow rates will not remain stable during furnace operation, precluding the possibility of adequate residence time. Moreover, NOxOUT® technology has never been proposed nor successfully implemented to control NO_x emissions from EAFs. Any projected application of the process to the EAF would be considered a "technology transfer." In view of the above limitations, the NOxOUT® option is considered technically infeasible with significant environmental impacts for this application and will not be considered any further in this BACT analysis.

Low Temperature Oxidation (LTO) -- LTO technology has never been utilized for any steel mill EAF application. Applications have been mostly for industrial boilers and cogeneration gas turbines which have a more favorable energy balance. The technology is a variant of SNCR technology using ozone. The ozone is injected into the gas stream and the NO_x in the gas stream is oxidized to nitrogen pentoxide (N₂O₅) vapor which is absorbed in the scrubber as dilute nitric acid (HNO₃). The nitric acid is then neutralized with caustic (NaOH) in the scrubber water forming sodium nitrate (NaNO₃). The overall chemical reaction can be summarized as follows:



For optimal performance, the technology requires stable gas flows, lack of thermal cycling, invariant pollutant concentrations and residence times on the order of 1.0 – 1.5 seconds. In addition, LTO technology requires frequent calibration of analytical instruments which sense the NO_x concentrations for proper adjustment of ozone injection. Since LTO uses ozone injection, it has a potential for ozone slip which can vary between 5 – 10 ppmv. Also, the technology requires a cooler flue gas of less than 300 °F at the point of ozone injection, otherwise the reactive gas is rendered redundant. The technology also suffers from low NO_x conversion rates (40% - 60%), potential for nitric acid vapor release (in the event of a scrubber malfunction) with subsequent regional haze impacts and the handling, treatment and disposal issues for the spent scrubber effluent.

⁴ USEPA "ACT Document - NO_x Emissions from Iron and Steel Mills" Sept., 1994

In conclusion, the technology is evolving for reliable SNCR application utilizing reactive gas-phase ozone to control NO_x emissions from combustion applications. The technology is neither applicable nor proven for steel mill EAF applications and attendant limitations render it technically infeasible in its current manifestation. In view of the above, the LTO control option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

In order to implement an effective technical applicability for the control options discussed above, a stable temperature regime (along with non-varying gas flows and pollutant concentrations) for specific target windows is imperative which cannot be afforded by Nucor's EAF operation for the following reasons:

1. As discussed earlier, the add-on control options cannot be located upstream of the baghouse in order to acquire the requisite temperature window due to particulate interference which can severely degrade the effective technical applicability of the respective control alternative;
2. In order to avoid particulate interference, the add-on control options will have to be located downstream of the EAF baghouse. The exhaust gas temperatures exiting the baghouse vary according to the following:
 - a. Overall seasonal variation due to changes in the temperature of the ambient air;
 - b. Changes in ambient air relative humidity;
 - c. Operational cycle of the EAF - tapping, charging, bucket charge, etc.; and,
 - d. Type of materials being added to the furnace depending on the grade of steel being produced.
3. The add-on control systems are not very adept at load-follow with varying process conditions resulting in significant erosion of their effective technical applicability; and,
4. The catalytic systems are susceptible to poisoning by certain interferents and heavy metals.

Step 3: Rank Remaining Control Technologies by Control Effectiveness

Various control alternatives were reviewed for technical feasibility in controlling NO_x emissions from the EAF. With the exception of combustion control utilizing existing natural gas-fired oxyfuel burners, the applicability of the remaining control options is questionable and is considered technically infeasible.

Step 4: Evaluate the Most Effective Controls and Document Results

Since, only a single control option was ascertained to be technically feasible, no ranking of control alternatives has been provided.

The proposed emission limit of 0.42 lb NO_x / ton steel produced reflects the present emission limit. None of the steel mills reviewed in this analysis have proposed or successfully implemented any controls besides natural gas-fired oxyfuel burners. The other control options have been shown to be technically infeasible. Based on a review of similar EAF melt shop applications, the proposed controls and the

emission limit represent BACT technology for the existing EAF (based on furnace configuration and past stack tests).

Step 5: Select BACT

As outlined above, for the existing EAF, the oxy-fuel fired burners are the only technically feasible control option to meet the existing BACT emission limit of 0.42 lbs NO_x/ ton of steel slab produced.

3.2.2 BACT CONTROL OF CARBON MONOXIDE (CO) EMISSIONS

CO will be emitted as a byproduct of incomplete combustion from the following potential sources -- charged and injected carbon, scrap steel, scrap substitutes, electrodes, natural gas, and "foaming slag" operating practice. EAFs generate CO as a result of oxidation of carbon introduced into the furnace charge to refine the steel and as a result of the sublimation / oxidation of the carbon electrode.

The present limit for CO is 2.3 lbs /ton of steel produced. The existing EAF is equipped with a DEC for the mitigation of CO emissions.

Step 1: Identify All Control Technologies

The alternatives available to control CO emissions from the EAF include the following:

- (1) Operating Practice Modifications;
- (2) Flaring of CO Emissions;
- (3) CO Oxidation Catalysts;
- (4) Post-Combustion Reaction Chamber;
- (5) Catalytic Incineration;
- (6) Oxygen Injection; and,
- (7) Direct Evacuation Control (DEC).

Step 2: Eliminate Technical Infeasible Options

The test for technical feasibility of any control option is whether it is both available and applicable to reducing CO emissions from the EAF. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

- (1) Operating Practice Modifications -- Due to customer demands on quality and to stay competitive in the marketplace, the mill incorporates an improved foamy process to produce steel. In this process, carbon and oxygen will be blown into the furnaces below the slag line, creating an expanding "foam". The process will utilize a greater amount of charge and injection carbon to produce a competitive, marketable product. In this process, additional chemical energy is produced along with CO (due to oxidation of carbon), which is intrinsically related to product quality. This process reduces electrical usage and extends the equipment life.

Due to marketplace demands on the type of products to be manufactured at the mill and the required product quality, Nucor does not propose any additional operating practice modifications that will alter CO emissions from the EAF.

(2) Flaring of CO Emissions -- Based upon a review of the previously listed information resources, there is no known application of flaring EAF exhaust gases. Flaring of emissions for CO destruction would require raising the exhaust gas temperature to 1,300 °F at a residence time of 0.5 second. The exhaust gas stream will be approximately 1,100,000 dscfm. Thus, based on the relatively large gas volumetric flow at a substantial temperature differential, the auxiliary fuel requirements needed to operate the flare would be overwhelmingly large. Additionally, it can be speculated as to whether the flare would actually result in a decrease of CO emissions or increase thereof from supplemental fuel combustion, which would also result in an increase of NO_x emissions. Consequently, this control alternative is considered infeasible on an environmental/energy basis for EAF exhausts and thus, will not be considered any further in this BACT analysis.

(3) CO Oxidation Catalysts -- Based upon a review of the previously listed information resources, there is no known application of CO oxidation catalysts to control CO emissions from an EAF. The optimal working temperature range for CO oxidation catalysts is approximately 850 °F – 1,100 °F, with a minimum exhaust gas stream temperature of 500 °F for minimally acceptable CO control. Exhaust gases from the EAF will undergo rapid cooling as they are ducted from the furnace. Thus, the temperature will be far below the minimum 500 °F threshold for effective operation of CO oxidation catalysts. Additionally, the particulate loading in the exhaust gas stream is anticipated to be too high for efficient operation of a CO oxidation catalyst. Masking effects such as plugging and coating of the catalyst surface would almost certainly result in impractical maintenance requirements, and would significantly degrade the performance of the catalyst. Consequently, this control alternative is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(4) Post-Combustion Reaction Chambers -- Based upon a review of the previously listed information resources, there is no known successful application of duct burners or thermal incinerators to control CO emissions from an EAF. It should be noted that this type of technology has been proposed for EAFs in the United States; however, the feasibility of these units to effectively reduce CO emissions, without resulting in severe operational problems, is unknown. Further, such units are expected to consume large quantities of natural gas and oxygen, resulting in excessive annual operating costs.

The principle of destruction within post combustion chambers is to raise the EAF exhaust gases to a sufficiently high temperature and for a minimum amount of time to facilitate oxidation. The combustion chamber configuration must provide effective mixing within the chamber with an acceptable residence time. Recuperative heat exchangers can be used with these systems to recover a portion of the exiting exhaust gas heat and reduce the auxiliary fuel consumption.

The amount of CO which could be oxidized with post combustion systems is uncertain, and precise performance guarantees are expected to be difficult to obtain from equipment manufacturers because of the lack of operating experience. In addition, there is the potential for additional emissions of NO_x from auxiliary fuel combustion. Further, due to the heat and particulate loading, the burners would have a short life expectancy, and may sustain severe maintenance and reliability problems. Additionally,

a single or multiple duct burner system would not be able to heat the relatively cool gases from the EAF during cold cycling.

Potentially, there are two locations where post combustion chambers can be installed, i.e., upstream or downstream of an EAF baghouse. Locating upstream of the baghouse would take advantage of slightly elevated temperatures in the exhaust gas stream. However, at this location the post combustion chamber would be subject to high particulate loading. The units would be expected to foul frequently from the particulate accumulation, and the burners would have severe maintenance and reliability problems. Thus, the installation of the post combustion chamber upstream of the baghouse is considered technically infeasible. Alternatively, the post combustion chamber could be installed downstream of the EAF baghouse. However, even at this location, fouling due to particulate matter can occur, and more importantly, even cooler exhaust temperatures would be encountered. These cooler temperatures would greatly increase the auxiliary fuel requirements. The associated combustion of additional auxiliary fuel will result in an unacceptable increase in operating costs. Further, the combustion of additional fuel will result in increases in emissions to the atmosphere.

The only known proposed use of post combustion for CO was the initial minor source permit application (early 1990's) for Gallatin Steel, located in Ghent, Kentucky. This was proposed to control CO emissions of less than 100 tons per year. This control application was unsuccessful and the standard DEC was subsequently proposed and accepted as BACT (2.0 lbs. /ton) for the PSD permit.

Based upon the above discussions, the use of a post combustion chamber is considered technically infeasible for the EAF and will not be considered any further in this BACT analysis.

(5) Catalytic Incineration -- Based upon a review of the previously listed information resources, there is no known application of catalytic incineration to control CO emissions from EAFs. Catalytic incinerators use a bed of catalyst that facilitates the overall combustion of combustible gases. The catalyst increases the reaction rate and allows the conversion of CO to CO₂ at lower temperatures than a thermal incinerator. The catalyst is typically a porous noble metal material which is supported in individual compartments within the unit. An auxiliary fuel-fired burner ahead of the bed heats the entering exhaust gases to 500 °F – 600 °F to maintain proper bed temperature. Recuperative heat exchangers are used to recover the exiting exhaust gas heat and reduce the auxiliary fuel consumption. Secondary energy recovery is typically 70 percent.

Catalytic incineration systems are limited in application due to potential poisoning, deactivation, and/or blinding of the catalyst. Lead, arsenic, vanadium, and phosphorus are generally considered poisons to catalysts and deactivate the available reaction sites on the catalyst surface. Particulate can also build up on the catalyst, effectively blocking the porous catalyst matrix and rendering the catalyst inactive. In cases of significant levels of poisoning compounds and particulate loading, catalyst replacement costs are significant.

As in the thermal incineration discussion, potentially, there are two locations where the incinerator can be installed, i.e., upstream or downstream of the EAF baghouse. For the same reasons discussed earlier (e.g., fouling due to particulate matter), the upstream location is considered technically infeasible. Alternatively, the incinerator can be installed downstream of the EAF baghouse. However, even at this

location, fouling due to particulate matter can occur, and further, the exhaust will be at a lower temperature. These cooler temperatures would greatly increase the auxiliary fuel requirements. The associated combustion of additional auxiliary fuel will result in an unacceptable increase in operating costs. Further, the combustion of additional fuel will result in increases in emissions to the atmosphere.

Due to the lack of application of catalytic incineration in the steel industry and potentially adverse technology applicability issues, this control alternative is considered technically infeasible and will not be considered any further in this BACT analysis.

(6) Oxygen Injection -- Based upon a review of the previously-listed information resources, there is no known application of oxygen injection for controlling CO emissions from an EAF.

A theoretical means of reducing CO would be oxygen injection at the entrance of the ductwork to increase oxidation of the available CO to CO₂. The increase in CO oxidation which could be achieved, however, is unknown. This approach would be purely experimental and is a procedure that is currently not conducted in EAF operations in steel mills in the United States. Oxygen injection directly into the furnace is an experimental operating practice in Europe used to increase the heat input to the melt, but the practice has not been demonstrated to reduce CO emissions.

Typically, the DEC system will draw air into the duct, creating an oxygen-rich mixture of EAF exhaust gases where CO is oxidized. The addition of oxygen is expected to provide little if any additional conversion of CO. The capability is also limited due to the cyclic operating schedule (i.e., hot-cold cycling). Exhaust gas temperatures will fluctuate during each melt, and at times drop below 1,350°F. It is estimated that this will occur for 5 - 10 minutes during each melt. The minimum temperature encountered is estimated at approximately 350°F. Thus, during these periods, the thermal destruction efficiency is expected to decrease, resulting in elevated CO emissions. Consequently, this control alternative is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(7) Direct Evacuation System -- In the steel industry, there are generally two principal capture systems employed during EAF operation to control the process emissions generated during melting and refining. One is the DEC and the other is the side draft hood system. Side draft hoods require higher air flow rates than a DEC and are not widely used. Based upon a review of the previously listed information resources, DEC system continues to be the primary control technology for controlling CO emissions from an EAF. The EAF is equipped with a DEC for mitigation of CO emissions.

A DEC connected to the melt shop canopy collector system which further directs exhaust gases to the EAF baghouse. During melting and refining, a slight negative pressure is maintained within the furnace to withdraw exhaust gases through the DEC duct. The DEC allows excellent process emissions capture and combustion of CO, and requires the lowest air volume of other EAF capture devices.

Step 3: Rank Remaining Control Technologies by Control Effectiveness

Various control alternatives were reviewed for technical feasibility in controlling CO emissions from the EAF and none of the control options were determined to be technically feasible. Based on a review of the information resources referenced earlier, it is revealed that these control alternatives apart from the

DEC have not been successfully implemented to reduce CO emissions from EAFs. Thus, the projected use of any of these technologies would be considered a "technology transfer." Since, only a single control option was ascertained to be technically feasible, no ranking of control alternatives has been provided.

Step 4: Evaluate the Most Effective Controls and Document Results

A review of the RBLC database revealed that other steel mills have an emission limit ranging from about 1.93 – 6.0 lbs. CO / ton of steel. No other mills have proposed or successfully implemented any controls besides DEC. The other control options have been shown to be technically infeasible.

Based on a review of similar EAF melt shop applications, the proposed controls and the emission limit represent the best available control technology for the EAF.

Step 5: Select BACT

In conclusion, BACT for controlling CO emissions from the existing EAF is proposed as the use of the existing DEC to meet a CO emission rate of 2.3 lbs. /ton of steel produced, which represents the best achievable limit in the broader industry.

3.2.3 BACT CONTROL OF PARTICULATE MATTER EMISSIONS

Particulate emissions from the EAF will be captured by the DEC and a roof exhaust system and ultimately exhausted through a baghouse. The maximum flow rate through each baghouse is estimated at approximately 1,100,000 dscfm. The New Source Performance Standard (NSPS) and NESHAP for particulate matter emissions from an EAF are both 0.0052 grains / dscf. Fabric filtration in baghouses is the predominant control device for EAFs. Other particulate control options are not considered as effective or technically feasible. A review of the RBLC database revealed that generally EAFs have been permitted at 0.0018gr / dscf (filterable) and generally 0.0052 gr / dscf (filterable and condensable).

The PM₁₀ and PM_{2.5} BACT range for electric arc furnace emissions ranges from 0.0015 - 0.0052 gr / dscf using a baghouse. Nucor's present limits are of 0.0018 gr / dscf for PM₁₀ and PM_{2.5} (filterable) and 0.0052 gr / dscf for PM₁₀ and PM_{2.5} (filterable and condensable).

Steps 1-4: Identify, Eliminate, Rank, and Evaluate All Control Technologies

Fabric filtration is the predominant control option for abatement of particulate emissions (PM, PM₁₀, PM_{2.5}) from an EAF application. Other particulate control options are not considered as effective or technically feasible for an EAF application. Based on a review of the information resources referenced earlier, it was revealed that these control alternatives have not been successfully implemented to reduce particulate emissions from EAFs. Thus, the projected use of any of these technologies would be considered a "technology transfer." Since only a single control option was ascertained to be technically feasible, no ranking of control alternatives has been provided.

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

Based on a review of similar EAF melt shop applications, the proposed controls and the emission limit represent the best available control technology for the EAF.

Step 5: Select BACT

In conclusion, BACT for controlling PM / PM₁₀ / PM_{2.5} emissions from the EAF is proposed as the use of fabric filtration to meet a filterable PM limit of 0.0018 gr/dscf, and a filterable plus condensable emission limit of 0.0052 gr/dscf for both PM₁₀ and PM_{2.5}. Improvements in the existing control level are limited by the current technology of filter bag media which can also withstand the variability of temperature and particulate loading associated with an EAF steel mill, and these limits represent a high level of performance against peer steel mills in the industry.

3.2.4 BACT CONTROL OF SULFUR DIOXIDE (SO₂) EMISSIONS

The source of SO₂ emissions from the EAF is attributable to the sulfur content of the raw materials charged in the EAF and to the materials which are used in the foamy slag process. A review of the BACT emission limits for EAF steel mills shows a range of 0.2 to 0.7 lb/ton. The Decatur Steel Mill's melt shop baghouse is presently permitted at 0.35 lb/ton. The Decatur Steel Mill presently has a limit on the injection carbon utilized in the EAF that cannot exceed 2.0% S by weight, thus, controlling SO₂ emissions.

Step 1: Identify All Control Technologies

The alternatives which are potentially available to control SO₂ emissions from the EAF include the following:

- (1) Lower-Sulfur Charge Substitution; and
- (2) Flue Gas Desulfurization (FGD) options -
 - a. Wet Scrubbing
 - b. Spray Dryer Absorption (SDA)
 - c. Dry Sorbent Injection (DSI).

Step 2: Eliminate Technical Infeasible Options

The test for technical feasibility of any control option is whether it is both available and applicable to reducing SO₂ emissions from the EAF. The previously listed information resources were consulted to determine the extent of applicability of each identified control alternative.

- (1) Lower-Sulfur Charge Substitution -- the Decatur Steel Mill's current practice, and a condition in the current Title V permit, restricts the sulfur content in the injection carbon to less than or equal to 2% by weight (permit no. 712-0037; permit proviso no. 6 for emission standards for the EAFs, LMFs with

2 Meltshop Baghouses). As a result, Nucor has the supplier of injection carbon to certify that this condition is met.

CARBON TYPES

Carbon basically has 3 different uses at the EAF: scrap and scrap substitutes, charge carbon (bucket fed and top fed), and injection carbon. Each of these carbon types act differently on the operation. While there is some minor substitutability, none of these types can truly be a substitute for any of the others.

Scrap/Scrap Substitutes

This is carbon inherent in the scrap / scrap substitute charge fed to the furnace. This carbon is consumed in the liquid phase of the steel. As such, it has a very high heating efficiency and the majority of the sulfur remains dissolved in the steel.

Charge Carbon

This carbon is used to increase the amount of carbon in the liquid steel bath. While not as efficient as carbon already in the scrap / scrap substitutes, approximately 35% – 0% of the fixed carbon can be picked up in the bath depending on many variables. The balance of the fixed carbon acts on the slag (reducing FeO similar to injection carbon, but without the foaming effect) or burns in the top space. Because of slag and metal mixing during charging, about one-half of this sulfur leaves as SO_x while the remainder stays in the steel and slag.

Injection Carbon

This is a carbon media that is injected into the slag layer where it reduces FeO and generates CO gas. This foams the slag and improves electrical efficiency. There are four injection points at each EAF. It has a relatively high efficiency, with approximately 65% – 85% of the fixed carbon reducing FeO. Reaction in the middle of the slag layer means that approximately one-half of the sulfur leaves as SO_x, while the remainder stays in the steel and slag.

CARBON SOURCES

The sources of this carbon can take many forms. Nucor is dealing with the chemically active "fixed" carbon and not the total carbon or BTU value. Volatiles in the carbon are flash distilled in the top space and play very little part in the furnace. Typical carbon sources are coal, metallurgical coke, petroleum coke and tires.

Petroleum Coke

For many years petroleum coke was the preferred injection carbon source. This material was very high in fixed carbon, relatively low in sulfur (-1%), less abrasive, low in ash, and inexpensive. Since it was only available in small sizes (<1/4"), it was not usable as charge carbon. In recent years low sulfur petroleum coke has been in high demand, costs have increased and availability is limited. Most places have tried substituting some blend of low and high (2-3%) sulfur petroleum cokes. As the supply tightened, more

anthracite coal and metallurgical coke were blended to compensate for reduced availability of petroleum coke. The coal has a different density and does not transport well with petroleum coke in pneumatic systems. The metallurgical coke is very abrasive and erodes pipe and hoses at an unacceptable rate.

Metallurgical Coke

Metallurgical coke has been used both as charge and injection carbon. As charge carbon, the material works well. The high fixed carbon content and large piece size makes a good combination. The only drawback is that the coke tends to retain water. Excess water can be an explosion hazard, and precautions to drain water and avoid ice are vital. As mentioned above, the abrasive nature of metallurgical coke with the 10% – 20% ash content causes many problems as an injection carbon.

Coal

Anthracite coal is the primary coal used in EAF steelmaking. Bituminous coal can be used but has some serious problems. Due to higher volatile content, bituminous coal has lower ignition and flash points. This means that it can ignite and even explode under certain storage conditions. Some bituminous coal is used as charge carbon, but other than brief experiments, bituminous coal is not used as an injection carbon.

SUPPLY TRENDS

Petroleum coke has been rising in sulfur content for the past several years. As more of the world's available crude is heavier and higher in sulfur content, the sulfur levels in petroleum coke will continue to increase. Most domestic petroleum coke supplies are projected to be around 3% – 3.5% sulfur. The majority of the 2% – 2.5% sulfur is currently imported from Venezuela, a very politically unstable source. Lower sulfur petroleum cokes are essentially unavailable at the present time.

Metallurgical coke is currently both manufactured in the U.S. and imported from overseas. Many of the U.S. producers are at least partially dependent on foreign coal. In the early part of this decade, oversupply from China severely damaged domestic production capability and, when the Chinese government restricted the export of coke, a severe shortage developed. Metallurgical coke producers in the U.S. are also heavily dependent on a very few coking coal deposits in the Northeast.

Bituminous coal, while plentiful, is not suited to many steelmaking situations. The supply of low-volatile, low-sulfur bituminous coal is not much better than that of the low sulfur anthracite discussed below. The low fixed carbon levels mean that much larger quantities are required to meet the carbon requirements of the EAF. These coals also pose a safety hazard in many existing storage and handling systems.

Anthracite coal is the mainstay of the low sulfur EAF carbon supply. U.S. production is confined almost exclusively to central Pennsylvania. The main alternative use of this material is home and industrial heating. This means that price and availability varies seasonally, and even within the seasons, weather conditions can drastically affect market conditions. China, Russia, and Vietnam are major foreign suppliers of this material. High ocean freights and market disruptions caused by expansion in China

have made this imported material prohibitively expensive. Occasionally, spot cargos have been offered when Far East demand temporarily drops, but these cargos disappear as soon as the Oriental demand returns. Traders that do extensive business with China have been informed that the Chinese government plans to continue increasing tariffs and export restrictions to make China a net importer of coal, and conserve both future reserves and limited infrastructure, which is tied up moving coal to the coast, instead of expanding their domestic economy. Thus, Chinese coal will not be available on the market in the reasonably foreseeable future.

ASSESSMENT

Because of the factors outlined above, continued availability of low sulfur carbon sources used in the Decatur Steel Mill in the past is increasingly in question.

Petroleum coke sulfur concentrations are increasing and low sulfur petroleum cokes are essentially unavailable. Metallurgical coke is limited in supply, not useable as an injection carbon, and is used for other critical industrial operations besides steelmaking, making it difficult to consistently obtain and subject to periodic price spikes. Bituminous coals are largely unsuited to steelmaking, leaving anthracite as the remaining major source. Nucor uses anthracite coal with sulfur content equal to or less than 2%.

Fixed carbon is another important variable. As the percent of fixed carbon diminishes, correspondingly more of the carbon source must be used to achieve the same result. Not only are the lower sulfur coals and cokes decreasing in availability, but they are not cost effective. Because of the combined problems caused by decreasing availability, increased cost, and the consequent difficulty in relying upon the lower sulfur feedstocks for demonstrating compliance, the Decatur Steel Mill concludes that the current practice of using lower sulfur anthracite coal (meeting and certifying that the sulfur content is equal to or less than 2% S) reduces SO₂ in combination with good operating practices is BACT.

(2) Flue Gas Desulfurization -- FGD systems currently in use for SO₂ abatement can be classified as wet and dry systems. Note that based on a review of the RBLC database and discussions with various individuals knowledgeable about steel mill operations, it was revealed that control technologies for SO₂ abatement have not been successfully implemented for EAFs. However, FGD options which have been traditionally applied to utility boilers may be available to control SO₂ from the EAF. Therefore, the application of these technologies to the EAF will be examined further.

For FGD controls in general, the expected variability and low SO₂ concentrations in the gas stream are not amenable to responsive FGD treatment which is typically geared for high sulfur fuel combustion systems. In addition, the relatively large gas flow and the large amplitude temperature variations will play havoc with reaction kinetics as there are no available pre-concentration or uniform load scheme that would temper the perturbations. In conclusion, the effective SO₂ control efficiencies would be significantly impaired.

(2a) Wet Scrubbing-- Wet scrubbers are regenerative processes which are designed to maximize contact between the exhaust gas and an absorbing liquid. The exhaust gas is scrubbed with a 5% – 15% slurry, comprised of lime (CaO) or limestone (CaCO₃) in suspension. The SO₂ in the exhaust gas reacts with the

CaO or CaCO₃ to form calcium sulfite (CaSO₃·2H₂O) and calcium sulfate (CaSO₄). The scrubbing liquor is continuously recycled to the scrubbing tower after fresh lime or limestone has been added.

The types of scrubbers which can adequately disperse the scrubbing liquid include packed towers, plate or tray towers, spray chambers, and venturi scrubbers. In addition to calcium sulfite/ sulfate, numerous other absorbents are available including sodium solutions and ammonia-based solutions.

There are various potential operating problems associated with the use of wet scrubbers. First, particulates are not acceptable in the operation of wet scrubbers because they would plug spray nozzles, packing, plates and trays. Thus, the scrubber would have to be located downstream of the EAF baghouse. This would substantially increase the capital cost of the wet scrubber, which is typically two to three times more expensive than the capital cost for a dry scrubber. Wet scrubbers also require handling, treatment, and disposal of a sludge by-product. In this case, air emissions would be exchanged for a large-scale water pollution problem. Treatment of wet scrubber wastes requires reverse osmosis (RO) units which are unreliable; requiring frequent maintenance by an experienced operator. Finally, the volumetric exhaust gas flow rate from the EAF will be approximately 1,100,000 dscfm. When coupled with the relatively low SO₂ emission rates, a relatively small SO₂ concentration of around 1 – 20 ppmv will result in the exhaust. The SO₂ concentration will also vary widely over the EAF cycle which operates as a batch process. This will preclude efficient application of wet scrubbing.

Wet scrubbing technology for an EAF application has not been used in practice. This is supported from the review of the RBLC database and discussions with various individuals knowledgeable about steel mill operations that control technologies for SO₂ abatement have not been successfully implemented for EAFs. The possibility of water in the baghouse is a major operating problem, which would allow the dust to form into hard cement in the baghouse hoppers cause the bags to blend with the caked dust. This would then lead to opacity problems and broken dust augers in the baghouse.

In general, the consensus of vendors was against applying wet scrubbing technology for the following reasons:

1. Intrinsic nature of EAF operations on a batch basis;
2. Inability to efficiently control SO₂ due to cyclic nature of process, timing of SO₂ evolution from the furnace, and duration of SO₂ emissions;
3. Variability of SO₂ emissions and low SO₂ concentrations;
4. Variability of gas flow and temperature with unpredictable thermal cycling; and,
5. Inability to provide credible and sustained SO₂ removal guarantees due to above reasons.

Thus, there are significant reservations regarding effective technical applicability of this control alternative for the EAF application. Due to the large gas flows, the equipment would have to be oversized with care for corrosion resistance.

Besides the issues pertaining to pollutant concentration cycling and lack of compensatory system response, there are concerns about handling, treatment and disposal of sludge-phase and liquid-phase wastes which have the potential of being classified as hazardous wastes. Moreover, wet scrubbing has never been proposed nor successfully implemented for similar steel mill applications. In view of the above limitations, the wet scrubber option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(2b) Spray/Dryer Absorption (SDA) -- An alternative to wet scrubbing is a process known as dry scrubbing, or spray-dryer absorption (SDA). As in wet scrubbing, the gas-phase SO_2 is removed by intimate contact with a suitable absorbing solution. Typically, this may be a solution of sodium carbonate (Na_2CO_3) or slaked lime [$\text{Ca}(\text{OH})_2$]. In SDA systems the solution is pumped to rotary atomizers, which create a spray of very fine droplets. The droplets mix with the incoming SO_2 -laden exhaust gas in a very large chamber and subsequent absorption leads to the formation of sulfites and sulfates within the droplets. Almost simultaneously, the sensible heat of the exhaust gas which enters the chamber evaporates the water in the droplets, forming a dry powder before the gas leaves the spray dryer. The temperature of the desulfurized gas stream leaving the spray dryer is now approximately 30 – 50 °F above its dew point.

The exhaust gas from the SDA system contains a particulate mixture which includes reacted products. Typically, baghouses employing Teflon-coated fiberglass bags (to minimize bag corrosion) are utilized to collect the precipitated particulates.

The SDA process would not have many of the potential operating problems associated with the wet scrubbing systems. However, the volumetric exhaust gas flow rate from the melt shop(s) will be approximately 1,100,000 dscfm.

When coupled with the relatively low SO_2 emission rates, a relatively small SO_2 concentration of around 1 – 20 ppmv in the exhaust will result. The SO_2 concentration will also vary widely over the EAF cycle. This control alternative has significant limitations for effective technical applicability for an EAF application:

1. The very low SO_2 concentration of around 1 – 20 ppmv in the influent coupled with a gas flow of 1,100,000 dscfm would retard the adequate contact interface with the reagent.
2. The variations in the SO_2 concentration during and between heats would severely impair the control system's capability to respond adequately. SDA systems are not designed for adept load-follow flexibility;
3. The low temperature of the exhaust gas of around 250 °F, and the low gas moisture content, would not allow sufficient thermal gradient for an appropriate approach to saturation, which typically specifies that the temperature of the desulfurized gas stream leaving the spray dryer be around 30 - 50 °F above its dew point;
4. Thermal cycling during the regular batch operation of the EAF in concert with the melting and refining heats could potentially result in less than desirable temperature approaches to

saturation, thereby raising the prospect of wet fouling. The system would be hard to control with attendant near-loss of SO₂ control efficiencies; and

5. Unable to provide credible and sustained SO₂ removal guarantees due to above reasons.

Thus, there are significant reservations regarding effective technical applicability of this control alternative for the EAF application. In addition to the above issues, there are significant concerns about handling, treatment and disposal of large amounts of dry solid wastes which have the potential of being classified as hazardous wastes. Moreover, SDA has never been proposed nor successfully implemented for similar steel mill applications. In view of the above limitations, the SDA dry scrubbing option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(2c) Dry Sorbent Injection (DSI) -- This control option typically involves the injection of dry powders into either the furnace or post-furnace region of utility- sized boilers. This process was developed as a lower cost option to conventional FGD technology. Since the sorbent is injected directly into the exhaust gas stream, the mixing offered by the dry scrubber tower is not realized. The maximum efficiency realized for this SO₂ control technology is estimated to be fairly nominal. It is felt that if sufficient amounts of reactants are introduced into the flue gas, there is a possibility of some degree of mixing and reaction. The science is inexact and the coupling of reactant dosage and in-flue mixing, which impacts the SO₂ control efficiency, is susceptible to variability in SO₂ concentrations.

The dry sorbent injection process would not have many of the potential operating problems associated with the wet scrubbing systems. However, the volumetric exhaust gas flow rate from the EAF will be approximately 1,100,000 dscfm. When coupled with the relatively low SO₂ emission rates, a relatively small SO₂ concentration of 1 – 20 ppmv will result in the exhaust. The SO₂ concentration will also vary widely over the EAF cycle. The injection dose of sorbent materials would be hard to control in order to match variability in SO₂ concentrations. Similar control systems are fraught with chronic operational problems with the sensors requiring frequent maintenance and calibration.

This control alternative has significant limitations for effective technical applicability for an EAF application which were discussed earlier in the context of a dry scrubbing (SDA) system:

- a. The very low SO₂ concentration of around 1 – 20 ppmv in the influent, coupled with a gas flow of 1,100,000 dscfm, would retard the adequate contact interface with the reagent;
- b. The variations in the SO₂ concentration during and between heats would severely impair the control system's capability to respond adequately. DSI systems are not designed for adept load-follow flexibility and variable reactant dose control with fast response times comparable to anticipated process conditions;
- c. Due to the anomalies of mixing afforded by the process, the reaction kinetics are not very flexible and rather time-dependent. Unlike the SDA system, the mixing uncertainty can potentially reduce DSI technology to a sheer brute- force proposition resulting in unstable and unpredictable performance;

- d. In a DSI-fabric filter coupled system configuration, whereby most of the reaction takes place on the filter cake on the bags, adequate residence time would not be available since the attendant higher particulate load would necessitate a higher cleaning frequency of the fabric filter; and,
- e. Inability to provide credible and sustained SO₂ removal guarantees due to above reasons.

Thus, there are significant reservations regarding effective technical applicability of this control alternative for the EAF application. In addition to the above issues, similar to the SDA, there are significant concerns about handling, treatment and disposal of large amounts of dry solid wastes which have the potential of being classified as hazardous wastes. Moreover DSI has never been proposed nor successfully implemented for similar steel mill applications. In view of the above limitations, the DSI dry scrubbing option is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

Step 4: Evaluate the Most Effective Controls and Document Results

Various control alternatives were reviewed for technical feasibility in controlling SO₂ emissions from the EAF. All potential control options were determined to be technically infeasible. Based on a review of the information resources referenced earlier, it is revealed that these control alternatives have not been successfully implemented to reduce SO₂ emissions from EAFs. Thus, the projected use of any of these technologies would be considered a "technology transfer."

A review of the RBLC database revealed that other steel mills have a similar emission limit. None of the steel mills reviewed in this analysis have proposed or successfully implemented any controls. The other control options have been shown to be technically infeasible. Based on a review of similar EAF melt shop applications, the existing controls and the emission limit represent the best available control technology for the EAF melt shop application.

Step 5: Select BACT

In conclusion, BACT for controlling SO₂ emissions from the existing EAF is good operating practices to meet a maximum SO₂ emission rate of 0.35 lbs/ton of steel produced.

3.2.5 BACT CONTROL OF VOLATILE ORGANIC COMPOUND EMISSIONS

VOC emissions from the EAF will be intermittent and limited to the brief period during EAF charging when organic compounds such as oil or paint present in the scrap are volatilized.

Step 1: Identify All Control Technologies

Potential VOC control alternatives include the following:

- (1) Catalytic or Thermal Oxidation;
- (2) Degreasing of scrap metal prior to charging in the EAF; and,
- (3) Scrap management program.

Step 2: Eliminate Technical Infeasible Options

Implementation of any catalytic or thermal oxidation scheme would be non-viable and technically infeasible for the same reasons cited earlier in the previous section discussing CO control. Further, degreasing of scrap metal prior to charging in the EAF is impractical. The amount of pollution generated by degreasing scrap would be greater than the amount of pollution generated by melting the scrap. There would be tens of thousands of gallons of solvent required to degrease the large amount of scrap used annually in the EAFs. Thus, both of these control alternatives are considered technically infeasible and will be precluded from further consideration in this BACT analysis.

Step 3: Rank Remaining Control Technologies by Control Effectiveness

Various control alternatives were reviewed for technical feasibility in controlling VOC emissions from the EAF. With the exception of a scrap management program, the applicability of the remaining control options was determined to be technically infeasible. Based on a review of the information resources referenced earlier, it is revealed that these control alternatives have not been successfully implemented to reduce VOC emissions from EAFs. Thus, the projected use of any of these technologies would be considered a "technology transfer." Since only a single control option was ascertained to be technically feasible, no ranking of control alternatives has been provided.

Step 4: Evaluate the Most Effective Controls and Document Results

None of the steel mills reviewed in this analysis have proposed or successfully implemented any controls besides scrap management. The other control options have been shown to be technically infeasible.

Step 5: Select BACT

In conclusion, BACT for controlling VOC emissions from the EAFs is proposed as the utilization of a scrap management program to meet a VOC emission rate of 0.13 lbs / ton of steel. The mill will utilize a scrap management program to eliminate the purchase of scrap steel that is heavily oiled. A broker or a Nucor representative is responsible for inspecting shipments of scrap received. The scrap inspector visually inspects the shipments and determines compliance with the scrap management specifications.

3.2.6 BACT CONTROL OF LEAD EMISSIONS

Lead emissions from the EAF will be captured by the DEC and a roof exhaust system and ultimately exhausted through a baghouse. The maximum flow rate through each baghouse is estimated at approximately 1,100,000 dscfm. Fabric filtration in baghouses is the predominant control device for EAFs. Other lead control options are not considered as effective or technically feasible. A review of the RBLC database revealed that generally EAFs have been permitted between 0.0017 lbs / ton steel to 0.008 lbs / ton steel. Nucor's present limit for lead is 0.002 lbs /ton steel.

Steps 1-4: Identify, Eliminate, Rank, and Evaluate All Control Technologies

Fabric filtration is the predominant control option for abatement of lead emissions from an EAF application. Other lead control options are not considered as effective or technically feasible for an EAF

application. Based on a review of the information resources referenced earlier, it was revealed that these control alternatives have not been successfully implemented to reduce particulate emissions from EAFs. Thus, the projected use of any of these technologies would be considered a "technology transfer." Since only a single control option was ascertained to be technically feasible, no ranking of control alternatives has been provided.

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

Step 5: Select BACT

In conclusion, BACT for controlling lead emissions from the EAF is proposed as the use of fabric filtration to meet an emission limit of 0.002 lbs / ton steel. Improvements in the existing control level are limited by the current technology of filter bag media which can also withstand the variability of temperature and lead loading associated with an EAF steel mill, and these limits represent a high level of performance against peer steel mills in the industry.

3.2.7 BACT CONTROL OF GREENHOUSE GAS EMISSIONS

This section contains a high-level review of pollutant formation and possible control technologies for the EAF. CO₂ emissions from EAF are generated primarily during the melting and refining processes, which remove carbon as CO and CO₂ from the charge materials and carbon electrodes.

Step 1: Identify All Control Technologies

The Decatur Steel Mill searched for potentially applicable emission control technologies for CO₂ from EAFs by researching the U.S. EPA control technology database, guidance from U.S. EPA and other sources, technical literature, control equipment vendor information, state permitting authority files, and by using process knowledge and engineering experience. Based on the RBLC search, the control method described for one of the facilities was "designs and work practice standards" (i.e., no add-on control). No control method was listed for the rest of RBLC search results.

The Decatur Steel Mill's used a combination of published resources and general knowledge of industry practices to generate a list of potential controls for CO₂ emitted from EAFs. The following potential CO₂ control strategies were considered as part of this BACT analysis:

- (1) Carbon capture and storage (CCS); and,
- (2) Good Design and Operating Practices.

Step 2: Eliminate Technical Infeasible Options

(1) Carbon Capture and Storage – CCS involves cooling, separation and capture of CO₂ emissions from the flue gas prior to being emitted from the stack, compression of the captured CO₂, transportation of the compressed CO₂ (usually via pipeline), and finally injection of the captured CO₂ into a geologic

formation. For CCS to be technically feasible, all three components needed for CCS must be technically feasible.

Since there are no CO₂ pipelines currently operating in the area, the Decatur Steel Mill would need to construct a CO₂ pipeline to a storage location if it were to pursue carbon sequestration as a CO₂ control option. While it may be technically feasible to construct a CO₂ pipeline, considerations regarding the land use and availability need to be made. The closest operating CO₂ sequestration project site to the facility is the Citronelle oil field, located east of Citronelle, Alabama and approximately 255 miles from the Decatur Steel Mill. It is not plausible to consider the Decatur Steel Mill responsible for the construction of a major pipeline for that considerable distance. Therefore, CCS is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(2) Good Design and Operating Practices - Good design and operating practices are a potential control option for optimizing the operation of the EAFs. The Decatur Steel Mill operates the EAF in an efficient manner to minimize emissions, including CO₂. However, CO₂ is purposefully removed from the process for product fidelity. The reduction of CO₂ being emitted would cause the steel produced to not meet the Decatur Steel Mill's buyers' standards.

Step 3: Rank Remaining Control Technologies by Control Effectiveness

Since only a single control option was ascertained to be technically feasible, no ranking of control alternatives has been provided.

Step 4: Evaluate the Most Effective Controls and Document Results

The only option remaining is good design and operating practices. As previously discussed, the EAFs are designed to operate efficiently and the facility strives to operate the units in the most effecting manners.

Step 5: Select BACT

The Decatur Steel Mill proposes a CO₂e BACT of 504,000 tpy for the meltshop. The proposed emission limits are based on the proposed maximum production of the meltshop and the established emission factor of 280 lbs / ton.

3.3 BACT ANALYSIS FOR GALVANIZING LINE (NATURAL GAS-FIRED BURNERS)

Nucor will be installing a new galvanizing furnace with natural gas-fired burners as a part of the new galvanizing line. The maximum heat input rate for the galvanizing line will be 120.0 MMBtu/hr.

3.3.1 BACT CONTROL OF OXIDES OF NITROGEN (NO_x) EMISSIONS

NO_x emissions from the additional galvanizing line burners primarily result from combustion by-product of the fuel. The galvanizing line furnace presently controls NO_x emissions by the use of selective catalytic reduction (SCR). A review of the RLBC database for galvanizing furnaces shows that BACT for

NO_x control is achieved through the use of SCR and the combination of SNCR (direct-fired section) / SCR (radiant tube section). SCR with urea as the reductant has been demonstrated to reduce uncontrolled NO_x emissions to levels at or below the current permitted emission limit of 0.067 lb/MMBtu. The capital and operating expenses associated with this control are not prohibitive and will reduce NO_x levels below what is achieved just with low-NO_x burners.

In USEPA's "Air Pollution Control Technology Fact Sheet for Selective Catalytic Reduction, EPA-452/F-03-032" it is stated that SCR is capable of NO_x reduction efficiencies in the range of 70% to 90%, and higher reductions are possible but generally not cost-effective. Effective SCR control includes an exit gas temperature in the range of 480 °F to 800 °F and NO_x concentration from 20 ppm (>70% control) to 150 ppm (higher control efficiency). At NO_x concentrations greater than 150 ppm, the reaction rate does not increase control efficiency. This document also states that "SCR can be cost effective for large industrial boilers and process heaters operating at high to moderate capacity factors (> 100 MMBtu/hr for coal-fired boilers and >50 MMBtu/hr for gas-fired boilers)." For the galvanizing line furnace at the Decatur steel mill, it is estimated that the SCR control efficiency will be 90%.

In conclusion, for the new galvanizing line, BACT will be SCR system to control NO_x emissions. The Decatur Steel Mill will limit urea feed ahead of the SCR catalyst for flue gas temperatures in the 600 °F - 800 °F range. The NO_x emission limits for the new galvanizing line will be and 0.067 lbs / MMBtu.

3.3.2 BACT CONTROL OF PARTICULATE MATTER EMISSIONS

Particulate matter emissions from the new galvanizing line primarily result from carryover of non-combustible trace constituents in the fuel. Typically, particulates are hard to detect with natural gas firing due to the low ash content. The USEPA reference AP-42 recommends that all particulate emissions from natural gas combustion are less than 1 micron in aerodynamic diameter; therefore, they are classified as PM/PM₁₀/PM_{2.5}. Due to the relatively small emissions from natural gas combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis.

Based on a review of the previously listed information resources including the RBLC database, it was revealed that with the exception of natural gas as fuel and good combustion practices, no other control technologies for particulate abatement have been successfully implemented for small preheaters and dryers emissions. In addition, the RBLC database did not reveal any add-on control technologies for similar sized natural gas-fired combustion equipment in other industries.

Based on a review of similar natural gas-fired applications, the proposed emission limit represents the best available control technology for the new galvanizing line. In conclusion, BACT for controlling PM/PM₁₀/PM_{2.5} emissions from the new galvanizing line is proposed as the use of natural gas combustion with good combustion practices per manufacturer's guidance to meet a PM/PM₁₀/PM_{2.5} emission rate of 7.6 lbs / MMscf.

3.3.3 BACT CONTROL OF SULFUR DIOXIDE (SO₂) EMISSIONS

SO₂ emissions from the new galvanizing line primarily result from combustion by-product of the fuel. Due to the relatively small emissions from natural gas combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for SO₂ control from similar sized natural gas-fired combustion equipment in other industries. Based on a review of similar natural gas-fired applications, the current emission limit represents the best available control technology for the new galvanizing line.

In conclusion, for the new galvanizing line, BACT for controlling SO₂ emissions is proposed as the use of natural gas-fired burners employing good combustion practices per manufacturer's guidance to meet an SO₂ emission rate of 0.6 lbs / MMscf.

3.3.4 BACT CONTROL OF CARBON MONOXIDE (CO) EMISSIONS

CO emissions from the new galvanizing line primarily result from combustion by-product of the fuel. Due to the relatively small emissions from natural gas combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for CO control from similar sized natural gas-fired combustion equipment in other industries. Based on a review of similar natural gas-fired applications, the proposed emission limit represents the best available control technology for the new galvanizing line.

In conclusion, for the new galvanizing line, BACT for controlling CO emissions is proposed as the use of natural gas-fired burners employing good combustion practices per manufacturer's guidance to meet a CO emission rate of 84 lbs / MMscf.

3.3.5 BACT CONTROL OF VOLATILE ORGANIC COMPOUND EMISSIONS

VOC emissions from the new galvanizing line primarily result from combustion by-product of the fuel. Due to the relatively small emissions from natural gas combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis. A review of the RBLC database did not indicate the application of add-on control alternatives for VOC control from similar sized natural gas-fired combustion equipment in other industries. Based on a review of similar natural gas-fired applications, the proposed emission limit represents the best available control technology for the new galvanizing line.

In conclusion, for the new galvanizing line, BACT for controlling VOC emissions is proposed as the use of natural gas-fired burners employing good combustion practices per manufacturer's guidance to meet a VOC emission rate of 5.5 lbs / MMscf.

3.3.6 BACT CONTROL OF LEAD EMISSIONS

Lead emissions from the new galvanizing line primarily result from carryover of non-combustible trace constituents in the fuel. Typically, lead emissions are hard to detect with natural gas firing due to the low particulate emissions. Due to the relatively small emissions from natural gas combustion, the application of add-on controls is considered impractical and will be precluded from further consideration in this BACT analysis.

Based on a review of similar natural gas-fired applications, the proposed emission limit represents the best available control technology for the new galvanizing line. In conclusion, BACT for controlling lead emissions from the new galvanizing line is proposed as the use of natural gas combustion with good combustion practices per manufacturer's guidance to meet a lead emission rate of 0.000271 lbs / MMscf.

3.3.7 BACT CONTROL OF GREENHOUSE GAS EMISSIONS

This section contains a high-level review of pollutant formation and possible control technologies for natural gas combustion.

Step 1: Identify All Control Technologies

The Decatur Steel Mill searched for potentially applicable emission control technologies for CO₂ from natural gas combustion researching the U.S. EPA control technology database, guidance from U.S. EPA and other sources, technical literature, control equipment vendor information, state permitting authority files, and by using process knowledge and engineering experience. Based on the RBLC search, the control method described for one of the facilities was thermally efficient combustion and good operating practices (i.e., no add-on control). No control method was listed for the rest of RBLC search results.

The Decatur Steel Mill used a combination of published resources and general knowledge of industry practices to generate a list of potential controls for CO₂ emitted from galvanizing line natural gas combustion. The following potential CO₂ control strategies were considered as part of this BACT analysis:

- (1) Carbon capture and storage (CCS); and
- (2) Good Design and Operating Practices.

Step 2: Eliminate Technical Infeasible Options

(1) Carbon Capture and Storage - CCS involves cooling, separation and capture of CO₂ emissions from the flue gas prior to being emitted from the stack, compression of the captured CO₂, transportation of the compressed CO₂ (usually via pipeline), and finally injection of the captured CO₂ into a geologic formation. For CCS to be technically feasible, all three components needed for CCS must be technically feasible.

Since there are no other CO₂ pipelines in the area, the Decatur Steel Mill would need to construct a CO₂ pipeline to a storage location if it were to pursue carbon sequestration as a CO₂ control option. While it may be technically feasible to construct a CO₂ pipeline, considerations regarding the land use and availability need to be made. The closest operating CO₂ sequestration project site to the facility is the Citronelle oil field, located east of Citronelle, Alabama and approximately 255 miles from the Decatur Steel Mill. It is not plausible to consider the Decatur Steel Mill responsible for the construction of a major pipeline for that considerable distance. Therefore, CCS is considered technically infeasible for this application and will not be considered any further in this BACT analysis.

(2) Good Design and Operating Practices - As the baseline of most analyses, pollutant formation can be most cost-effectively minimized by good design and proper operation. Within combustion units, operators can control the localized peak combustion temperature and combustion stoichiometry to achieve efficient fuel combustion. Good design can include minimizing the energy loss by providing sufficient insulation to the combustion units and associated duct work.

For the purposes of this GHG control technology assessment, it is important to note that good operating practices includes periodic maintenance by abiding by an operations and maintenance (O&M) plan. Maintaining the combustion units to the designed combustion efficiency and operating parameters is important for compliance on energy efficiency related requirements.

Step 3: Rank Remaining Control Technologies by Control Effectiveness

Since only a single control option was ascertained to be technically feasible, no ranking of control alternatives has been provided.

Step 4: Evaluate the Most Effective Controls and Document Results

Use of high efficiency burners, fueled by natural gas and employing good combustion/operating practices are the remaining control technologies and represent the base case. The only option remaining is good design and operating practices.

Step 5: Select BACT

The Decatur Steel Mill proposes a CO₂e BACT of 61,842 tpy for the new galvanizing line. The proposed emission limits are based on the proposed maximum heat capacity and the established emission factors⁵.

⁵ 40 CFR 98 Subpart C, Tables C-1 and C-2

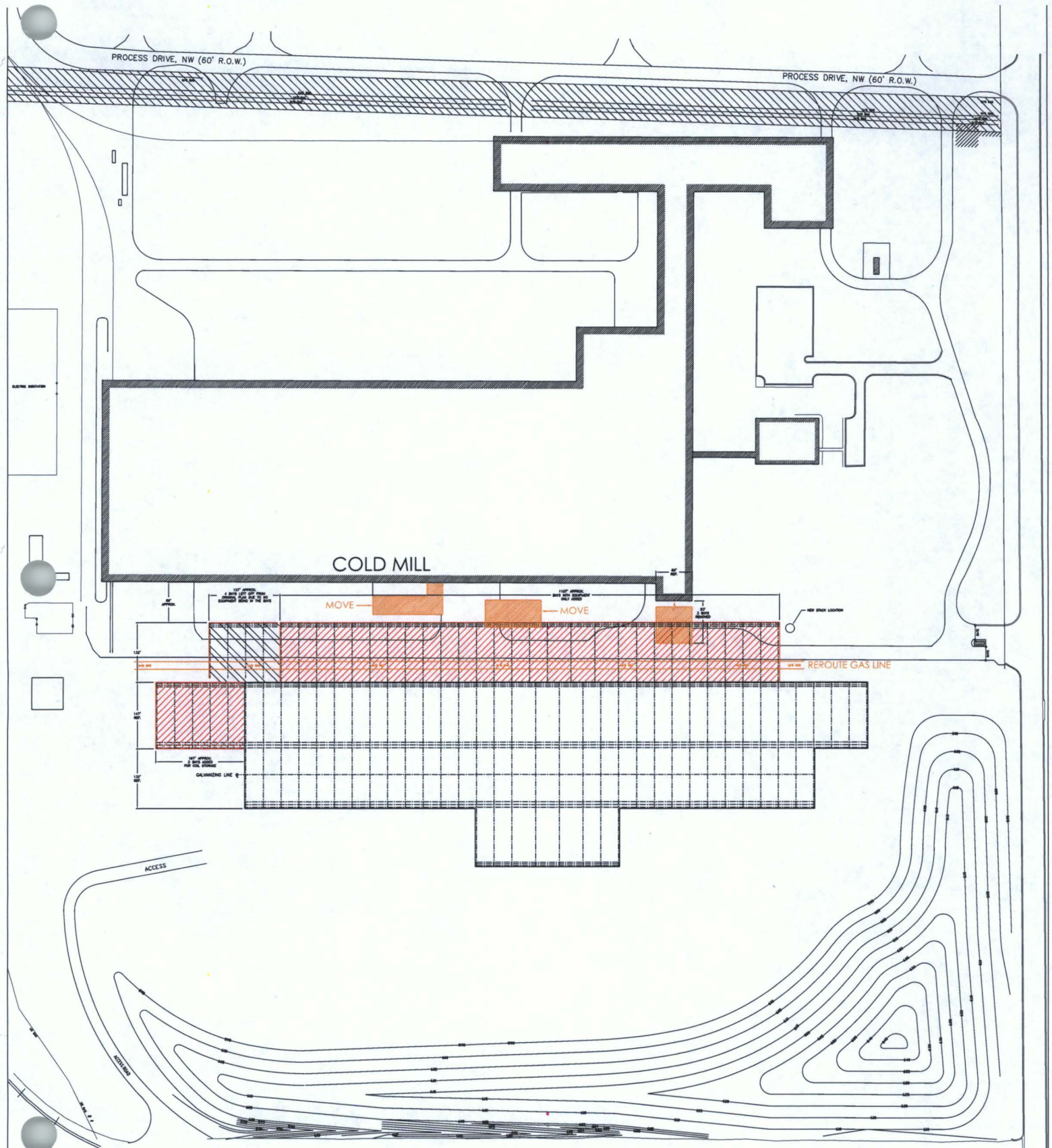
APPENDIX A












PLOT PLANS AND PROCESS FLOW DIAGRAMS

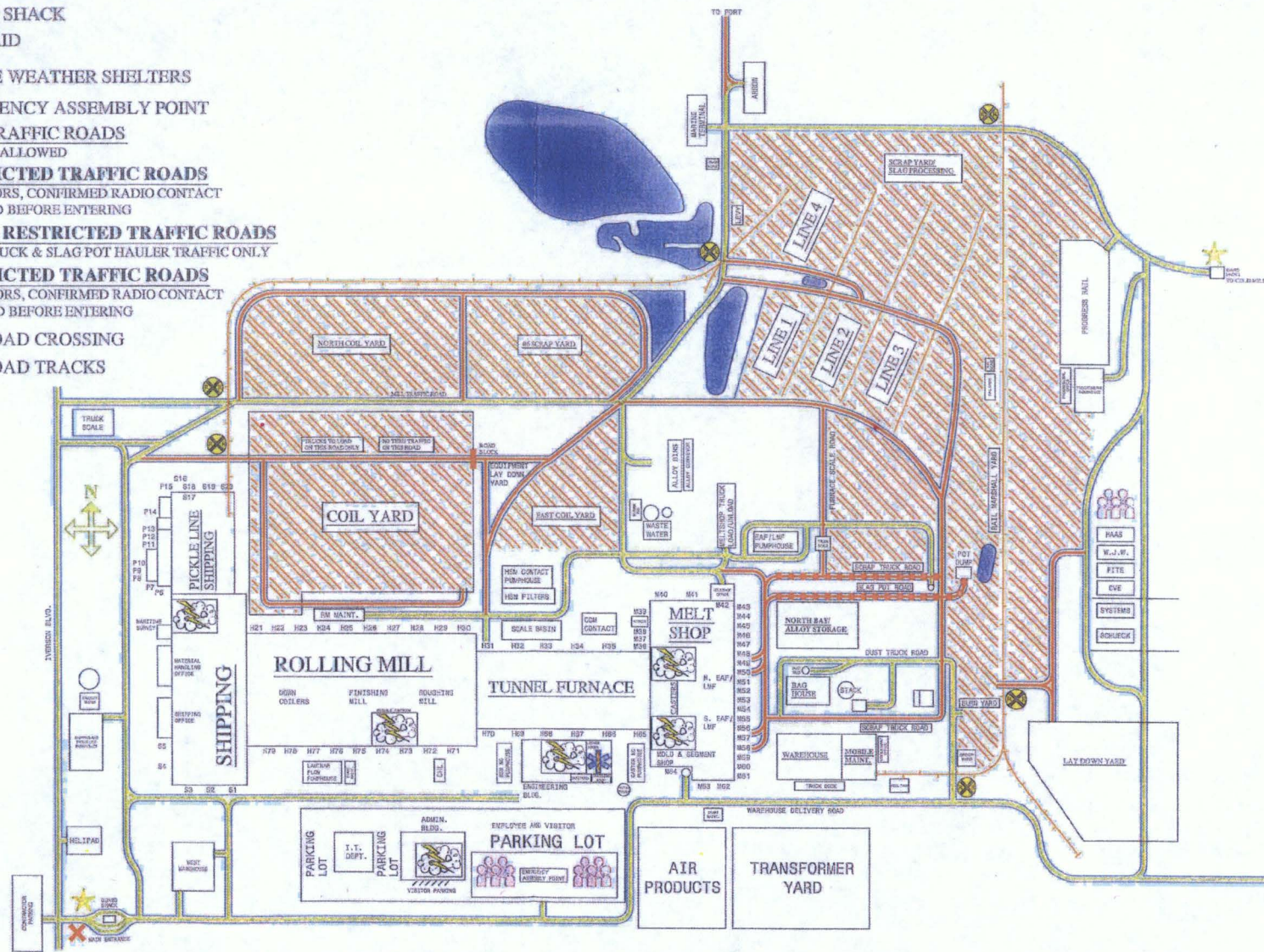
Prevention of Significant Deterioration and Title V Permits Significant Modification Application

Nucor Steel Decatur, LLC
4301 Iverson Blvd
Trinity, AL 35673

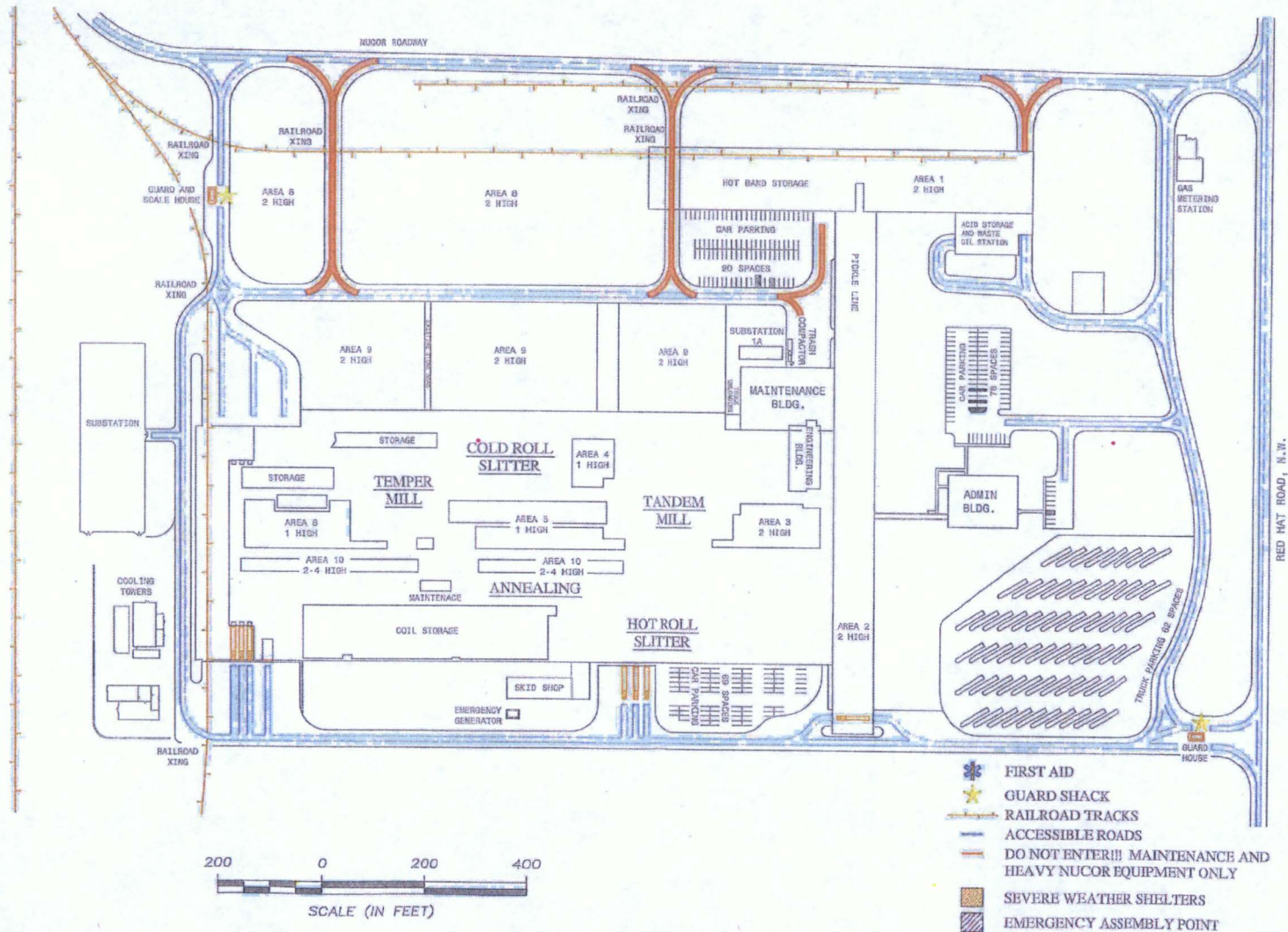
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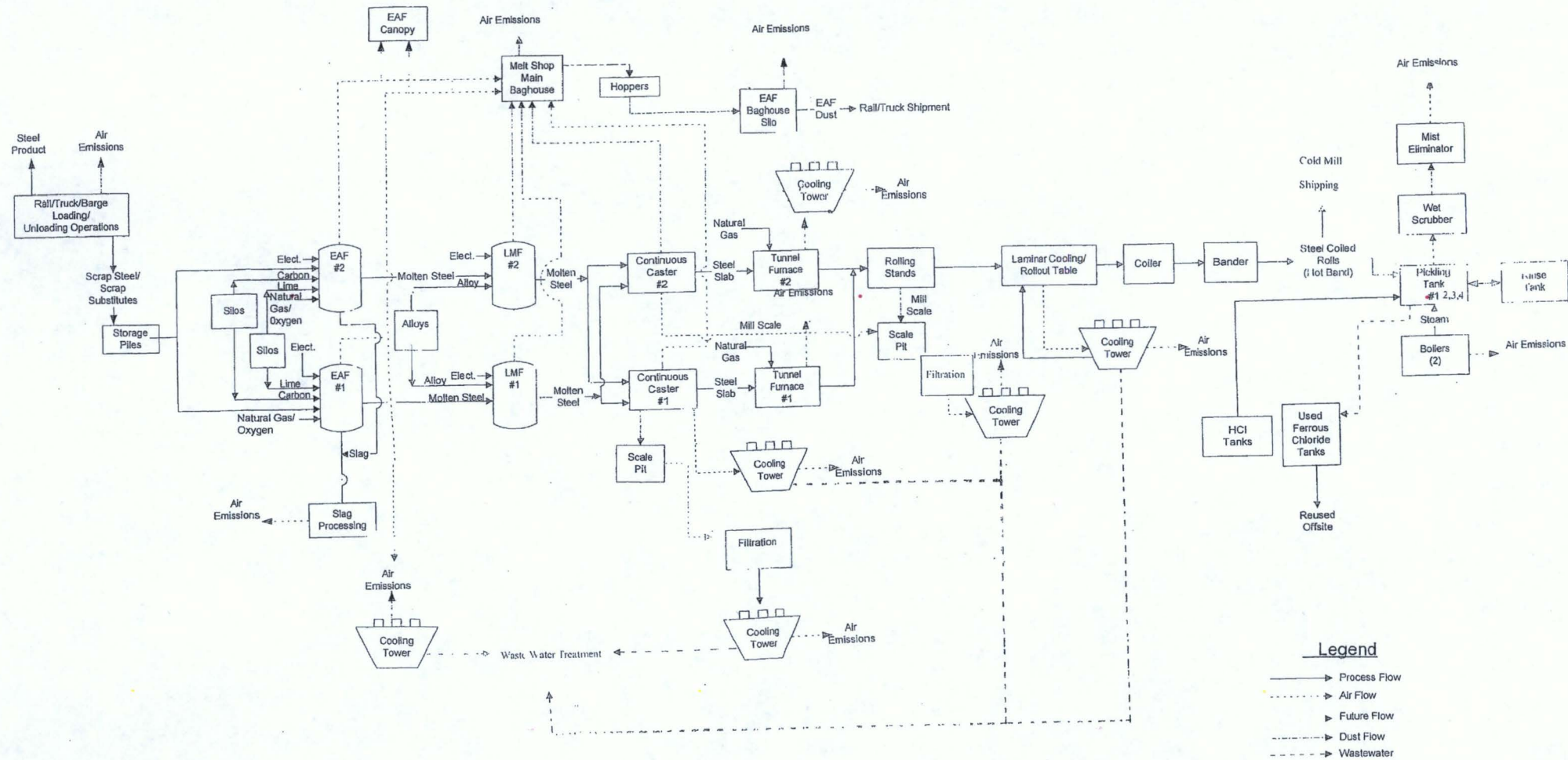
-  **YOU ARE HERE**
-  **GUARD SHACK**
-  **FIRST AID**
-  **SEVERE WEATHER SHELTERS**
-  **EMERGENCY ASSEMBLY POINT**
-  **MILL TRAFFIC ROADS**
VISITORS ALLOWED
-  **RESTRICTED TRAFFIC ROADS**
NO VISITORS, CONFIRMED RADIO CONTACT
REQUIRED BEFORE ENTERING
-  **TOTAL RESTRICTED TRAFFIC ROADS**
SCRAP TRUCK & SLAG POT HAULER TRAFFIC ONLY
-  **RESTRICTED TRAFFIC ROADS**
NO VISITORS, CONFIRMED RADIO CONTACT
REQUIRED BEFORE ENTERING
-  **RAILROAD CROSSING**
-  **RAILROAD TRACKS**



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Hot Process Flow



APPENDIX B

ADEM APPLICATION FORMS

Prevention of Significant Deterioration and Title V Permits Significant Modification Application

Nucor Steel
4301 Iverson Blvd
Trinity, AL 35673

November 2018

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT (AIR DIVISION)

Facility Number

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CONSTRUCTION/OPERATING PERMIT APPLICATION
FACILITY IDENTIFICATION FORM

1. Name of Facility, Firm, or Institution: Nucor Steel Decatur, LLC

Facility Physical Location Address

Street & Number: 4301 Iverson Boulevard

City: Trinity County: Morgan Zip: 35673

Facility Mailing Address (If different from above)

Address or PO Box: P.O. Box 2249

City: Decatur State: AL Zip: 35673

Owner's Business Mailing Address

2. Owner: Same as facility mailing address

Street & Number: City:

State: Zip: Telephone:

Responsible Official's Business Mailing Address

3. Responsible Official: Michael D. Lee Title: Vice President and General Manager

Street & Number: 4301 Iverson Boulevard

City: Trinity State: AL Zip: 35673

Telephone Number: 256-301-3500 E-mail Address: mike.lee@nucor.com

Plant Contact Information

4. Plant Contact: Brian Avery Title: Environmental Manager

Telephone Number: 256-301-3508 E-mail Address: brian.avery@nucor.com

5. Location Coordinates:

UTM 492.217 E-W 3832.656 N-S

Latitude/Longitude LAT LONG

6. Permit application is made for:

- ☐ Existing source (initial application)
☒ Modification
☐ New source (to be constructed)
☐ Change of ownership
☐ Change of location
☐ Other (specify) _____

Existing source (permit renewal)

If application is being made to construct or modify, please provide the name and address of installer or contractor

_____ Telephone _____

Date construction/modification to begin _____ to be completed _____

7. Permit application is being made to obtain the following type permit:

- ☒ Air permit
☐ Major source operating permit
☐ Synthetic minor source operating permit
☐ General permit

8. Indicate the number of each of the following forms attached and made a part of this application: (if a form does not apply to your operation indicate "N/A" in the space opposite the form). Multiple forms may be used as required.

- 1 _____ ADEM 104 - INDIRECT HEATING EQUIPMENT
1 _____ ADEM 105 - MANUFACTURING OR PROCESSING OPERATION
_____ ADEM 106 - REFUSE HANDLING, DISPOSAL, AND INCINERATION
_____ ADEM 107 - STATIONARY INTERNAL COMBUSTION ENGINES
_____ ADEM 108 - LOADING, STORAGE & DISPENSING LIQUID & GASEOUS ORGANIC COMPOUNDS
_____ ADEM 109 - VOLATILE ORGANIC COMPOUND SURFACE COATING EMISSION SOURCES
3 _____ ADEM 110 - AIR POLLUTION CONTROL DEVICE
_____ ADEM 112 - SOLVENT METAL CLEANING
_____ ADEM 438 - CONTINUOUS EMISSION MONITORS
_____ ADEM 437 - COMPLIANCE SCHEDULE

9. General nature of business: (describe and list appropriate standard industrial classification (SIC) and North American Industry Classification System (NAICS) (www.naics.com) code(s)):

Steel Mill (3312; 331111)

10. For those making application for a synthetic minor or major source operating permit, please summarize each pollutant emitted and the emission rate for the pollutant. Indicate those pollutants for which the facility is major.

Regulated pollutant	Potential Emissions* (tons/year)	Major source? yes/no
NOx		
PM10		
PM2.5		
SO2		
CO		
VOC		
Lead		
HCl		
CO2e		
See Table 1.0 in permit application, emissions associated with modification		

*Potential emissions are either the maximum allowed by the regulations or by permit, or, if there is no regulatory limit, it is the emissions that occur from continuous operation at maximum capacity.

11. For those applying for a major source operating permit, indicate the compliance status by program for each emission unit or source and the method used to determine compliance. Also cite the specific applicable requirement.

Emission unit or source: _____
(description)

Emission Point No.	Pollutant ⁴	Standard	Program ¹	Method used to determine compliance	Compliance Status	
					IN ²	OUT ³

¹PSD, non-attainment NSR, NSPS, NESHAP (40 CFR Part 61), NESHAP (40 CFR Part 63), accidental release (112(r)),SIP regulation, Title IV, Enhanced Monitoring, Title VI, Other (specify)

²Attach compliance plan

³Attach compliance schedule (ADEM Form-437)

⁴Fugitive emissions must be included as separate entries

- [illegible]

13. List and explain any exemptions from applicable requirements the facility is claiming:

a.

b.

c.

d.

e.

f.

g.

h.

i.

14. List below other attachments that are a part of this application (all supporting engineering calculations must be appended):

a. Air Permit Application Forms

b. Emission Rate Calculations

c. Process Flow Diagrams

d. Plot Plan and Site Location Maps

e. Modeling Report - Class I (including CD with model input/output)

f. Modeling Report - Class II & Toxics (including CD with model input/output)

g.

h.

i.

I CERTIFY UNDER PENALTY OF LAW THAT, BASED ON INFORMATION AND BELIEF FORMED AFTER REASONABLE INQUIRY, THE STATEMENTS AND INFORMATION CONTAINED IN THIS APPLICATION ARE TRUE, ACCURATE AND COMPLETE.

I ALSO CERTIFY THAT THE SOURCE WILL CONTINUE TO COMPLY WITH APPLICABLE REQUIREMENTS FOR WHICH IT IS IN COMPLIANCE, AND THAT THE SOURCE WILL, IN A TIMELY MANNER, MEET ALL APPLICABLE REQUIREMENTS THAT WILL BECOME EFFECTIVE DURING THE PERMIT TERM AND SUBMIT A DETAILED SCHEDULE, IF NEEDED FOR MEETING THE REQUIREMENTS.

SIGNATURE OF RESPONSIBLE OFFICIAL

TITLE

DATE

**PERMIT APPLICATION
FOR
INDIRECT HEATING EQUIPMENT
(FUEL BURNING EQUIPMENT)**

			-				-			
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1. **Name of firm or organization:** Nucor Steel Decatur LLC

2. **Unit Description (i.e. No. 1 Power Boiler):** Galvanizing Line #2

Equipment manufacturer's information

Name of manufacturer: _____

Model number: _____

Rated capacity-input: 120.0 (Btu/hr.)

Boiler type: ☐ Fire tube ☐ Water tube ☐ other(specify): _____

Manufactured date: _____

Proposed installation date: _____

Original installation date (if existing): _____

Reconstruction or Modification date (if applicable): _____

3. **Type of fuel used:**

Primary:

Fuel	Heat Content	Units	Max. % Sulfur	Max. % Ash	Grade No. [fuel oil only]	Supplier [used oil only]
Coal		Btu/lb				
Fuel Oil		Btu/gal				
Natural Gas	1020	Btu/ft ³				
L. P. Gas		Btu/ft ³				
Wood		Btu/lb				
Other (specify)						

Standby:

Fuel	Heat Content	Units	Max. % Sulfur	Max. % Ash	Grade No. [fuel oil only]	Supplier [used oil only]
Coal		Btu/lb				
Fuel Oil		Btu/gal				
Natural Gas		Btu/ft ³				
L. P. Gas		Btu/ft ³				
Wood		Btu/lb				
Other (specify)						

4. Purpose (if multipurpose, note percent in each use category):

☐ Space heat _____ % ☐ Power generation _____ % ☒ Process heat ¹⁰⁰ _____ %

Other (specify): _____

5. Normal schedule of operation:

Hours per day: ²⁴ _____ Days per week: ⁷ _____ Weeks per year: ⁵² _____

6. For each regulated pollutant, describe any limitations on source operation which affects emissions or any work practice standard (attach additional page if necessary):

None

7. Fugitive Emissions (attach calculation worksheets):

POLLUTANT	POTENTIAL EMISSIONS		BASIS OF CALCULATION	REGULATORY EMISSION LIMIT (lb/hr)	REGULATORY EMISSION LIMIT (in units of standard)
	lb/hr	t/yr			
Particulate					
Sulfur dioxide					
Nitrogen oxides					
Carbon monoxide					
VOC's					
Other					

8. Is there any emission control equipment on this emission source?

☒ Yes ☐ No (If "yes", complete ADEM Form 110)

9. Point Emissions (attach calculation worksheets):

POLLUTANT	POTENTIAL EMISSIONS		BASIS OF CALCULATION	REGULATORY EMISSION LIMIT (lb/hr)	REGULATORY EMISSION LIMIT (in units of standard)
	lb/hr	t/yr			
Particulate	0.89	3.92	AP-42		
Sulfur dioxide	0.07	0.31	AP-42		
Nitrogen oxides	8.04	35.22	Vendor guarantee		
Carbon monoxide	0.99	4.33	AP-42		
VOC's	0.06	0.28	AP-42		
Other					

10. Stack data:

UTM Coordinate (E-W) 493.2084 (km)

UTM Coordinate (N-S) 3832.9010 (km)

Height above grade 248 (feet)

Gas temperature at exit 340 (°F)

Inside diameter at exit 5.9 (feet)

Volume of gas discharged 34,450 (ACFM)

Base Elevation 584 (feet)

Are sampling ports available? ☒ Yes ☐ No (If "yes", describe. Draw on separate sheet if necessary):

11. Is this item in compliance with all applicable air pollution rules and regulations?

☒ Yes ☐ No (if "no", a compliance schedule, ADEM Form 437, must be attached.)

Name of person preparing application: Brad Arnold

Signature: *Brad Arnold* Date: October 30, 2018

**PERMIT APPLICATION
FOR
MANUFACTURING OR PROCESSING OPERATION**

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Do not write in this space

1. Name of firm or organization: Nucor Steel Decatur LLC

2. Briefly describe the operation of this unit or process in your facility: (separate forms are to be submitted for each type of process or for multiple units of one process type. If the unit or process receives input material from, or provides input material to, another operation, please indicate the relationship between the operations.) An application should be completed for each alternative operating scenario.

Operating scenario number _____

EAFs, LMFs, and Casters

Melt shop operations will exhaust to melt shop baghouses

3. Type of unit or process (e.g., calcining kiln, cupola furnace): _____

EAGs, LMFs, and Casters

Make: _____ Model: _____

Rated process capacity (manufacturer's or designer's guaranteed maximum) in pounds/hour: _____

Manufactured date: _____ Proposed installation date: _____

Original installation date (if existing): _____

Reconstruction or Modification date (if applicable): _____

4. Normal operating schedule:

Hours per day: 24 Days per week: 7 Weeks per year: 52

Peak production season (if any): _____

5. Materials (feed input) used in unit or process (include solid fuel materials used, if any):

Material	Process Rate Average (lb/hr)	Maximum (lb/hr)	Quantity tons/year
scrap, HBI, DRI, carbon, alloy additives			

6. Total heat input capacity of process heating equipment (exclude fuel used by indirect heating equipment previously described on ADEM Form 104): _____ MMBtu/hr

Fuel	Heat Content	Units	Max. % Sulfur	Max. % Ash	Grade No. [fuel oil only]	Supplier [used oil only]
Coal		Btu/lb				
Fuel Oil		Btu/gal				
Natural Gas		Btu/ft ³				
L. P. Gas		Btu/ft ³				
Wood		Btu/lb				
Other (specify)						

7. Products of process or unit:

Products	Quantity/year	Units of production
liquid steel	3,600,000 tons	

8. For each regulated pollutant, describe any limitations on source operation which affects emissions or any work practice standard (attach additional page if necessary):

Request permit limit of 3.6 million tons/year production.

11. Air contaminants emitted: Basis of estimate (material balance, stack test, emission factor, etc.) must be clearly indicated on calculations appended to this form. Fugitive emissions must be included and calculations must be appended.

Emission Point	Pollutants	Potential Emissions		Basis of Calculation	Regulatory Emission Limit	
		(lb/hr)	(Tons/yr)		(lb/hr)	(units of standard)
01	PM (filterable)	49.0	215	BACT		
01	PM10/PM2.5 (filt. & cond.)	49.0	215	BACT		
01 & 02	NOx	227	756	BACT		
01 & 02	SO2	189	630	BACT		
01 & 02	CO	1,242	4,140	BACT		
01 & 02	VOC	70.2	234	BACT		
01 & 02	Pb	1.08	3.60	BACT		
02	PM (filterable)	49.0	215	BACT		
02	PM10/PM2.5 (filt. & cond.)	49.0	215	BACT		

12. Using a flow diagram:

- (1) Illustrate input of raw materials,
- (2) Label production processes, process fuel combustion, process equipment and air pollution control equipment,
- (3) Illustrate locations of air contaminant release so that emission points under item 10 can be identified.

☐ (Check box if extra pages are attached)
Process flow diagram



ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

PERMIT APPLICATION

FOR

AIR POLLUTION CONTROL DEVICE

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(ADEM Use Only)

1. Name of firm or organization

Nucor Steel Decatur LLC *

2. Type of pollution control device: (if more than one, check each; however, separate forms are to be submitted for each specific device.)

- | | |
|---|---|
| <input type="checkbox"/> Settling chamber | <input type="checkbox"/> Electrostatic precipitator |
| <input type="checkbox"/> Afterburner | <input checked="" type="checkbox"/> Baghouse |
| <input type="checkbox"/> Cyclone | <input type="checkbox"/> Multiclone |
| <input type="checkbox"/> Absorber | <input type="checkbox"/> Adsorber |
| <input type="checkbox"/> Condenser | <input type="checkbox"/> Wet Suppression |

Wet scrubber (kind):

Stage 1 - Vapor balance (type):

Other (describe):

3. Control device manufacturer's information:

Name of manufacturer

Model No.

4. Emission source to which device is installed or is to be installed:

Meltshop - Baghouse 01

5. Emission parameters:

	Pollutants Removed		
	Pollutant #1	Pollutant #2	Pollutant #3
	PM (filterable)		
Mass emission rate (#/hr)			
Uncontrolled	approx. 0.6 gr/dscf		
Designed			
Manufacturer's guaranteed	0.0018 gr/dscf		
Mass emission rate (Expressed as units of standard)			
Required by regulation	0.0018 gr/dscf		
Manufacturer's guaranteed	0.0018 gr/dscf		
Removal efficiency (%)			
Designed	99%+		
Manufacturer's guaranteed			

6. Gas conditions:

	Inlet	Intermediate Locations	Outlet
Volume (SDCFM, 68°F, 29.92" hg)			1,100,000
(ACFM, existing conditions)			1,500,000
Temperature (°F)			250
Velocity (ft/sec)			47.1
Percent moisture			3.8

Pressure drop across device: 4-16 (inches H₂O)

7. Stack dimensions:

UTM Coordinates (E-W)..... 492.1688 (km)
 UTM Coordinates (N-S)..... 3832.8658 (km)
 Height above grade 150 (feet)
 Inside diameter at exit (if opening is round)..... 26 (feet)
 Inside area at exit (if opening is not round) (sq. feet)
 Base Elevation..... 584 (feet)
 GEP Stack Height (feet)

8. Provide a flow diagram which includes gas exit from process, each control device, location of by-pass, fan or blower, each emission point, exits for collected pollutants, and location of sampling ports.

9. Enclosed are:

- | | |
|--|--|
| <input type="checkbox"/> Blueprints | <input type="checkbox"/> Particle size distribution report |
| <input type="checkbox"/> Manufacturer's literature | <input type="checkbox"/> Size-efficiency curves |
| <input type="checkbox"/> Emissions test of existing installation | <input type="checkbox"/> Fan curves |
| <input type="checkbox"/> Other _____ | |

10. If the pollution control device is of unusual design, please provide a sketch of the device.

11. List below the important operating parameters for the device. (For example: air/cloth ratio and fabric type, weight, and weave for baghouse; throat velocity and water use rate for a venturi scrubber; etc.)

cloth area = 46,312 ft²

total cloth area = 694,680 ft²

2.2:1 air to cloth ratio

12. By-pass (if any) is to be used when:

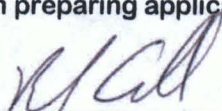
13. Disposal of collected air pollutants:

	Solid waste	Solid waste	Liquid waste	Liquid waste
Volume	1,300 tons	500 tons	N/A	N/A
Composition				
Is waste hazardous?	KO61	no		
Method of disposal	shipped offsite	shipped offsite		
Final destination				

If collected air pollutants are recycled, describe:

Name of person preparing application Brad Arnold

Signature



Date October 30, 2018



ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

PERMIT APPLICATION

FOR

AIR POLLUTION CONTROL DEVICE

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(ADEM Use Only)

1. Name of firm or organization

Nucor Steel Decatur LLC

2. Type of pollution control device: (if more than one, check each; however, separate forms are to be submitted for each specific device.)

- | | |
|---|---|
| <input type="checkbox"/> Settling chamber | <input type="checkbox"/> Electrostatic precipitator |
| <input type="checkbox"/> Afterburner | <input checked="" type="checkbox"/> Baghouse |
| <input type="checkbox"/> Cyclone | <input type="checkbox"/> Multiclone |
| <input type="checkbox"/> Absorber | <input type="checkbox"/> Adsorber |
| <input type="checkbox"/> Condenser | <input type="checkbox"/> Wet Suppression |

Wet scrubber (kind):

Stage 1 - Vapor balance (type):

Other (describe):

3. Control device manufacturer's information:

Name of manufacturer

Model No.

4. Emission source to which device is installed or is to be installed:

Meltshop - Baghouse 02

5. Emission parameters:

	Pollutants Removed		
	Pollutant #1	Pollutant #2	Pollutant #3
	PM (filterable)		
Mass emission rate (#/hr)			
Uncontrolled	approx. 0.6 gr/dscf		
Designed			
Manufacturer's guaranteed	0.0018 gr/dscf		
Mass emission rate (Expressed as units of standard)			
Required by regulation	0.0018 gr/dscf		
Manufacturer's guaranteed	0.0018 gr/dscf		
Removal efficiency (%)			
Designed	99%+		
Manufacturer's guaranteed			

6. Gas conditions:

	Inlet	Intermediate Locations	Outlet
Volume (SDCFM, 68°F, 29.92" hg)			1,100,000
(ACFM, existing conditions)			1,500,000
Temperature (°F)			250
Velocity (ft/sec)			68.3
Percent moisture			3.8

Pressure drop across device: 4-16 (inches H₂O)

7. Stack dimensions:

UTM Coordinates (E-W)..... 492.2992 (km)
 UTM Coordinates (N-S)..... 3832.8317 (km)
 Height above grade 150.5 (feet)
 Inside diameter at exit (if opening is round)..... 21.75 (feet)
 Inside area at exit (if opening is not round) (sq. feet)
 Base Elevation..... 584 (feet)
 GEP Stack Height (feet)

8. Provide a flow diagram which includes gas exit from process, each control device, location of by-pass, fan or blower, each emission point, exits for collected pollutants, and location of sampling ports.

9. Enclosed are:

- | | |
|--|--|
| <input type="checkbox"/> Blueprints | <input type="checkbox"/> Particle size distribution report |
| <input type="checkbox"/> Manufacturer's literature | <input type="checkbox"/> Size-efficiency curves |
| <input type="checkbox"/> Emissions test of existing installation | <input type="checkbox"/> Fan curves |
| <input type="checkbox"/> Other _____ | |

10. If the pollution control device is of unusual design, please provide a sketch of the device.

11. List below the important operating parameters for the device. (For example: air/cloth ratio and fabric type, weight, and weave for baghouse; throat velocity and water use rate for a venturi scrubber; etc.)

cloth area = 46,312 ft²

total cloth area = 694,680 ft²

2.2:1 air to cloth ratio

12. By-pass (if any) is to be used when:

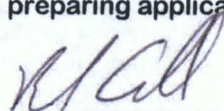
13. Disposal of collected air pollutants:

	Solid waste	Solid waste	Liquid waste	Liquid waste
Volume	1,300 tons	500 tons	N/A	N/A
Composition				
Is waste hazardous?	KO61	no		
Method of disposal	shipped offsite	shipped offsite		
Final destination				

If collected air pollutants are recycled, describe:

Name of person preparing application Brad Arnold

Signature



Date October 30, 2018



ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
PERMIT APPLICATION
FOR
AIR POLLUTION CONTROL DEVICE

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(ADEM Use Only)

1. Name of firm or organization Nucor Steel Decatur
2. Type of pollution control device: (if more than one, check each; however, separate forms are to be submitted for each specific device.)
- ☐ Settling chamber ☐ Electrostatic precipitator
☐ Afterburner ☐ Baghouse
☐ Cyclone ☐ Multiclone
☐ Absorber ☐ Adsorber
☐ Condenser ☐ Wet Suppression
- Wet scrubber (kind): SCR
- Stage 1 - Vapor balance (type): _____
- Other (describe): _____
3. Control device manufacturer's information:
- Name of manufacturer TBD Model No. _____
4. Emission source to which device is installed or is to be installed:
- Galvanizing Line

5. Emission parameters:

	Pollutants Removed		
	Pollutant #1	Pollutant #2	Pollutant #3
	NOx		
Mass emission rate (#/hr)			
Uncontrolled	80.4		
Designed	8.04		
Manufacturer's guaranteed	N/A		
Mass emission rate (Expressed as units of standard)			
Required by regulation			
Manufacturer's guaranteed			
Removal efficiency (%)			
Designed	90%		
Manufacturer's guaranteed			

6. Gas conditions:

	Inlet	Intermediate Locations	Outlet
Volume (SDCFM, 68°F, 29.92" hg)			
(ACFM, existing conditions)			34,450
Temperature (°F)			340
Velocity (ft/sec)			21
Percent moisture			

Pressure drop across device: _____ (inches H₂O)

7. Stack dimensions:

UTM Coordinates (E-W)..... 493.2084 (km)
 UTM Coordinates (N-S)..... 3832.9010 (km)
 Height above grade 248 (feet)
 Inside diameter at exit (if opening is round)..... 5.9 (feet)
 Inside area at exit (if opening is not round) (sq. feet)
 Base Elevation..... 584 (feet)
 GEP Stack Height (feet)

8. Provide a flow diagram which includes gas exit from process, each control device, location of by-pass, fan or blower, each emission point, exits for collected pollutants, and location of sampling ports.

9. Enclosed are:

- | | |
|--|--|
| <input type="checkbox"/> Blueprints | <input type="checkbox"/> Particle size distribution report |
| <input type="checkbox"/> Manufacturer's literature | <input type="checkbox"/> Size-efficiency curves |
| <input type="checkbox"/> Emissions test of existing installation | <input type="checkbox"/> Fan curves |
| <input type="checkbox"/> Other _____ | |

10. If the pollution control device is of unusual design, please provide a sketch of the device.

11. List below the important operating parameters for the device. (For example: air/cloth ratio and fabric type, weight, and weave for baghouse; throat velocity and water use rate for a venturi scrubber; etc.)

Water recirculation rate of 15 - 30 gpm, air pressure differential across scrubber media of 2" - 6" water column, temperature of less than 120° F

12. By-pass (if any) is to be used when:

N/A

13. Disposal of collected air pollutants:

	Solid waste	Solid waste	Liquid waste	Liquid waste
Volume				
Composition				
Is waste hazardous?				
Method of disposal				
Final destination				

If collected air pollutants are recycled, describe:

Scrubber blowdown is used as make-up for pickling solution.

Name of person preparing application Brad Arnold

Signature

Brad Arnold

Date October 30, 2018

APPENDIX C

EMISSIONS CALCULATIONS

Prevention of Significant Deterioration and Title V Permits Significant Modification Application

Nucor Steel
4301 Iverson Blvd
Trinity, AL 35673

November 2018

Emission Point Source Calculations

Emission Point Identifier: Meltshop
Description: Meltshop Current

Inputs

Description	Value	Units
Current Actal Annual Steel Projection ¹	2,565,135	ton/yr
Current Maximum Potential Hourly Steel Projection ¹	440	tph
Meltshop Baghouses Volumetric Throughput ²	1,971,188	dscfm
Meltshop Baghouse Hours of Operation ²	8,760	hr/yr
NOx Emission Factor ³	0.26	lb/ton
SO2 Emission Factor ³	0.082	lb/ton
CO Emission Factor ³	1.90	lb/ton
VOC Emission Factor ³	0.074	lb/ton
Lead Emission Factor ³	5.50E-05	lb/ton
CO2 Emission Factor ⁴	280	lb/ton
PM Emission Factor ⁵	0.0052	gr/dscf

1. Maximum steel production for 10 year lookback period, July 2013 - June 2015.

2. Tested average throughput of the baghouses from March 2016 stack test report. (North Baghouse avg. 1,105,697 dscfm; South Baghouse avg. 865,491 dscfm)

3. Average tested emission factor from December 2016 tests.

4. Established CO2 emission factor the Nucor Decatur's EAF from 2015 PSD application through CEMS data.

5. Baghouse designed grain loading.

Emissions Summary

Pollutant	Hourly Emission Rate (lb/hr)	Annual Emission Rate (tpy)
TSP	87.9	385
PM ₁₀	87.9	385
PM _{2.5}	87.9	385
NOx	114	333
SO ₂	36	105
CO	836	2,437
VOC	32.6	95
Lead (Pb)	0.024	0.071
CO ₂ e ¹	123,200	359,119

1. Global Warming Potentials from 40 CFR 98 Subpart A, Table A-1

Calculate Emissions

Pollutant	Emission Factor	Volumetric Throughput	Hourly Emission Rate ¹	Annual Emission Rate
	gr/dscf	dscfm	(lb/hr)	(tons/yr)
TSP	0.0052	1,971,188	87.86	384.82
PM ₁₀	0.0052	1,971,188	87.86	384.82
PM _{2.5}	0.0052	1,971,188	87.86	384.82

1. Emission rate (lb/hr) = Volumetric Throughput (dscfm) * Emission Factor (gr/dscf) * 60 min/hr * 1 lb/7,000 gr

Pollutant	Emission Factor	Hourly Emission Rate	Annual Emission Rate
	lb/ton	(lb/hr)	(tons/yr)
NOx	0.26	114	333
SO2	0.08	36	105
CO	1.90	836	2,437
VOC	0.074	32.6	95
Lead (Pb)	5.50E-05	0.024	0.07
CO2e	280	123,200	359,119

Emission Point Source Calculations

Emission Point Identifier: Meltshop
Description: Meltshop Current

Inputs

Description	Value	Units
Future Maximum Potential Annual Steel Projection ¹	3,600,000	ton/yr
Future Maximum Potential Hourly Steel Projection ¹	540	tph
Meltshop Baghouse Volumetric Throughput ²	2,200,000	dscfm
Meltshop Baghouse Hours of Operation ²	8,760	hr/yr
NOx Emission Factor ³	0.42	lb/ton
SO2 Emission Factor ³	0.35	lb/ton
CO Emission Factor ³	2.30	lb/ton
VOC Emission Factor ³	0.13	lb/ton
Lead Emission Factor ³	0.002	lb/ton
CO2 Emission Factor ⁴	280	lb/ton
PM Emission Factor ^{3,5}	0.0052	gr/dscf

1. Projected future maximum annual and hourly throughput.
2. Baghouse designed maximum volumetric throughput.
3. BACT Emission rates.
4. Established CO2 emission factor the Nucor Decatur's EAF from 2015 PSD application through CEMS data.
5. PM emission rates are based on a factor of 0.0018 gr/dscf for filterable and 0.0034 gr/dscf for condensable.

Emissions Summary

Pollutant	Hourly Emission Rate (lb/hr)	Annual Emission Rate (tpy)
TSP	98.1	429
PM ₁₀	98.1	429
PM _{2.5}	98.1	429
NOx	227	756
SO ₂	189	630
CO	1242	4,140
VOC	70.2	234
Lead (Pb)	1.080	3.600
CO ₂ e ¹	151,200	504,000

1. Global Warming Potentials from 40 CFR 98 Subpart A, Table A-1

Calculate Emissions

Pollutant	Emission Factor gr/dscf	Volumetric Throughput dscfm	Hourly Emission Rate ¹ (lb/hr)	Annual Emission Rate (tons/yr)
TSP	0.0052	2,200,000	98.1	429
PM ₁₀	0.0052	2,200,000	98.1	429
PM _{2.5}	0.0052	2,200,000	98.1	429

1. Emission rate (lb/hr) = Volumetric Throughput (dscfm) * Emission Factor (gr/dscf) * 60 min/hr * 1 lb/7,000 gr

Pollutant	Emission Factor lb/ton	Hourly Emission Rate ³ (lb/hr)	Annual Emission Rate (tons/yr)
NOx	0.42	227	756
SO2	0.35	189	630
CO	2.30	1242	4,140
VOC	0.130	70.2	234
Lead (Pb)	2.00E-03	1.080	3.60
CO ₂ e	280	151,200	504,000

Emission Point Source Calculations

Emission Point Identifier: TBD
Description: New Galv Line

Inputs

Description	Value	Units
Annual Hours of Operation	8,760	hr/yr
Normal Natural Gas Heating Value (LHV) ¹	1,020	Btu/scf
Annealing Furnace and Auxiliary Burner Firing Rate	120	MMBtu/hr
PM Emission Factor ²	7.6	lb/MMscf
NO _x Uncontrolled Emission Factor ³	0.67	lb/MMBtu
CO Emission Factor ⁴	84	lb/MMscf
SO ₂ Emission Factor ⁴	0.6	lb/MMscf
VOC Emission Factor ⁴	5.5	lb/MMscf
SCR Control Efficiency ⁵	90%	%
Lead Emission Factor	0.000271	lb/MMscf

1. Lower Heating Value (LHV) is based on AP-42 Table 1.4-1 footnote.
2. The PM Emission Factor includes both Filterable and Condensable PM. Per AP-42 Chapter 1.4: *Combustion of Natural Gas*, assume all PM <1 micrometer in diameter.
3. NO_x uncontrolled emission rate based on previous Galvanization Line BACT maximum allowed controlled emission rate (@ 90% control).
4. Emission factors from AP-42 Chapter 1.4 Tables 1.4-1 and 1.4-2
5. AP-42 3.2.4.2 Selective Catalytic Reduction, "SCR... can achieve efficiencies as high as 90 percent."

Emissions Summary

Pollutant	Average Emission Rate (lb/hr)	Annual Emission Rate (tpy)
TSP	0.89	3.92
PM ₁₀	0.89	3.92
PM _{2.5}	0.89	3.92
NO _x	8.04	35.22
SO ₂	0.07	0.31
CO	0.99	4.33
VOC	0.06	0.28
Lead (Pb)	0.000	0.000
CO ₂ e ¹	14,119	61,842

1. Global Warming Potentials from 40 CFR 98 Subpart A, Table A-1

Calculate Emissions

Pollutant	Emission Factor (lb/MMBtu)	Firing Rate (MMBtu/hr)	Hourly Emission Rate (lb/hr)	Annual Emission Rate (tons/yr)
TSP	0.007	120	0.89	3.92
PM ₁₀	0.007	120	0.89	3.92
PM _{2.5}	0.007	120	0.89	3.92
SO ₂	5.88E-04	120	0.07	0.31

Pollutant	Firing Rate (MMBtu/hr)	Emission Factor (lb/MMBtu)	Control Efficiency (%)	Hourly Emission Rate (lb/hr)	Annual Emission Rate (tons/yr)
CO	120	0.08	90%	0.99	4.33
NO _x	120	0.67	90%	8.04	35.22
VOC	120	0.005	90%	0.06	0.28
Lead (Pb)	120	2.66E-07	90%	0.000	0.000

GHG Emissions

Pollutant	Total NG Firing Rate	Emission Factor ¹	Hourly Emission Rate ²	Annual Emission Rate
	(MMBtu/hr)	(kg/MMBtu)	(lb/hr)	(tons/yr)
CO ₂	120	53.06	14,040	61,494
N ₂ O ³	120	1.00E-03	0.26	1.16
CH ₄	120	1.00E-04	0.03	0.12

1. Emission Factors from 40 CFR 98 Subpart C, Tables C-1 and C-2

HAP Emissions

Pollutant	Total NG Firing Rate	Emission Factor ¹	Hourly Emission Rate	Annual Emission Rate
	(MMBtu/hr)	(lb/MMBtu)	(lb/hr)	(tons/yr)
Benzene	120	2.06E-06	2.47E-04	1.08E-03
Dichlorobenzene	120	1.18E-06	1.41E-04	6.18E-04
Formaldehyde	120	7.35E-05	8.82E-03	3.86E-02
n-Hexane	120	1.76E-03	2.12E-01	9.28E-01
Naphthalene	120	5.98E-07	7.18E-05	3.14E-04
Toluene	120	3.33E-06	4.00E-04	1.75E-03
PAH	120	8.24E-08	9.88E-06	4.33E-05
Arsenic	120	1.96E-07	2.35E-05	1.03E-04
Barium	120	4.31E-06	5.18E-04	2.27E-03
Beryllium	120	1.18E-08	1.41E-06	6.18E-06
Cadmium	120	1.08E-06	1.29E-04	5.67E-04
Chromium	120	1.37E-06	1.65E-04	7.21E-04
Cobalt	120	2.94E-06	3.53E-04	1.55E-03
Copper	120	8.33E-07	1.00E-04	4.38E-04
Manganese	120	2.94E-06	3.53E-04	1.55E-03
Mercury	120	2.55E-07	3.06E-05	1.34E-04
Molybdenum	120	1.08E-06	1.29E-04	5.67E-04
Nickel	120	2.06E-06	2.47E-04	1.08E-03
Selenium	120	2.35E-08	2.82E-06	1.24E-05
Vanadium	120	2.25E-06	2.71E-04	1.19E-03
Zinc	120	2.84E-05	3.41E-03	1.49E-02

1. Emission factors from AP-42 Table 1.4-2 and 1.4-3.

Emission Point Source Calculations

Emission Point Identifier:

Description: EAF Fugitive Emissions

Inputs

Description	Value	Units
Current Actual Annual Steel Projection ¹	2,565,135	ton/yr
Future Maximum Potential Annual Steel Projection ²	3,600,000	ton/yr
Current Maximum Potential Hourly Steel Projection ¹	440	tph
Future Maximum Potential Hourly Steel Projection ²	540	tph
TSP Emission Factor ³	1.4	lb/ton
PM10 Speciation ³	58%	%
PM2.5 Speciation ³	43%	%
Baghouse Capture Efficiency ⁴	98%	%
PM Settlement Rate ⁵	50%	%

1. Maximum steel production for 10 year lookback period, July 2013 - June 2015.

2. Projected future maximum annual and hourly throughput.

3. AP-42 Tables 12.5-1 and 12.5-2

4. Baghouse designed minimum capture efficiency.

5. Engineering estimate.

Emissions Summary

Pollutant	Current Hourly Emission Rate (lb/hr)	Current Annual Emission Rate (tpy)	Future Hourly Emission Rate (lb/hr)	Future Annual Emission Rate (tpy)	Increase Hourly Emission Rate (lb/hr)	Increase Annual Emission Rate (tpy)
TSP	6.16	18.0	7.56	25.2	1.40	7.2
PM ₁₀	3.57	10.4	4.38	14.6	0.81	4.2
PM _{2.5}	2.65	7.7	3.25	10.8	0.60	3.1

Calculate Emissions

Pollutant	Emission Factor	"Controlled" Emission Factor	Current Hourly Emission Rate	Current Annual Emission Rate	Future Hourly Emission Rate	Future Annual Emission Rate
	lb/ton	lb/ton	(lb/hr)	(tons/yr)	(lb/hr)	(tons/yr)
TSP	1.40	0.0140	6.16	18.0	7.56	25.2
PM ₁₀	0.81	0.0081	3.57	10.4	4.38	14.6
PM _{2.5}	0.60	0.0060	2.65	7.7	3.25	10.8

Emission Point Source Calculations

Emission Point Identifier:

Description: LMF Fugitive Emissions

Inputs

Description	Value	Units
Current Actual Annual Steel Projection ¹	2,565,135	ton/yr
Future Maximum Potential Annual Steel Projection ²	3,600,000	ton/yr
Current Maximum Potential Hourly Steel Projection ¹	440	tph
Future Maximum Potential Hourly Steel Projection ²	540	tph
TSP Emission Factor ³	0.6	lb/ton
PM10 Speciation ³	58%	%
PM2.5 Speciation ³	43%	%
Baghouse Capture Efficiency ⁴	99%	%
PM Settlement Rate ⁵	50%	%

1. Maximum steel production for 10 year lookback period, July 2013 - June 2015.

2. Projected future maximum annual and hourly throughput.

3. AP-42 Tables 12.5-1 and 12.5-2

4. Baghouse designed minimum capture efficiency.

5. Engineering estimate.

Emissions Summary

Pollutant	Current Hourly Emission Rate (lb/hr)	Current Annual Emission Rate (tpy)	Future Hourly Emission Rate (lb/hr)	Future Annual Emission Rate (tpy)
TSP	1.32	3.8	1.62	5.4
PM ₁₀	0.77	2.2	0.94	3.1
PM _{2.5}	0.57	1.7	0.70	2.3

Calculate Emissions

Pollutant	Emission Factor	"Controlled" Emission Factor	Current Hourly Emission Rate	Current Annual Emission Rate
	lb/ton	lb/ton	(lb/hr)	(tons/yr)
TSP	0.60	0.0030	1.32	3.8
PM ₁₀	0.35	0.0017	0.77	2.2
PM _{2.5}	0.26	0.0013	0.57	1.7

Increase Hourly Emission Rate (lb/hr)	Increase Annual Emission Rate (tpy)
0.30	1.6
0.17	0.9
0.13	0.7

Future Hourly Emission Rate (lb/hr)	Future Annual Emission Rate (tons/yr)
1.62	5.4
0.94	3.1
0.70	2.3

Emission Point Source Calculations

Emission Point Identifier:

Description: Caster Fugitive Emissions

Inputs

Description	Value	Units
Current Actual Annual Steel Projection ¹	2,565,135	ton/yr
Future Maximum Potential Annual Steel Projection ²	3,600,000	ton/yr
Current Maximum Potential Hourly Steel Projection ¹	440	tph
Future Maximum Potential Hourly Steel Projection ²	540	tph
TSP Emission Factor ³	0.07	lb/ton
PM10 Speciation ³	58%	%
PM2.5 Speciation ³	43%	%
Baghouse Capture Efficiency ⁴	99%	%
PM Settlement Rate ⁵	50%	%

1. Maximum steel production for 10 year lookback period, July 2013 - June 2015.

2. Projected future maximum annual and hourly throughput.

3. AP-42 Tables 12.5-1 and 12.5-2

4. Baghouse designed minimum capture efficiency.

5. Engineering estimate.

Emissions Summary

Pollutant	Current Hourly Emission Rate (lb/hr)	Current Annual Emission Rate (tpy)	Future Hourly Emission Rate (lb/hr)	Future Annual Emission Rate (tpy)	Increase Hourly Emission Rate (lb/hr)	Increase Annual Emission Rate (tpy)
TSP	0.154	0.449	0.189	0.630	0.035	0.181
PM ₁₀	0.089	0.260	0.110	0.365	0.020	0.105
PM _{2.5}	0.066	0.193	0.081	0.271	0.015	0.078

Calculate Emissions

Pollutant	Emission Factor	"Controlled" Emission Factor	Current Hourly Emission Rate	Current Annual Emission Rate	Future Hourly Emission Rate	Future Annual Emission Rate
	lb/ton	lb/ton	(lb/hr)	(tons/yr)	(lb/hr)	(tons/yr)
TSP	0.07	0.0004	0.154	0.449	0.189	0.630
PM ₁₀	0.04	0.0002	0.089	0.260	0.110	0.365
PM _{2.5}	0.03	0.0002	0.066	0.193	0.081	0.271

Emission Point Source Calculations

Emission Point Identifier:

Description: Baghouse Dust Silo

Inputs

Description	Value	Units
Current Actual Annual Steel Projection ¹	2,565,135	ton/yr
Future Maximum Potential Annual Steel Projection ²	3,600,000	ton/yr
Current Maximum Potential Hourly Steel Projection ¹	440	tph
Future Maximum Potential Hourly Steel Projection ²	540	tph
TSP Emission Factor ³	0.012	lb/ton
Baghouse Capture Efficiency ⁴	99%	%

1. Maximum steel production for 10 year lookback period, July 2013 - June 2015.

2. Projected future maximum annual and hourly throughput.

3. Permitted emission factor.

4. Baghouse designed minimum capture efficiency.

Emissions Summary

Pollutant	Current Hourly Emission Rate (lb/hr)	Current Annual Emission Rate (tpy)	Future Hourly Emission Rate (lb/hr)	Future Annual Emission Rate (tpy)	Increase Hourly Emission Rate (lb/hr)	Increase Annual Emission Rate (tpy)
TSP	0.051	0.149	0.063	0.209	0.012	0.060
PM ₁₀	0.051	0.149	0.063	0.209	0.012	0.060
PM _{2.5}	0.051	0.149	0.063	0.209	0.012	0.060

Calculate Emissions

Pollutant	Emission Factor	"Controlled" Emission Factor	Current Hourly Emission Rate	Current Annual Emission Rate	Future Hourly Emission Rate	Future Annual Emission Rate
	lb/ton	lb/ton	(lb/hr)	(tons/yr)	(lb/hr)	(tons/yr)
TSP	0.01	0.0001	0.051	0.149	0.063	0.209
PM ₁₀	0.01	0.0001	0.051	0.149	0.063	0.209
PM _{2.5}	0.01	0.0001	0.051	0.149	0.063	0.209

Emission Point Source Calculations

Emission Point Identifier:

Description: Unpaved and Paved Road Fugitive Dust

Inputs

Description	Value	Units
Days of Operation per year	365	days/yr
Average road surface silt loading (sL) ¹	9.7	g/m ²
Number of Days with > 0.01 inches of rain ²	84	days/yr
Surface Material Silt Content (s) ³	6%	%
Unpaved Road Mean Vehicle Fleet Weight (W)	17.8	tons
Unpaved Road Vehicle Miles Traveled	10	miles/day

1. From AP-42, Section 13.2.1, Table 13.2.1-4
2. Rainfall data is for Decatur, AL taken from National Oceanic and Atmospheric Administration (NOAA) database.
3. From AP-42, Section 13.2.2, Table 13.2.2-1, Dated 11/2006

Emissions Summary - Paved Roads

Pollutant	Hourly Emission Rate (lb/hr)	Annual Emission Rate (tons/yr)
TSP ⁽¹⁾	0.89	3.91
PM ₁₀	0.18	0.78
PM _{2.5}	0.04	0.19

1. Per AP-42 (Table 13.2.2-2), PM-30 is assumed equivalent to total suspended particle matter (TSP)

Emissions Summary - Unpaved Roads

Pollutant	Hourly Emission Rate (lb/hr)	Annual Emission Rate (tons/yr)
TSP ⁽¹⁾	0.61	2.69
PM ₁₀	6.51E-02	0.29
PM _{2.5}	6.51E-03	2.85E-02

1. Per AP-42 (Table 13.2.2-2), PM-30 is assumed equivalent to total suspended particle matter (TSP)

Paved Road Calculation Basis:

Calculation methodology derived from Section 13.2.1, "Paved Roads," dated AP-42 (1/11)
Accounts for all vehicular traffic on paved roads (assumes 1 mile of paved road at facility)

$$Emission\ Factor\ (E) = k \cdot sL^{0.91} \cdot W^{1.02}$$

where: sL = road surface silt loading, g/m² ⁽¹⁾
W = average vehicle weight, tons
k = particle size multiplier, lb/VMT ⁽²⁾

- Note:
1. From AP42, Section 13.2.1, Table 13.2.1-3, Dated 1/11
 2. From AP42, Section 13.2.1, Table 13.2.1-1, Dated 1/11

$$Emission\ Factor\ Extrapolated\ for\ Natural\ Mitigation\ (E_{ext}) = E \cdot \left(1 - \frac{P}{4N}\right)$$

where: E = Uncontrolled emission factor
P = Number of days with > 0.01 inches of precipitation
N = Number of days in the averaging period (365 for annual)

Particle Size Range	k (lb/VMT)
< 30 micrometers	0.011
< 15 micrometers	0.0027
< 10 micrometers	0.0022
< 2.5 micrometers	0.00054

Paved Road Emission Calculations:

Average Annual Particulate Emissions (TSP) from Vehicular Traffic on Paved Roads

Vehicle Type	Vehicle Mean Weight ¹	Vehicle Miles Traveled ²	Emission Factor	Uncontrolled Emission Rate	Overall Control Efficiency	Controlled Emission Rate	
	(tons)	(VMT/day)	(lb/VMT)	(lb/day)	%	(lb/hr)	(tpy)
Light Duty Trucks	24	37.88	2.10	79.39	75%	0.83	3.62
Cars	2	37.88	0.17	6.30	75%	0.07	0.29
Total					75%	0.89	3.91

1. Engineering estimate.
2. Based on scaling up previous VMT estimates with the increase in meltshop production.

Average Annual Particulate Emissions (PM₁₀) from Vehicular Traffic on Paved Roads

Vehicle Type	Vehicle Mean Weight ¹	Vehicle Miles Traveled ²	Emission Factor	Uncontrolled Emission Rate	Overall Control Efficiency	Controlled Emission Rate	
	(tons)	(VMT/day)	(lb/VMT)	(lb/day)	%	(lb/hr)	(tpy)
Light Duty Trucks	24	37.88	0.42	15.88	75%	0.17	0.72
Cars	2	37.88	3.32E-02	1.26	75%	1.31E-02	0.06
Total					75%	0.18	0.78

1. Engineering estimate.
2. Based on scaling up previous VMT estimates with the increase in meltshop production.

Average Annual Particulate Emissions (PM_{2.5}) from Vehicular Traffic on Paved Roads

Vehicle Type	Vehicle Mean Weight ¹	Vehicle Miles Traveled ²	Emission Factor	Uncontrolled Emission Rate	Overall Control Efficiency	Controlled Emission Rate	
	(tons)	(VMT/day)	(lb/VMT)	(lb/day)	%	(lb/hr)	(tpy)
Light Duty Trucks	24	37.88	0.10	3.90	75%	4.06E-02	0.18
Cars	2	37.88	8.16E-03	0.31	75%	3.22E-03	1.41E-02
Total					75%	0.04	0.19

1. Engineering estimate.
2. Based on scaling up previous VMT estimates with the increase in meltshop production.

Unpaved Roads Calculation Basis:

Calculation methodology derived from Section 13.2.2, "Unpaved Roads," dated AP-42 (11/2006)
Accounts for all vehicular traffic on unpaved industrial roads

$$\text{Emission Factor (E)} = k \cdot (s/12)^a (W/3)^b$$

where: E = size-specific emission factor
 s = surface material silt content ¹
 W = mean vehicle weight
 k, a, b = empirical constants ²

k = particle size multiplier, lb/VMT ⁽²⁾
 Note:
 1. From AP42, Section 13.2.2, Table 13.2.2-1, Dated 11/2006
 2. From AP42, Section 13.2.2, Table 13.2.2-2 Dated 11/2006

$$\text{Emission Factor Extrapolated for Natural Mitigation (E}_{ext}) = E \cdot [(365 - P)/365]$$

where: E = Uncontrolled emission factor
 P = Number of days with > 0.01 inches of precipitation

Empirical Constants	Industrial Roads		
	PM _{2.5}	PM ₁₀	PM ₃₀
k (lb/VMT)	0.15	1.5	4.9
a	0.9	0.9	0.7
b	0.45	0.45	0.45

Unpaved Roads Emission Calculations:

Average Annual Particulate Emissions (TSP) from Vehicular Traffic on Unpaved Industrial Roads

Emission Point	Vehicle Mean Weight ¹	Vehicle Miles Traveled ²	Emission Factor	Uncontrolled Emission Rate		
	(tons)	(VMT/day)		(lb/day)	(lb/hr)	(tpy)
Light Duty Trucks	2	0.625	0.077	0.05	2.01E-03	8.79E-03
Graders	15	2.5	0.191	0.48	1.99E-02	0.09
Backhoes	20	0.125	0.217	0.03	1.13E-03	4.95E-03
Water Trucks	20	8.125	0.217	1.76	7.35E-02	0.32
Forklifts	20	0.625	0.217	0.14	5.65E-03	2.48E-02
Cranes	30	0.125	0.261	0.03	1.36E-03	5.94E-03
Loaders	40	3.75	0.297	1.11	4.63E-02	0.20
Haul Trucks	60	27.5	0.356	9.79	0.41	1.79
Pot Carriers	75	3.125	0.394	1.23	5.12E-02	0.22
Vac Trucks	15	0.0125	0.191	2.38E-03	9.93E-05	4.35E-04
Roll Trucks	15	0.625	0.191	0.12	4.97E-03	2.18E-02
Total		47		14.74	0.61	2.69

1. Engineering estimate.
2. Based on scaling up previous VMT estimates with the increase in meltshop production.

Average Annual Particulate Emissions (PM₁₀) from Vehicular Traffic on Unpaved Industrial Roads

Emission Point	Vehicle Mean Weight ¹	Vehicle Miles Traveled ²	Emission Factor	Uncontrolled Emission Rate		
	(tons)	(VMT/day)		(lb/day)	(lb/hr)	(tpy)
Light Duty Trucks	2	0.625	0.008	5.11E-03	2.13E-04	9.32E-04
Graders	15	2.5	0.020	0.05	2.11E-03	0.01
Backhoes	20	0.125	0.023	2.88E-03	1.20E-04	5.25E-04
Water Trucks	20	8.125	0.023	0.19	7.80E-03	0.03
Forklifts	20	0.625	0.023	1.44E-02	6.00E-04	2.63E-03
Cranes	30	0.125	0.028	3.46E-03	1.44E-04	6.31E-04
Loaders	40	3.75	0.031	0.12	4.92E-03	0.02
Haul Trucks	60	27.5	0.038	1.04	0.04	0.19
Pot Carriers	75	3.125	0.042	0.13	5.44E-03	0.02
Vac Trucks	15	0.0125	0.020	2.53E-04	1.05E-05	4.62E-05
Roll Trucks	15	0.625	0.020	1.26E-02	5.27E-04	2.31E-03
Total		47		1.56	0.07	0.29

1. Engineering estimate.
2. Based on scaling up previous VMT estimates with the increase in meltshop production.

Average Annual Particulate Emissions (PM_{2.5}) from Vehicular Traffic on Unpaved Industrial Roads

Emission Point	Vehicle Mean Weight ¹	Vehicle Miles Traveled ²	Emission Factor	Uncontrolled Emission Rate		
	(tons)	(VMT/day)		(lb/day)	(lb/hr)	(tpy)
Light Duty Trucks	2	0.625	0.001	5.11E-04	2.13E-05	9.32E-05
Graders	15	2.5	0.002	5.06E-03	2.11E-04	9.23E-04
Backhoes	20	0.125	0.002	2.88E-04	1.20E-05	5.25E-05
Water Trucks	20	8.125	0.002	1.87E-02	7.80E-04	3.42E-03
Forklifts	20	0.625	0.002	1.44E-03	6.00E-05	2.63E-04
Cranes	30	0.125	0.003	3.46E-04	1.44E-05	6.31E-05
Loaders	40	3.75	0.003	1.18E-02	4.92E-04	2.15E-03
Haul Trucks	60	27.5	0.004	1.04E-01	4.33E-03	1.90E-02
Pot Carriers	75	3.125	0.004	1.30E-02	5.44E-04	0.00
Vac Trucks	15	0.0125	0.002	2.53E-05	1.05E-06	4.62E-06
Roll Trucks	15	0.625	0.002	1.26E-03	5.27E-05	2.31E-04
Total		47		0.16	6.51E-03	2.85E-02

1. Engineering estimate.
2. Based on scaling up previous VMT estimates with the increase in meltshop production.

APPENDIX D

CLASS I MODELING REPORT

Prevention of Significant Deterioration and Title V Permits Significant Modification Application

Nucor Steel
4301 Iverson Blvd
Trinity, AL 35673

November 2018

NUCOR STEEL DECATUR, LLC NEW GALVANIZATION LINE PROJECT

Class I Area Dispersion Modeling Report

Prepared for:

Nucor Steel Decatur, LLC

November 2018

A large, stylized graphic of a curved, metallic-looking structure, possibly a bridge or a large pipe, dominates the lower half of the page. It is rendered in black and white with a textured, metallic appearance. The letters "SLR" are printed in a bold, white, sans-serif font in the bottom right corner of the image.

SLR

Class I Area Dispersion Modeling Report

Prepared for:
Nucor Steel Decatur, LLC
4301 Iverson Blvd
Trinity, AL 35673

This document has been prepared by SLR International Corporation (SLR). The material and data in this report were prepared under the supervision and direction of the undersigned.



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CONTENTS

1.	INTRODUCTION	1
2.	Model Inputs and Methodology	3
2.1	Class I Analyses	3
2.1.1	Air Quality Related Values.....	3
2.1.2	Class I Increment	3
2.2	Emissions Inventory.....	4
2.2.1	New and Modified Sources	4
2.2.2	Downwash.....	5
2.3	CALPUFF Modeling Procedures	5
2.3.1	CALMET Data.....	6
2.3.2	CALPUFF Domain.....	6
2.3.3	CALPUFF Options.....	6
2.3.4	Receptors	6
2.3.5	Background Ammonia and Ozone Data	7
2.4	AERMOD Modeling Procedures	7
2.4.1	Model Selection	7
2.4.2	Model Options.....	7
2.4.3	Urban Source Classification.....	7
2.4.4	Meteorological Data Processing	7
2.4.4.1	On-Site Data.....	8
2.4.4.2	National Weather Service Data	8
2.4.4.3	NWS Upper Air Data	8
2.4.4.4	Surface Characteristics	8
2.4.4.5	Seasonal Classification and Soil Moisture Determination.....	9
2.4.4.6	AERMET Stage 3.....	10
2.4.5	Receptors	10
3.	Modeling Results and Analyses	11
3.1	Air Quality Related Values.....	11
3.1.1	Emissions Speciation and Postprocessing.....	11
3.1.2	Visibility	11
3.1.3	N and S Deposition	12
3.2	Air Quality.....	12
3.2.1	Significant Impact Analysis.....	12
3.2.1.1	Secondary Particulate and Ozone Formation.....	13
3.2.2	Cumulative Increment Impact Analysis.....	13
4.	Works Cited	15
	Figure 1: Area Map	17
	Figure 2: Location of Project and Class I Areas	18
	Figure 3: Location of Facility Emissions.....	19
	Figure 4: Pryor Field Composite Wind Rose	20
	Figure 5: Total Sulfur Deposition at Sipsey.....	21
	Figure 6: Slide 8 from Recent PowerPoint Presentation Provided by ADEM.....	23
	Table 1: Project Emissions	26
	Table 2: Q/D Calculation for Sipsey with Project Emissions.....	27

Table 3: Project Emission Rates and Release Parameters – Point Sources.....	28
Table 4: Project Emission Rates and Release Parameters – Paved Road Sources	29
Table 5: Project Emission Rates and Release Parameters – Unpaved Road Sources.....	29
Table 6: Non-Default CALPUFF Switch Settings	30
Table 7: Non-Default CALPOST Switch Settings	33
Table 8: Speciated Particulate Emissions for the Electric Arc Furnace	34
Table 11: CALPUFF Regional Haze Results.....	35
Table 12: CALPUFF Deposition Results.....	36
Table 13: Class I Air Quality Impacts (maximum of both meteorological datasets)	37
Table 14: Step 1 MERPs Analysis for Secondary PM _{2.5} and Ozone.....	38
Table 15: Step 2 MERPs Analysis for Secondary PM _{2.5} and Ozone.....	39
Table 16: Cumulative SO ₂ Impacts at Sipsey WA	40

1. INTRODUCTION

Nucor Steel Decatur, LLC, a subsidiary of Nucor Corporation (collectively Nucor), owns and operates a steel recycling mill in Trinity, Morgan County, Alabama (the Decatur Steel Mill). The mill is categorized under the Standard Industrial Classification (SIC) code 3312: Steel Works, Blast Furnaces (including Coke Ovens), and Rolling Mills. The mill is a major stationary source under the Title V Operating Permit Program administered by the Alabama Department of Environmental Management (ADEM) under Air Pollution Control Program, Chapter 335-3-10. The mill currently operates under Title V Permit No. 712-0037 which expires September 5, 2021.

In this permit application, Nucor and the Decatur Steel Mill will expand the facility by adding a new galvanization line and debottlenecking the existing meltshop. The project includes the following changes at the facility:

- A new 500,000 metric tonnes per year (TPY) Galvanizing Line with a natural gas ceiling of 120 MMBtu/hour;
- A third Ladle Metallurgical Furnace (LMF) Station;
- Four new Electric Arc Furnace (EAF) transformers (two per furnace), upgrading from the current rating of 75 megavolt-ampere (MVA) to 90 MVA;
- Increase in the slab width to 68 inches;
- The addition of an eighth casting segment on both casters;
- Upgrade to the existing charge crane; and
- An increase in the annual liquid metal limit production from 3.2 million tons per year (MM tpy) to 3.6 MM tpy and an increase in the hourly limit increased from 440 tons per hour (tph) to 540 tph.

Table 1 provides a summary of estimated project emissions compared to the Prevention of Significant Deterioration (PSD) major modification thresholds. An illustration of the project area is provided in Figure 1.

The general contents of this modeling report were discussed at the pre-protocol meeting on December 14, 2017 with ADEM, Nucor, and SLR. This modeling report describes the regulatory framework and technical methods that were used for the PSD Class I compliance demonstration that is required to support the permit application. The modeling analysis was conducted in accordance with guidance provided by ADEM, the Environmental Protection Agency (EPA), and the Federal Land Managers (FLMs) as outlined in the following documents:

- PSD Air Quality Analysis AERMOD Modeling Guidelines (Alabama Department of Environmental Management, 2018).
- Guideline on Air Quality Models [published as 40 CFR 51, Appendix W] (EPA, 2017) hereafter referred to as the Appendix W.
- Federal Land Managers' Air Quality Related Values Workgroup (FLAG) Phase I Report (US Department of Interior, 2010), hereafter referred to as FLAG 2010.

- Federal Land Managers' Interagency Guidance for Nitrogen and Sulfur Deposition Analyses (National Park Service, 2011).

A nearfield, Class II area impact analysis was also performed for this project in order to demonstrate compliance with the Class II PSD increments and National Ambient Air Quality Standards (NAAQS). The nearfield, Class II area modeling report will be submitted under separate cover.

2. MODEL INPUTS AND METHODOLOGY

2.1 CLASS I ANALYSES

Under the PSD program, Class I areas are afforded the most stringent level of protection under the Clean Air Act. An illustration of the Nucor facility location relative to Class I areas is provided in Figure 2. The nearest Class I area to Nucor is Sipsey WA (Sipsey), which at its closest point is located approximately 43 km southwest of the Nucor facility. The western-most boundary of Sipsey is approximately 52 km from the Nucor facility. The next closest Class I area is Cohutta WA, located greater than 200 km east of the facility. Following the pre-protocol meeting on December 14, 2017, a modeling analysis was only required for Sipsey WA.

Project impacts to the following air quality metrics were analyzed at Sipsey:

- Class I significant impact levels (SIL) and PSD increments; and
- An analysis of air quality related values (AQRVs), i.e., regional haze and acid deposition.

The procedures to analyze these metrics are provided in the following sections.

2.1.1 AIR QUALITY RELATED VALUES

FLAG 2010 provides a screening method to determine whether project impacts could reasonably be expected to affect AQRVs. This method involves calculating the ratio Q/D , where Q is the total of the project SO_2 , NO_x , PM_{10} , and H_2SO_4 emissions, in tons per year based on maximum 24-hour allowable emissions, and D is the distance to the Class I area in kilometers. If this ratio is less than or equal to 10, it is assumed that project emissions would have a negligible impact on AQRVs and that further analyses would not be required.

Q/D calculations for regional haze and deposition at Sipsey are provided in Table 2. One calculation is based on the project ton per year emissions due to the increase in annual steel production (up 40%). The other calculation is based on the project's maximum hourly emissions increase (up 23%) and annualized assuming continuous operation for the year. The project does not have sulfuric acid mist emissions. Based on these calculations, the Q/D screening analysis indicates that this ratio exceeds 10 for Sipsey WA, thus further analyses for Sipsey was required. This calculation also shows that any Class I area beyond 125.2 km (based on a maximum Q value of 1252) from the project will have Q/D values less than 10 and not require further analyses. As shown in Figure 2, there are no additional Class I areas within 200 km of the project site, therefore only Sipsey WA was further analyzed for AQRV impacts.

Discussion about the AQRV analysis at Sipsey is provided in Section 2.3 and 3.1.

2.1.2 CLASS I INCREMENT

The project impacts were compared to the Class I significant impact levels and PSD Class I increments at Sipsey WA. Since the majority of Sipsey WA is located within 50 km of the project, the ambient air quality impact analysis for comparison to the Class SILs and PSD increments were performed using the AERMOD model.

Discussion about the Class I SIL and PSD increment analyses at Sipsey is provided in Section 2.4 and 3.2.

2.2 EMISSIONS INVENTORY

The emission inventory for the Class I modeling is identical to the Class II modeling, except for the following:

- Paved and unpaved roads were included in the Class I AQRV analysis¹;
- Source coordinates were transformed to the Lambert Conformal Conic (LCC) projection to be consistent with the CALMET meteorological model output; and
- Particulate emissions from the electric arc furnace were speciated for the regional haze modeling as discussed in Section 3.1.1.

2.2.1 NEW AND MODIFIED SOURCES

As described in Section 1 the project consists of construction of a new galvanizing line (Galvanizing Line #2). Emissions from this source will be collected and vented through a single stack. For modeling purposes it was assumed that the new galvanizing line will operate for 8,760 hours per year at its maximum potential to emit.

In addition, the project will result in net emissions increases from several existing sources:

- Melt Shop Baghouses 1 and 2;
- North Caster Steam Vent;
- South Caster Steam Vent; and
- Paved roads and unpaved roads.

Emissions from the Melt Shop Baghouses and North/South Caster Steam Vents are vented through individual stacks and were modeled as point sources that operate 8,760 hours per year. The paved and unpaved roads were modeled as fugitive sources and also assumed to operate continuously. The emission rates were set equal to their post-project potential to emit minus the most recent 2 years of actual emissions (i.e., future potentials minus current actuals). The resulting emissions were based on the maximum hourly emissions for comparison to short-term standards and thresholds (less than or equal to 24 hours), while annual ton per year emissions were modeled for comparison to annual standards and thresholds.

Emission rates and release parameters for all project sources are provided in Table 3, Table 4, and Table 5. Descriptions of how the modeled source locations, release parameters, and emission rates were derived are provided below. An illustration showing the spatial layout of all project-related Nucor emission sources in the modeling is provided in Figure 3. The source location and stack parameters for the new Galvanizing Line stack were provided by Nucor based on existing information. Source locations and stack parameters for existing sources were obtained from Nucor and the previous PSD permit application (ERM, 2016).

¹ They were removed from the Class II analysis per ADEM's request.

The Haul Road Workgroup Final Report (EPA, 2012) provides guidance on modeling haul roads as either area or volume sources. Due to the close proximity of some paved road sections to the ambient air boundary (originally designed for the nearfield analysis), paved roads were modeled as area sources rather than volume sources to avoid the possibility of the center of a volume's "virtual" point source falling outside the ambient air boundary for certain wind directions.

The location of facility paved roads were obtained from a georeferenced aerial photograph and information provided by Nucor. The width of the paved road sections was assumed to be 10 m based on site information. As recommended by the EPA Haul Road Workgroup Final Report, an additional 6 m was added to this assumed road width.

The plume height of paved road area sources were assumed to be 1.8 m, based on an assumed typical height of vehicles travelling on paved roads (light duty trucks and cars), and scaled up by a factor of 1.7 as recommended by the EPA Haul Road Workgroup Final Report. The release height was assumed to be one-half of this calculated plume height. The initial vertical spread of the area source was set equal to the plume height divided by 2.15 following standard practice for surface-based sources.

The unpaved roads are located in the area north of the hot mill and were also modeled as an area source. Activities in this area include finished product storage and other general plant activities. Due to the nature of activities in this area, one large area source was defined rather than individual rectangular road segments.

The plume height of paved road area sources was assumed to be 3.5 m, based on an assumed typical height of vehicles travelling in the area (medium duty trucks), and scaled up by a factor of 1.7 as recommended by the EPA Haul Road Workgroup Final Report. The release height was assumed to be one-half of this calculated plume height. The initial vertical spread of the area source was set equal to the plume height divided by 2.15 following standard practice for surface-based sources.

2.2.2 DOWNWASH

The effects of plume downwash were considered for all project point sources, based on building locations and heights relative to facility emission sources. Direction-specific downwash parameters were calculated using the current version of the EPA-approved Building Profile Input Program (BPIPPRM Version 04274). Building dimensions for new structures was obtained from information provided by Nucor, while building dimensions for existing structures was obtained from a recent PSD permit application prepared for the facility (ERM, 2016).

An illustration showing the location of the point sources and buildings that were included in BPIP is provided in Figure 3. In addition to calculating direction-specific building dimensions, the BPIPPRM program also calculates the Good Engineering Practice (GEP) stack height. All Nucor facility stack heights were checked to verify that they are within the GEP stack height limit.

2.3 CALPUFF MODELING PROCEDURES

The CALPUFF modeling system was used to determine potential AQRV impacts at Sipsey. The current official EPA version of the CALPUFF modeling system found on the model developer's (Exponent) web

page and on EPA's Support Center for Regulatory Atmospheric Modeling (SCRAM) website was used. Specifically, these include²:

- CALPUFF - Version 5.8.5, Level 151214
- POSTUTIL – Version 1.56, Level 070627
- CALPOST - Version 6.221, Level 080724

Unpaved road emissions were modeled as a polygonal area source with 10 vertices; however, the default CALPUFF model code was compiled with the maximum number of vertices set at 5 in module PARAMS.PUF. To allow use of an area source with more than 5 vertices SLR modified the PARAMETER statement for the variable *mxvert* in PARAMS.PUF from the default value of 5 to 10, then recompiled the source code³ using the Intel compiler batch file provided with the model source code.

2.3.1 CALMET DATA

The CALMET output files (provided by ADEM) for this analysis are from the Visibility Improvement State and Tribal Association of the Southeast (VISTAS) Domain 4 covering calendar years 2001 through 2003. These data were processed using CALMET Version 5.8 Level: 070623. These files were used as-provided.

2.3.2 CALPUFF DOMAIN

The CALPUFF computational domain was a subset of the CALMET domain, and extends at least 50 km in all directions from the project site and 50 km in all directions beyond any portion of Sipsey. This additional buffer will allow for puff recirculation that can occur at the edge of the domain. The extent of the CALPUFF modeling domain is shown in Figure 2.

2.3.3 CALPUFF OPTIONS

Model options used in CALPUFF and CALPOST conformed to the default values specified for the model versions listed in Section 2.3. Table 6 and Table 7 provide listings of proposed user-defined options for CALPUFF and CALPOST, respectively.

2.3.4 RECEPTORS

Receptor locations and elevations for Sipsey WA were obtained from the National Park Service (NPS) Nature and Science web site for Sipsey⁴ and converted to the same LCC projection and datum that was used in the CALMET processing.

² The CALMET meteorological processor was not required since model-ready meteorological output files were provided by ADEM.

³ SLR used the Visual Fortran Intel(R) 64 Compiler XE for applications running on Intel(R) 64, Version 14.0.2.176 Build 20140130.

⁴ <https://www.nps.gov/subjects/air/permitresources.htm>

2.3.5 BACKGROUND AMMONIA AND OZONE DATA

FLAG 2010 provides background ammonia concentrations for several land use categories. Forested areas have a recommended value of 0.5 ppb, which was used in the CALPUFF analysis based on the predominance of forested land in and around Sipsey. The hourly ozone files generated for the VISTAS domain 4 was used in the analysis.

2.4 AERMOD MODELING PROCEDURES

The AERMOD inputs and modeling procedures for this analysis was identical to those used in the Class II modeling, except that 100% NO_x to NO₂ conversion was assumed and the need to generate receptor scale heights for FLM receptors as discussed in Section 2.4.5.

2.4.1 MODEL SELECTION

SLR used the current version of the EPA-approved American Meteorological Society/EPA Regulatory Model (AERMOD) modeling system to meet the nearfield dispersion modeling requirements for this analysis. AERMOD is recommended for use in modeling multi-source emissions, and can account for plume downwash, stack tip downwash, and point, area, and volume sources (EPA, 2018).

Current version numbers of the AERMOD model and pre-processors that were used include:

- AERMAP version 18081,
- AERMET version 18081, and
- AERMOD version 18081.

2.4.2 MODEL OPTIONS

All model input options were set to their regulatory default values.

2.4.3 URBAN SOURCE CLASSIFICATION

An Auer land-use analysis, as described in 40 CFR 51 Appendix W was conducted to determine the appropriate dispersion coefficients to use in the AERMOD model. Less than 50 percent of the area within a 3 km radius of either the Pryor Field tower or the assumed Nucor meteorological monitoring tower could be classified as land use types I1, I2, C1, R2, or R3 (heavy industrial, light/moderate industrial, commercial, compact residential (single family), or compact residential (multi-family), respectively). Therefore, the URBANOPT keyword in AERMOD was not used.

2.4.4 METEOROLOGICAL DATA PROCESSING

Hourly meteorological data used for air quality modeling must be spatially and climatologically representative of the area of interest. Appendix W recommends a minimum of one year of site-specific meteorological data or five consecutive years from the most recent, readily available data collected at a representative National Weather Service (NWS) station. Required surface meteorological data inputs to

the AERMOD meteorological processor (AERMET) include, at minimum, hourly observations of wind speed, wind direction, temperature, and cloud cover (or solar radiation and low-level vertical temperature difference data in lieu of cloud cover). The meteorological processor also requires morning upper air sounding data from a representative NWS station.

2.4.4.1 On-Site Data

On-site surface meteorological data are not available for this facility.

2.4.4.2 National Weather Service Data

The nearest NWS surface observing station is located at Pryor Field (WBAN No. 53852), approximately 13 km east of the Nucor facility. Hourly average and 1-minute average Automated Surface Observing Systems (ASOS) data are also available for this station.

At a meeting at the ADEM offices on December 14, 2017 ADEM, indicated that they would provide processed data for use in the permit application. On April 30, 2018 ADEM provided a 5-year meteorological dataset (calendar years 2012-2016) from the Pryor Field station. This dataset included AERMOD-ready processed surface and profile files (.sfc and .pfl), merged output files from AERMET Stage 2, AERSURFACE output files, and AERSURFACE processing instructions. ADEM included surface and profile files processed with and without the ADJ-U* option in AERMET Stage 3. For reasons discussed in Section 2.4.4.6 SLR used the data files processed with the ADJ_U* option. A composite windrose for Pryor field is provided in Figure 4.

2.4.4.3 NWS Upper Air Data

The temperature structure of the atmosphere prior to sunrise is required by AERMET to estimate the growth of the convective boundary layer for the day. AERMET uses the 1200 Greenwich Mean Time (GMT) upper air sounding from the provided NWS upper-air observing station for this purpose.

ADEM used concurrent upper-air data from the Nashville, TN NWS surface station in their AERMET processing.

2.4.4.4 Surface Characteristics

Final processing of the meteorological data requires assigning appropriate surface characteristics including surface roughness length (z_0), Bowen Ratio (B_0) and albedo (r). Surface characteristics should be assigned following guidance provided in the current version of the AERMOD Implementation Guide (AIG) (EPA, 2018).

The AIG recommends that the surface characteristics be determined based on digitized land cover data. EPA has developed the AERSURFACE processor that was used to determine the site characteristics based on digitized land cover data in accordance with the recommendations from the AIG discussed above. AERSURFACE incorporates look-up tables of representative surface characteristic values by land cover category and seasonal category. The current version of AERSURFACE provided by EPA (version 13016)

supports the use of land cover data from the United States Geological Survey (USGS) National Land Cover Data 1992 archives (NLCD92).

ADEM provided data processed with Pryor Field NLCD92 surface characteristics. As noted by ADEM, surface characteristics at airports may be different from those at an application site. To account for this, ADEM required that Nucor process the Pryor Field/Nashville data using surface characteristics representative of the Nucor site, run AERMOD with both datasets (the ADEM-processed dataset using Pryor Field surface characteristics and the Nucor-processed dataset using Nucor surface characteristics), and report the highest concentration from the two datasets for each modeled pollutant and averaging period.

AERSURFACE requires that the meteorological tower location be input so that appropriate surface characteristics in the vicinity of the tower can be obtained from the NLCD92 data file. For purposes of running AERSURFACE, SLR assumed that the Nucor “tower” is located near the approximate center of the mill. This location is the same as was used for the 2016 permit application (ERM, 2016).

2.4.4.5 Seasonal Classification and Soil Moisture Determination

In AERSURFACE, the various land cover categories are linked to a set of seasonal geophysical characteristics. As such, AERSURFACE requires specification of the seasonal category for each month of the year. The following five seasonal categories are offered by AERSURFACE:

- Midsummer with lush vegetation;
- Autumn with un-harvested cropland;
- Late autumn after frost and harvest, or winter with no snow;
- Winter with continuous snow on ground; and
- Transitional spring with partial green coverage or short annuals.

To determine the Bowen ratio, the land use values are linked to three categories of surface moisture corresponding to average, wet, and dry conditions. The surface moisture conditions for the site may vary depending on the meteorological data period for which the surface characteristics are applied. As recommended in the AERSURFACE User’s Guide, the surface moisture condition for each month should be determined by comparing precipitation for the period of data to be processed to the 30-year climatological record. “Wet” conditions are selected if precipitation was in the upper 30th percentile, “dry” conditions if precipitation was in the lower 30th percentile, and “average” conditions if precipitation was in the middle 40th percentile.

As stated in Section 2.4.4.2 ADEM provided AERSURFACE processing instructions on April 30, 2018. These included recommendations for assigning each month of the year to the proper season as well as the appropriate soil moisture condition to assume for each calendar year processed. These values were used as input to AERSURFACE, along with the NLCD92 data.

2.4.4.6 AERMET Stage 3

ADEM's AERMET Stage 2 output, along with the AERSURFACE output files processed with Nucor surface characteristics, were input to AERMET Stage 3 to produce model-ready surface and profile files for calendar years 2012 through 2016. Since ASOS data do not include turbulence measurements, the ADJ_U* option was used for the stable boundary layer calculations.

2.4.5 RECEPTORS

The receptors used for input into AEMROD were based on the NPS receptors locations and elevations⁵, but also include the AERMOD-required scale heights. The scale heights were obtained using the AERMAP terrain processor and a digital terrain dataset (National Elevation Dataset (NED) digital terrain data at 1/3 arc-second resolution, which is equivalent to approximately 10 meters in the project area). To assure that the correct hill height scale for each receptor was chosen, the NED data file provided to AERMAP included a buffer of approximately 10 km beyond the receptor grid area. The proposed modifications to the receptors are as follows:

- AERMAP was run to obtain AERMAP-assigned elevations and scale heights at the NPS receptor locations.
- Scale heights for the FLM receptor locations were calculated based on the FLM receptor heights and AERMAP-assigned scale heights. For cases where the AERMAP-assigned receptor height and scale heights are equal, the FLM receptor scale height was set equal to the FLM receptor height. Otherwise, the scale height was determined by adding the difference between the AERMAP-assigned receptor height and scale height and the FLM receptor height.
- Receptor coordinates were converted from longitude/latitude to UTM Zone 16 NAD83 coordinates.

This approach is intended to preserve the FLM-provided receptor elevations and the AERMAP-provided relationship between receptor heights and scale heights.

⁵ <https://www.nps.gov/subjects/air/permitresources.htm>

3. MODELING RESULTS AND ANALYSES

3.1 AIR QUALITY RELATED VALUES

3.1.1 EMISSIONS SPECIATION AND POSTPROCESSING

The particulate emissions for the electric arc furnace (controlled by a baghouse) were speciated according to AP-42 Table 12.5-2. The CALPUFF model inputs for the speciated emissions are provided in Table 8.

The POSTUTIL processor was used to convert the modeled species into AQRV-specific species, i.e., total sulfur mass for sulfur deposition, total nitrogen mass for nitrogen deposition, and coarse (greater than or equal to 10 microns) particulates into PM_{10} .

The creation of the deposition species follows the IWAQM Phase 2 recommendations for accounting for total molar mass:

- $S = (0.5 \times SO_2) + (0.33 \times SO_4)$
- $N = (0.2917 \times SO_4) + (0.3043 \times NO_x) + (0.2222 \times HNO_3) + (0.4516 \times NO_3)$

For visibility impacts, the PM_{10} species was created as the sum of the PM_{10} and PM_{15} species in POSTUTIL. The POSTUTIL output for each AQRV was used as input into CALPOST to determine project impacts.

3.1.2 VISIBILITY

CALPUFF-predicted 24-hour concentrations of nitrate, sulfate, PM_{10} and $PM_{2.5}$ (conservatively assumed to be elemental carbon) at Sipsey WA was converted to light extinction values using CALPOST following the procedures described in FLAG 2010. This analysis used the annual-averaged natural background visibility conditions and monthly relative humidity factors from FLAG 2010 for Sipsey, based on:

- FLAG 2010 Table 6 for the annual average natural conditions and Rayleigh scattering;
- FLAG 2010 Table 7 for the monthly, large particle relative humidity adjustment factors;
- FLAG 2010 Table 8 for the monthly, small particle relative humidity adjustment factors; and
- FLAG 2010 Table 9 for the monthly, sea salt relative humidity adjustment factors.

With these inputs, CALPOST was run by setting the $MVISBK = 8$ and $MVISCHECK = 1$, which calculates light extinction using the IMPROVE (2006) formula and inputs. The results of the analysis are presented in Table 9. The results demonstrate that no adverse impacts to regional haze will result due to project emissions.

3.1.3 N AND S DEPOSITION

Total (wet and dry) deposition fluxes for both nitrogen and sulfur species due to project emissions are compared to the deposition analysis thresholds (DATs) in Table 10. The DATs represent screening level values for nitrogen and sulfur deposition from project-only emissions below which the impacts are considered to be negligible. The DATs established for both nitrogen and sulfur deposition in Sipsey is 0.010 kilograms per hectare per year (kg/ha/yr).⁶

The results of the analysis indicate that project impacts are below the nitrogen DATs but above the sulfur DATs. As a result, SLR performed additional analyses for sulfur deposition at Sipsey. Using the appropriate guidance (National Park Service, 2011), the following items were considered:

- Are AQRVs in the affected area sensitive to deposition?
- Are AQRVs in the affected area currently impacted by deposition?
- Have critical loads or target loads been developed for AQRVs in the area?
- Do the current deposition rates exceed the critical loads(s) or target load(s) in the area? If so, by how much?
- Does current deposition approach the critical load or target load?

According to the lowest (most conservative) critical load information for Sipsey, sulfur deposition fluxes below 5 kg/ha/yr are not expected to have negative effects to soil and vegetation.⁷ Review of the National Atmospheric Deposition Program for Total Deposition (NADP-TD)⁸, which combines monitored data from several programs (e.g., CASTNET, NTN, AMoN, SEARCH, etc.) and photochemical modeling, indicates that current total sulfur deposition values at Sipsey are less than 5 kg/ha/yr. This dataset, which is available back to 2000, shows a significant downward trend in total sulfur deposition at Sipsey. For the period of 2000 to 2015, the total sulfur deposition has decreased approximately 10 kg/ha, or about 0.67 kg/ha/yr. An illustration of the NADP-TD values in around Sipsey for the 2000 to 2002 and 2012 to 2015 periods is provided in Figure 5. Based on this analysis, project emissions will add 0.4% to the most conservative critical load threshold at Sipsey, which has experienced a significant decline in sulfur deposition since year 2000.

3.2 AIR QUALITY

3.2.1 SIGNIFICANT IMPACT ANALYSIS

A significant impact analysis was performed to determine whether the proposed project could cause a significant impact, in terms of air quality concentrations, at Sipsey WA. The results of the analysis are provided in Table 11 and demonstrate that project emissions results in impacts above the 3- and 24-hour Class I SO₂ SILs.

⁶ https://www.fs.fed.us/air/technical/class_1/wilds.php?recordID=73 (accessed on May 8, 2018)

⁷ Ibid.

⁸ <http://nadp.slh.wisc.edu/committees/tdep/tdepmaps/>

3.2.1.1 Secondary Particulate and Ozone Formation

In addition to the impacts of primary pollutants, the analysis of project emissions for the secondarily-formed pollutants, i.e., secondary $PM_{2.5}$ ⁹, is required by Appendix W. Secondary $PM_{2.5}$ is formed from the emissions of the precursor pollutants SO_2 and NO_x . Following guidance from ADEM^{10,11}, the following steps were used to determine the potential secondary formation from project emissions based on EPA's existing database (EPA, 2016):

1. The highest impacts from the most representative source were used (step 1); and
2. The refined impacts from the most representative source were used (step 2).

The Eastern US Source #19 (EUS19) was chosen as the most representative source over the closest source (Central US Source #3) since its precursor emission rates most closely match the Nucor project emission rates for each of the analyzed precursor pollutants. The relatively close proximity of the source also makes it broadly representative of the project area in terms of climate, land use, and regional emission sources. An illustration of the project location relative to EPA-modeled locations is provided in Figure 6. The results of the analysis for the first step is provided in Table 12, which indicates that 24-hour $PM_{2.5}$ may have significant secondary formation and annual $PM_{2.5}$ will not have significant secondary formation.

The second step of the analysis for 24-hour $PM_{2.5}$ is based on the EPA-modeled results at 50 km from EUS19, which are provided in a recent presentation.¹² On page 8 of the presentation, the modeled concentrations as a function of distance from the EUS19 is provided for the "low" stack height scenario (see Figure 7). The selected model results for use in the calculation of the MERP values are the average of the impacts between 50 and 70 km in order to take into account the increase in secondary formation just beyond 50 km.¹³ As noted above, EUS19 is considered the most representative source for the project emissions, however, the project stack heights are much higher than 1 meter. Therefore, use of these specific modeling results should be considered representative, yet conservative for project emissions. The results of this refined analysis are provided in Table 13 and demonstrate that primary and secondary $PM_{2.5}$ impacts will be below the Class I SIL.

3.2.2 CUMULATIVE INCREMENT IMPACT ANALYSIS

Based on the results significant impact analysis, cumulative modeling for 3-hour and 24-hour SO_2 is required for Sipsey WA. In 2008, ADEM conducted a cumulative SO_2 impact analysis for the Sipsey WA that included the original Nucor facility along with all other relevant sources.¹⁴ These modeling results were used as the basis of determining the cumulative SO_2 increment impacts at Sipsey WA. To these results, the following modeled impacts were added:

⁹ There are no Class I PSD standards for ozone, therefore, only $PM_{2.5}$ is addressed in this analysis. Ozone is addressed in the Class II PSD analysis.

¹⁰ Megan Travis (ADEM) to Brad Arnold (SLR) "Tier 1 MERPs Demonstration Example" on September 27, 2018.

¹¹ The first two screening steps, using the most conservative MERP value from the eastern and central U.S. and then the most conservative MERP values from the closest source are too conservative for the more stringent PSD Class I SILs.

¹² Megan Travis (ADEM) to Brad Arnold (SLR) "Tier 1 MERPs Demonstration Example" on September 27, 2018.

¹³ This was done visually. Slide 10 of this presentation has a tabular list of impacts but they are not labelled as to which source these represent.

¹⁴ Cumulative Class I SO_2 Analysis for the Sipsey Wilderness Area, available from ADEM.

- The maximum, project-only impacts from the previous permit application (ERM, 2016); and
- The maximum project-only impacts from this proposed project.

The results of this analysis are provided in Table 14 and demonstrate the cumulative SO₂ impacts will be below the PSD Class I SO₂ increments.

4. WORKS CITED

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- EPA. (2018). *AERMOD Implementation Guide*.
- EPA. (2018). *User's Guide for the AMS/EPA Regulatory Model (AERMOD)*.
- ERM. (2016). *Revised Prevention of Significant Deterioration Permit Application for a Proposed Modification of the Decatur Steel Mill*.
- National Park Service. (2011). • *Federal Land Managers' Interagency Guidance for Nitrogen and Sulfur Deposition Analyses* .

FIGURES

Figure 1: Area Map

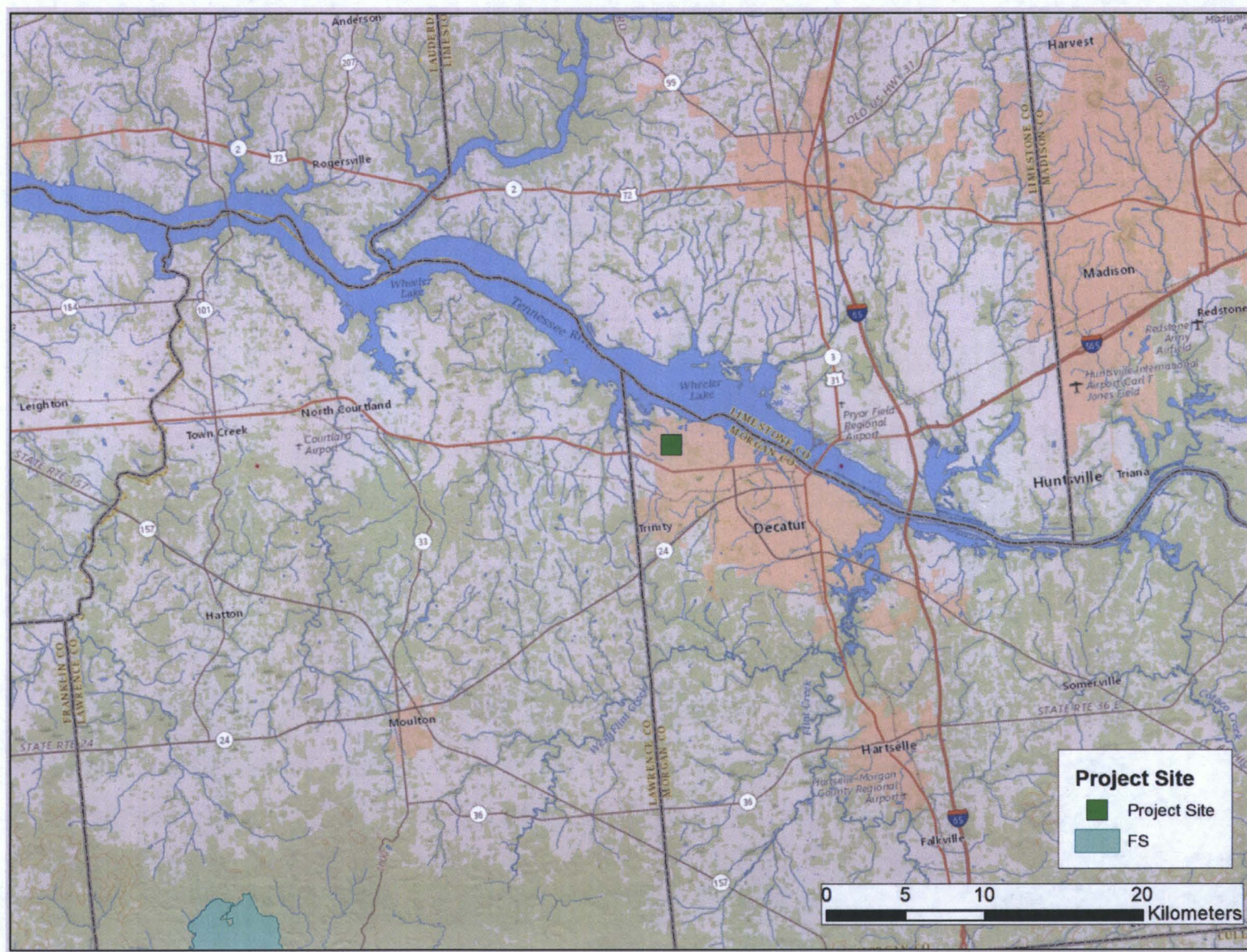


Figure 2: Location of Project and Class I Areas

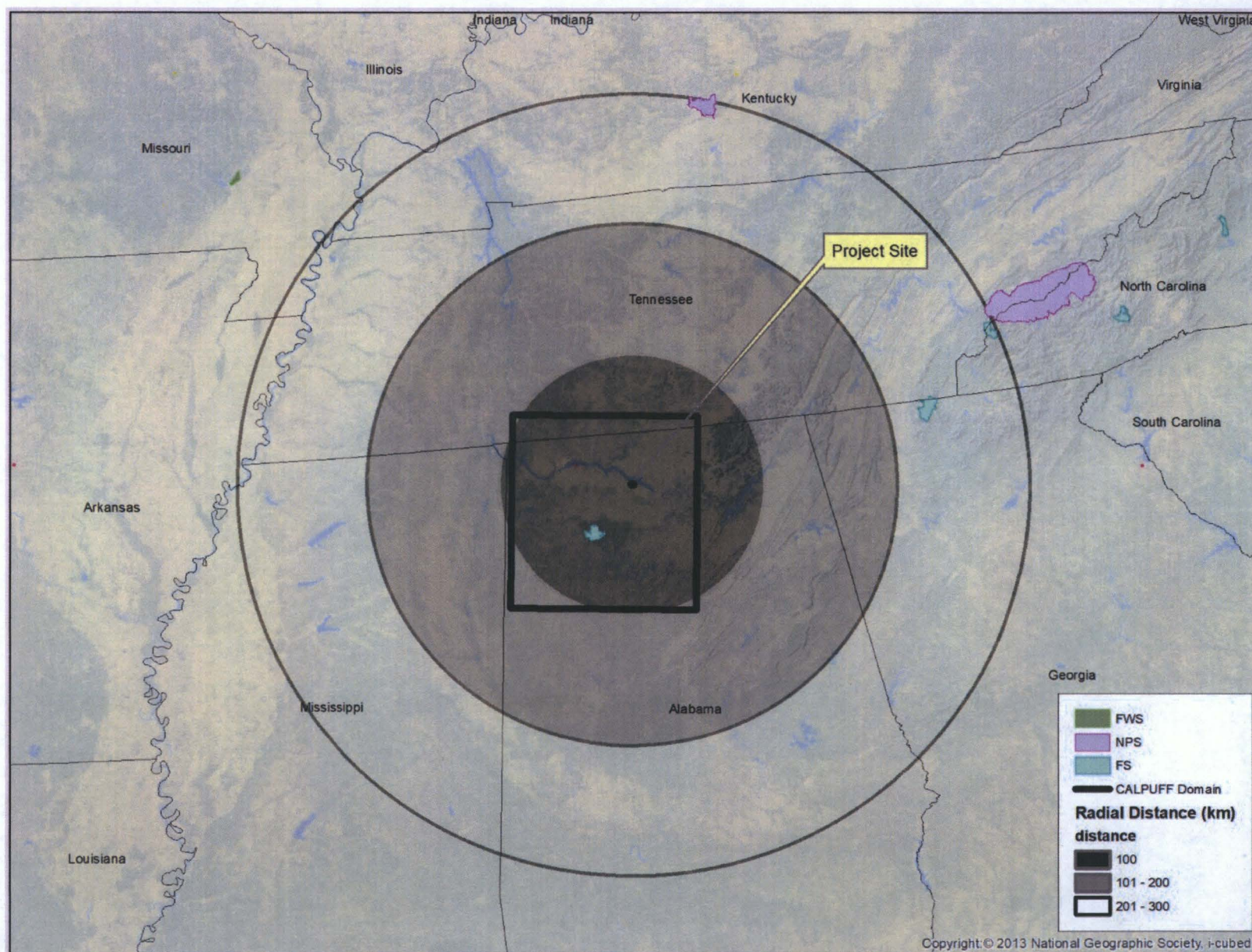


Figure 3: Location of Facility Emissions

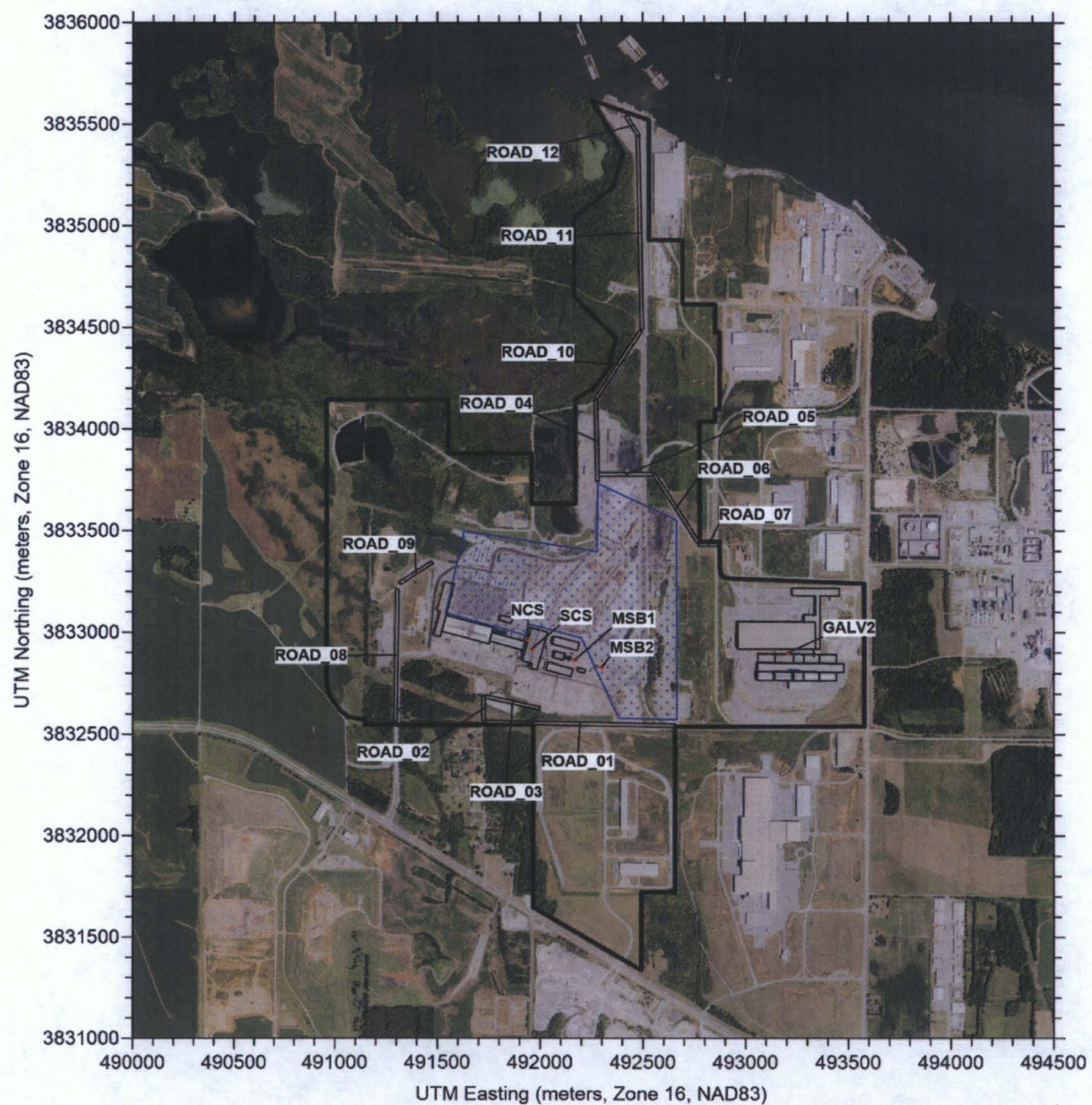
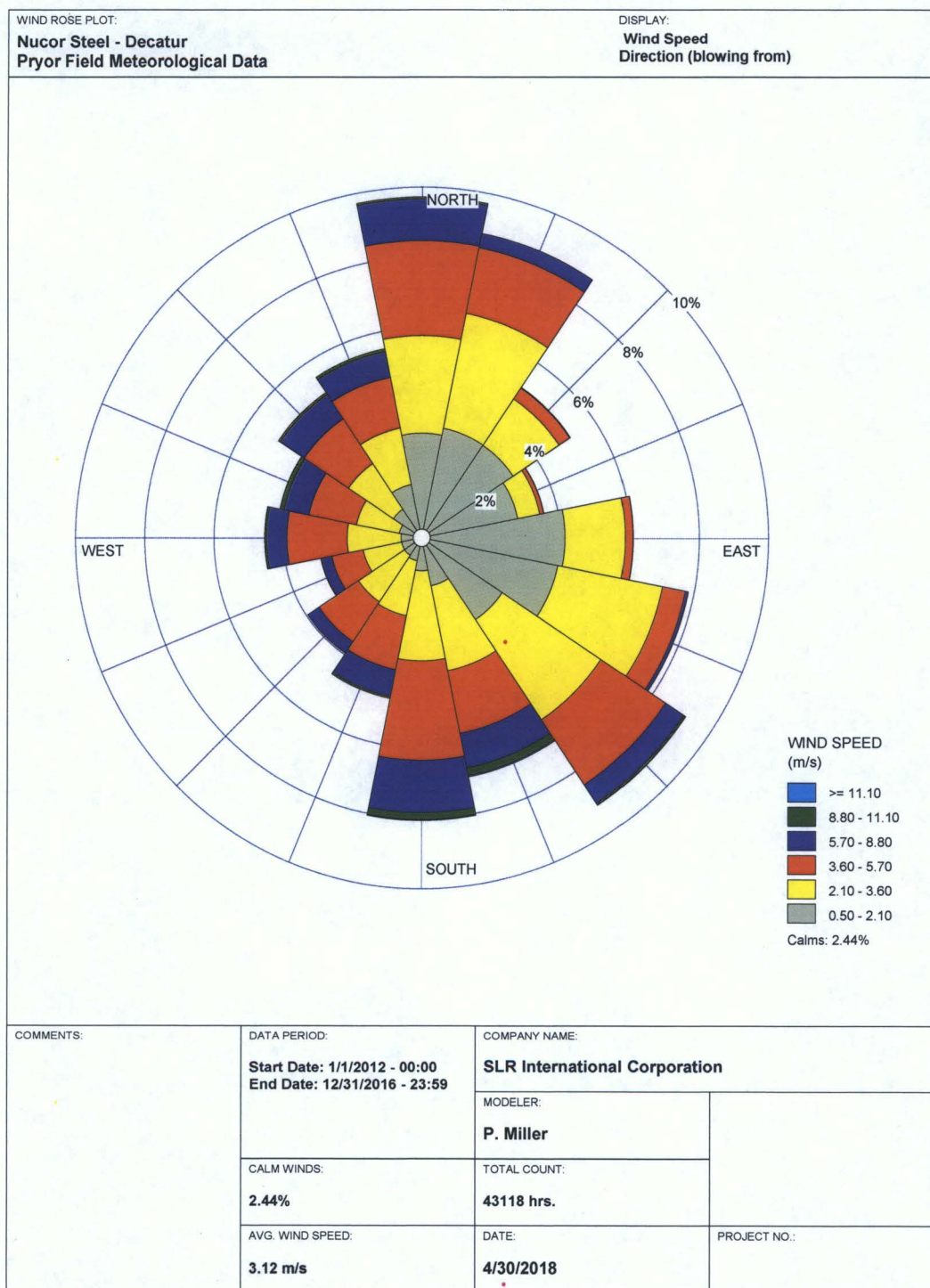
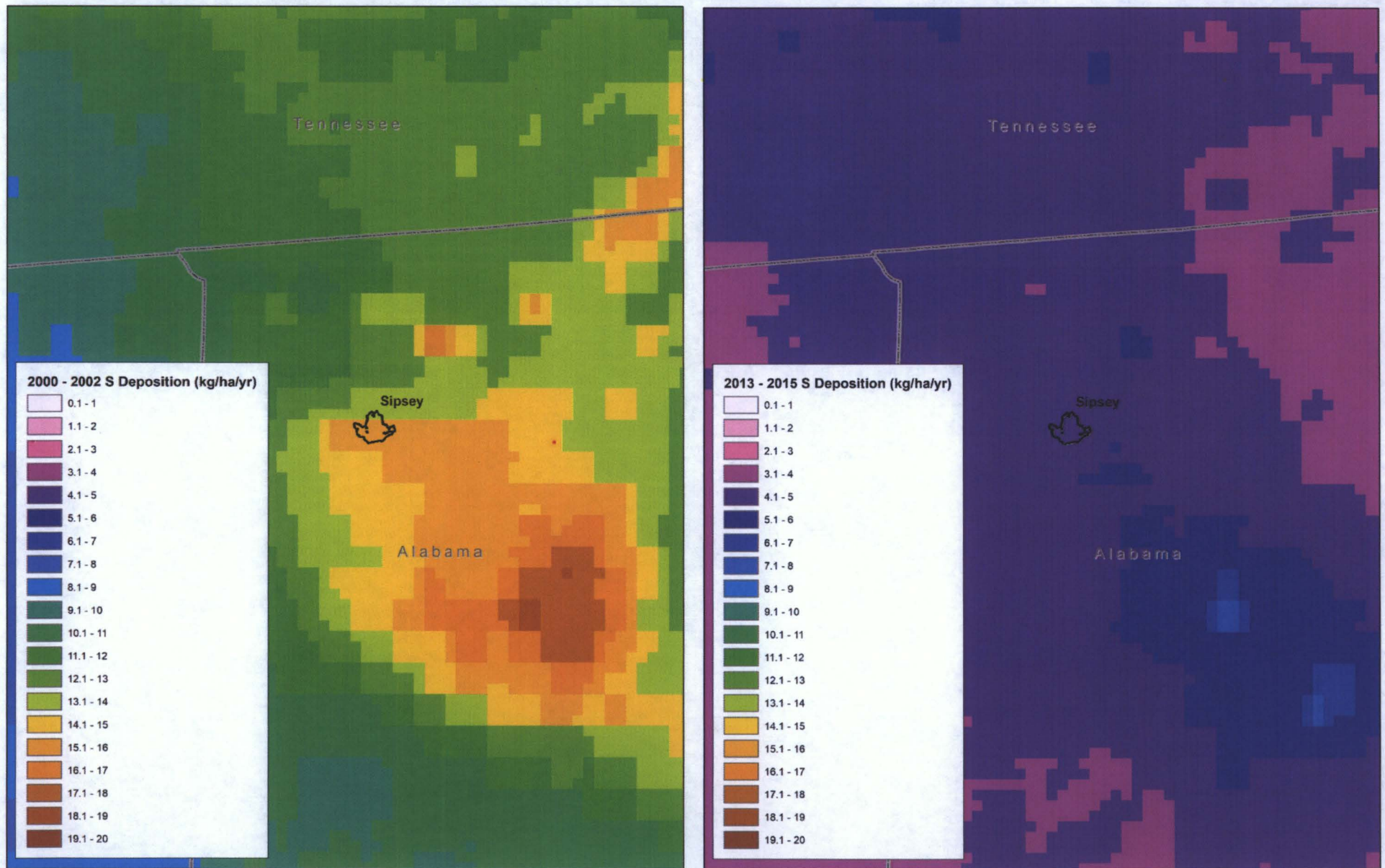


Figure 4: Pryor Field Composite Wind Rose



WRPLOT View - Lakes Environmental Software

Figure 5: Total Sulfur Deposition at Sipsey



(2000 to 2002)

(2013 to 2015)

Figure 6: Location of Project and EPA-Modeled Sources

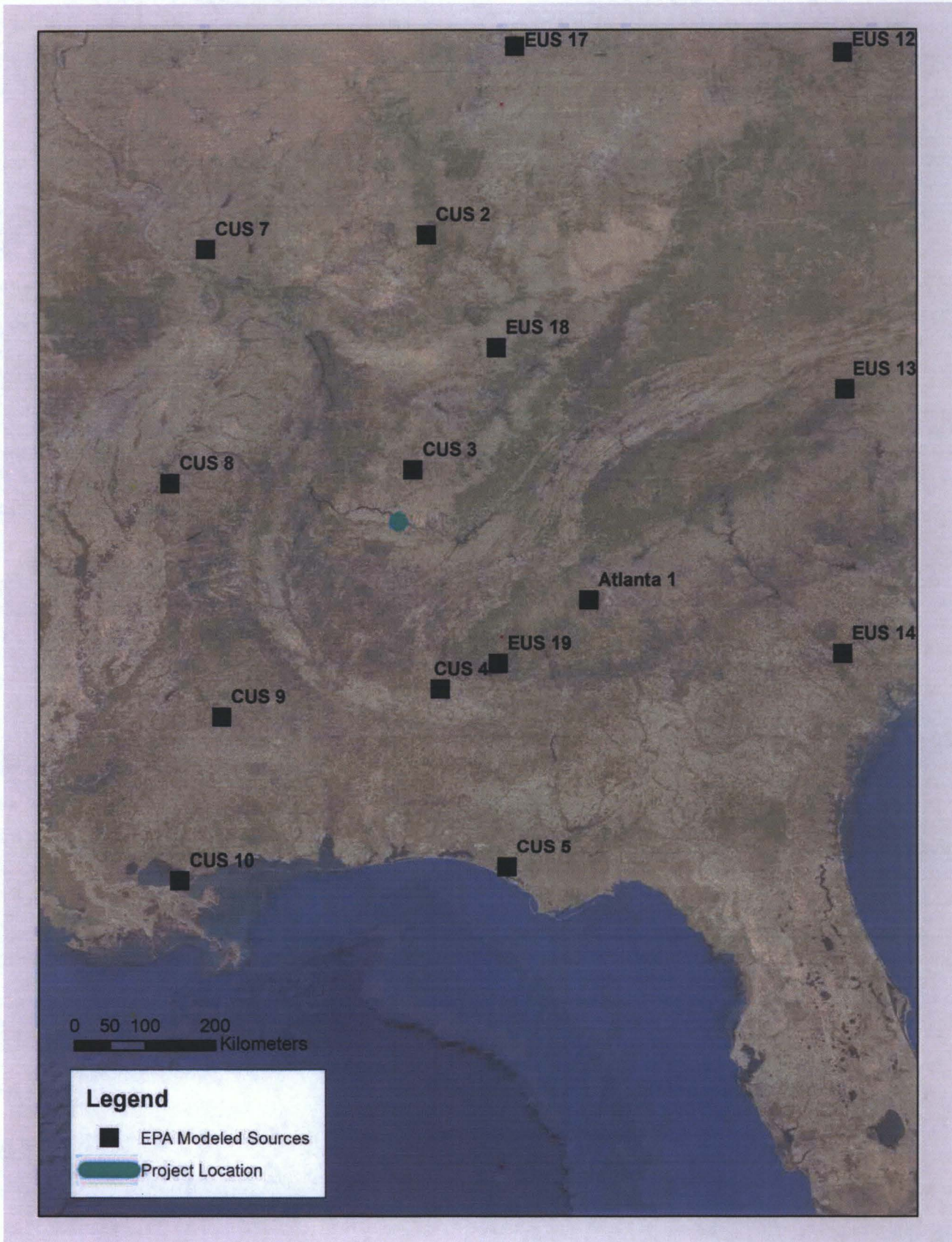


Figure 7: Slide 8 from Recent PowerPoint Presentation Provided by ADEM

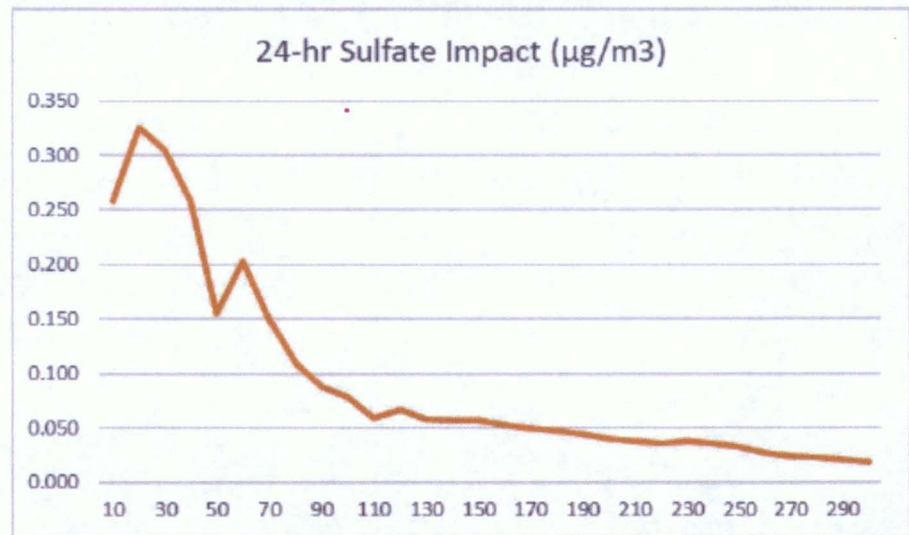
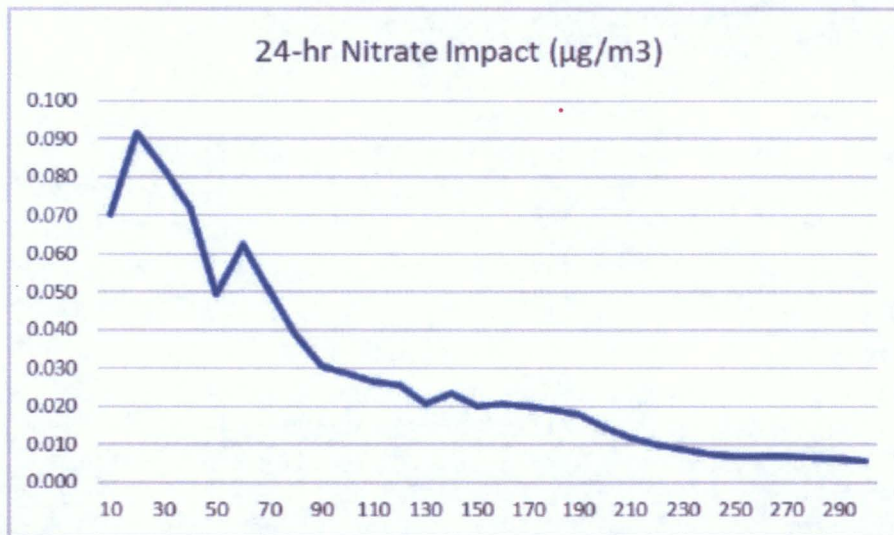
Tier 1 Demonstration: Class I Analysis Example (Daily PM_{2.5})

Example: A small, surface-level source in central Florida with 100 tpy of NO_x and 100 tpy of SO₂ with 0.19 $\mu\text{g}/\text{m}^3$ concentration of Primary PM_{2.5} at 50 km and the nearest Class I area is 150 km away.

What to do when neither Step 1 – 3 will work and the nearest Class I area is significantly further than 50km?

The maximum predicted secondary concentrations are within 10 – 50 km of the source and decrease substantially with distance. Taking the conservative, maximum values from the MERPs may not work for all projects, requiring a more refined approach.

Alabama, Tallapoosa: 500 tpy, L Height (From MERPs Guidance Modeling)



TABLES

Table 1: Project Emissions

Pollutant	Actual Meltshop Emissions (tpy)	Future Meltshop Emissions (tpy)	Project Meltshop Emissions (tpy)	New Galv Line Emissions (tpy)	EAF Fugitive Emissions Increase (tpy)	LMF Fugitive Emissions Increase (tpy)	Caster Fugitive Emissions Increase (tpy)	Baghouse Dust Silo Emissions Increase (tpy)	Unpaved Road Emissions Increase (tpy)	Paved Road Emissions Increase (tpy)	Total Project Emissions Increase (tpy)	PSD Major Mod Threshold (tpy)	PSD Major? (Y/N)
TSP	385	429	44.7	3.92	7.24	1.552	0.181	0.060	2.69	3.91	64.2	25	Yes
PM ₁₀	385	429	44.7	3.92	4.20	0.900	0.105	0.060	0.285	0.782	54.9	15	Yes
PM _{2.5}	385	429	44.7	3.92	3.11	0.667	0.078	0.060	0.029	0.192	52.7	10	Yes
NO _x	333	756	423	35.22	--	--	--	--	--	--	458	40	Yes
SO ₂	105	630	525	0.31	--	--	--	--	--	--	525	40	Yes
CO	2,437	4,140	1,703	4.33	--	--	--	--	--	--	1707	100	Yes
VOC	95	234	139.1	0.28	--	--	--	--	--	--	139.4	40	Yes
Lead (Pb)	0.07	3.60	3.53	0.000	--	--	--	--	--	--	3.529	0.6	Yes

Table 2: Q/D Calculation for Sipsey with Project Emissions

Emissions Based on Increased Annual Throughput

Pollutant	Project Meltshop Emissions (tpy)	New Galv Line Emissions (tpy)	EAF Fugitive Emissions Increase (tpy)	LMF Fugitive Emissions Increase (tpy)	Caster Fugitive Emissions Increase (tpy)	Baghouse Dust Silo Emissions Increase (tpy)	Unpaved Road Emissions Increase (tpy)	Paved Road Emissions Increase (tpy)	Total Project Emissions Increase (tpy)
PM ₁₀	44.7	3.92	4.20	0.900	0.105	0.060	0.285	0.782	54.9
NO _x	423	35.2	--	--	--	--	--	--	458
SO ₂	525	0.31	--	--	--	--	--	--	525 ⁽¹⁾

Q =1037.8
D = 43 (km)
Q/D = 24.1

Emissions Based on Increased Hourly Throughput

Pollutant	Project Meltshop Emissions (tpy)	New Galv Line Emissions (tpy)	EAF Fugitive Emissions Increase (tpy)	LMF Fugitive Emissions Increase (tpy)	Caster Fugitive Emissions Increase (tpy)	Baghouse Dust Silo Emissions Increase (tpy)	Unpaved Road Emissions Increase (tpy)	Paved Road Emissions Increase (tpy)	Total Project Emissions Increase (tpy)
PM ₁₀	44.7	3.92	3.56	0.762	0.089	0.051	0.285	0.782	54.1
NO _x	492	35.2	--	--	--	--	--	--	527.5
SO ₂	670	0.31	--	--	--	--	--	--	670.1

Q =1251.7
D = 43 (km)
Q/D = 29.1

Table 3: Project Emission Rates and Release Parameters – Point Sources

Model ID	Project?	Source Description	Location (Lambert Conformal)			Exhaust Direction	Capped?	Emission Rates (grams/second)												Modeled Stack Exit Parameters			
			Easting (km)	Northing (km)	Elevation (m)			NO _x		SO ₂				CO		PM _{2.5}		PM ₁₀		Height (m)	Temp (K)	Velocity (m/s)	Diameter (m)
								1-hr	Ann	1-hr	3-hr	24-hr	Ann	1-hr	8-hr	24-hr	Ann	24-hr	Ann				
MSB1	Yes	Meltshop Baghouse 1	902.8150	-544.0970	178.0	Vert	No	7.08E+00	6.08E+00	9.63E+00	9.63E+00	9.63E+00	7.55E+00	2.56E+01	2.56E+01	6.43E-01	6.43E-01	6.43E-01	6.43E-01	45.7	394.3	14.4	7.9
MSB2	Yes	Meltshop Baghouse 2	902.9480	-544.1170	178.0	Vert	No	7.08E+00	6.08E+00	9.63E+00	9.63E+00	9.63E+00	7.55E+00	2.56E+01	2.56E+01	6.43E-01	6.43E-01	6.43E-01	6.43E-01	45.9	394.3	20.8	6.6
GALV2	Yes	New Galv Line	903.8400	-543.9480	178.0	Vert	No	1.01E+00	1.01E+00	8.89E-03	8.89E-03	8.89E-03	8.89E-03	1.25E-01	1.25E-01	1.13E-01	1.13E-01	1.13E-01	1.13E-01	64.9	444.3	6.4	1.8
NCS	Yes	North Caster Steam Vent	902.5770	-544.0230	178.0	Vert	No									9.08E-03	1.07E-02	1.22E-02	1.45E-02	16.8	324.8	16.8	1.4
SCS	Yes	South Caster Steam Vent	902.6010	-544.0680	178.0	Vert	No									9.08E-03	1.07E-02	1.22E-02	1.45E-02	39.9	324.8	16.8	1.1

Table 4: Project Emission Rates and Release Parameters – Paved Road Sources

Model ID	Project?	Source Description	Location (Lambert Conformal)			Physical Parameters	Emission Rates (grams/second/square meter)				Modeled Parameters		
			Easting (km)	Northing (km)	Elevation (m)		Area (m²)	PM _{2.5}		PM ₁₀		Release Hgt (m)	Sz Init (m)
								24-hr	Ann	24-hr	Ann		
Road_01	Yes	Paved road segment 1	903.3300	-544.356	178.0	14720.0	7.20E-08	7.20E-08	2.93E-07	2.93E-07	1.6	0.7	
Road_02	Yes	Paved road segment 2	902.4170	-544.443	178.0	2000.0	7.20E-08	7.20E-08	2.93E-07	2.93E-07	1.6	0.7	
Road_03	Yes	Paved road segment 3	902.6720	-544.343	178.0	4320.0	7.20E-08	7.20E-08	2.93E-07	2.93E-07	1.6	0.7	
Road_04	Yes	Paved road segment 4	902.7690	-542.817	178.0	6400.0	7.20E-08	7.20E-08	2.93E-07	2.93E-07	1.6	0.7	
Road_05	Yes	Paved road segment 5	902.8310	-543.186	178.0	4320.0	7.20E-08	7.20E-08	2.93E-07	2.93E-07	1.6	0.7	
Road_06	Yes	Paved road segment 6	903.0880	-543.150	178.0	6400.0	7.20E-08	7.20E-08	2.93E-07	2.93E-07	1.6	0.7	
Road_07	Yes	Paved road segment 7	903.4460	-543.450	178.0	1600.0	7.20E-08	7.20E-08	2.93E-07	2.93E-07	1.6	0.7	
Road_08	Yes	Paved road segment 8	901.9920	-544.493	178.0	10400.0	7.20E-08	7.20E-08	2.93E-07	2.93E-07	1.6	0.7	
Road_09	Yes	Paved road segment 9	902.0700	-543.690	178.0	3040.0	7.20E-08	7.20E-08	2.93E-07	2.93E-07	1.6	0.7	
Road_10	Yes	Paved road segment 10	902.7830	-542.812	178.0	6400.0	7.20E-08	7.20E-08	2.93E-07	2.93E-07	1.6	0.7	
Road_11	Yes	Paved road segment 11	902.9680	-542.444	178.0	15200.0	7.20E-08	7.20E-08	2.93E-07	2.93E-07	1.6	0.7	
Road_12	Yes	Paved road segment 12	902.8470	-541.493	178.0	1840.0	7.20E-08	7.20E-08	2.93E-07	2.93E-07	1.6	0.7	

Table 5: Project Emission Rates and Release Parameters – Unpaved Road Sources

Model ID	Project?	Source Description	Location (Lambert Conformal)			Physical Parameters	Emission Rates (grams/second/square meter)				Modeled Parameters		
			Easting (km)	Northing (km)	Elevation (m)		Area (m²)	PM _{2.5}		PM ₁₀		Release Hgt. (m)	Sz Init. (m)
								24-hr	Ann	24-hr	Ann		
Unpaved	Yes	All unpaved roads	902.168	-543.936	178.0	707585.8	1.16E-09	1.16E-09	1.16E-08	1.16E-08	2.6	1.2	

Table 6: Non-Default CALPUFF Switch Settings

Parameter	Description	Default Value	Proposed Value	Notes
Group 3(a)				
	Species list	No Default	SO ₂ , SO ₄ , NO _x , HNO ₃ , NO ₃ , PM1000, PM1500, EC	MESOPUFF speciation of SO _x and NO _x emissions. AP-42 emission factor (Table 12-5.2) and species distribution for PM from electric arc furnaces controlled by a baghouse. Fine PM modeled as elemental carbon for regional haze impacts.
Group 4				
PMAP	Map projection	UTM	LCC	Matches the value in the CALMET input file
RLAT0	Latitude of projection origin	No Default	40N	Matches the value in the CALMET input file
RLON0	Longitude of projection origin	No Default	97W	Matches the value in the CALMET input file
XLAT1	Matching parallel(s) of latitude for projection	No Default	33N	Matches the value in the CALMET input file
XLAT2	Matching parallel(s) of latitude for projection	No Default	45N	Matches the value in the CALMET input file
DATUM	Datum-region for output coordinates	WGS-84	NWS-84	Matches the value in the CALMET input file
NX	No. X grid cells	No Default	248	Matches the value in the CALMET input file
NY	No. Y grid cells	No Default	257	Matches the value in the CALMET input file
NZ	No. vertical layers	No Default	10	Matches the value in the CALMET input file
DGRIDKM	Grid spacing	No Default	4 (km)	Matches the value in the CALMET input file
ZFACE	Cell face heights	No Default	0, 20, 40, 80, 120, 180, 260, 400, 600, 800, 1200, 2000, 3500	Matches the value in the CALMET input file
XORIGKM	Reference Coordinates of SOUTHWEST corner of grid cell (1, 1)	No Default	718.005	Matches the value in the CALMET input file

Table 6: Non-Default CALPUFF Switch Settings con't

Parameter	Description	Default Value	Proposed Value	Notes
YORIGKM	Reference Coordinates of SOUTHWEST corner of grid cell (1, 1)	No Default	-1214.003	Matches the value in the CALMET input file
IBCOMP	X index of LL corner; computational grid	No Default	25	Computational grid is a subset of the meteorological grid.
JBCOMP	Y index of LL corner; computational grid	No Default	145	Computational grid is a subset of the meteorological grid.
IECOMP	X index of UR corner; computational grid	No Default	59	Computational grid is a subset of the meteorological grid.
JECOMP	Y index of UR corner; computational grid	No Default	181	Computational grid is a subset of the meteorological grid.
LSAMP	Logical flag indicating if gridded receptors are used	T	F	Gridded receptors not used.
IBSAMP	X index of LL corner; sampling grid	No Default	0	
JBSAMP	Y index of LL corner; sampling grid	No Default	0	
IESAMP	X index of UR corner; sampling grid	No Default	0	
JESAMP	Y index of UR corner; sampling grid	No Default	0	
Group 5				
IPRTU	Print output units	1	3	Output options.
Group 6				
MHILL	Terrain and CTSG Receptor data for CTSG hills input in CTDM format?	No Default	0	Subgrid scale complex terrain inputs not used

Table 6: Non-Default CALPUFF Switch Settings con't

Parameter	Description	Default Value	Proposed Value	Notes
Group 7				
Dry Gas Deposition	Chemical parameters of gaseous deposition species	User Defined	SO ₂ =0.1509, 1000,8,0,0.04 NO _x =0.1656,1,8, 5,3.5 HNO ₃ =0.1628,1, 18,0,8E-8	Default values provided in CALPUFF user's guide.
Group 8				
Dry Particulate Deposition	Size parameters of particulate deposition species	User Defined	SO ₄ : 0.48, 2.0 NO ₃ : 0.48, 2.0 PM ₁₀₀₀ : 10.0, 2.0 PM ₁₅₀₀ : 15.0,2.0 EC: 0.50, 2.0	Use default values for all except PM ₁₀₀₀ , PM ₁₅₀₀ , which are from AP42, Table 12.5-2 (Metric And English Units). SIZE SPECIFIC EMISSION FACTORS for Electric arc furnace Fine PM is modeled as EC for visibility purposes
Group 10				
Wet Dep	Wet deposition parameters	User Defined	See Notes	Use values in Table 2-10 of CALPUFF User's guide; PM ₁₀₀₀ , PM ₁₅₀₀ , EC Liquid Precip = 1.0E-04; Frozen Precip = 3.0E-05 (same as fine PM)
Group 11				
BCKNH3	Ammonia background (ppb)	10	0.5	Appropriate for forest land per FLAG (2010)
SVMIN	Minimum turbulence velocities	.50, .50, .50, .50, .50, .50, .37, .37, .37, .37, .37, .37, .37, .37	0.50, 0.50, 0.50, 0.50, 0.50, 0.50, 0.50, 0.50, 0.50, 0.50, 0.50, 0.50, 0.50	MREG=1

Table 7: Non-Default CALPOST Switch Settings

Parameter	Description	Default Value	Proposed Value	Notes
Group 1				
ASPEC	Species to process	No Default	Varies by AQRV	CALPOST run separately for each AQRV analysis
ILAYER	Layer/deposition code	1	1 or -3	Set to 1 for VISIB; Set to -3 for wet + dry deposition
LD	Discrete receptors processed	F	T	
NDRECP	Receptors to process	-1	148	Set to number of receptors at Sipsey WA
Group 2 for Visibility				
LVOC, LVPMF	Modeled species to be included in computing light extinction	T	F	Project is not emitting organic carbon and all fine PM is being treated as elemental carbon (conservatively) for visibility processing
SPECPMC, SPECPMF	Species name used for particulates in CALPOST input file	PMC, PMF	PM10, PM25	
RHFAC	monthly RH adjustment factor in place of an hourly RH factor	No Default	0 for all months	
BKSO4, BKNO3, BKPMC, BKOC, BKSOIL, BKEC, BKSALT, RHFSML, RHFLRG, RHFSEA, BEXTRAY	Background extinction coefficients	No Default	See Notes	Used values from FLAG (2010) Table 6 through Table 9
Group 3				
IPRTU	Units for outputs	1	3 or 1	Set to 3 for micrograms/cubic meter; Set to 1 for deposition (g/m ² /s)

Table 8: Speciated Particulate Emissions for the Electric Arc Furnace

Particle Size	Size Distribution (%)	Particle Diameter (μm)	Standard Deviation of Diameter (μm)	Modeled Species
< 10 μm	74	0.5	2	EC (elemental carbon)
10 μm	2	10	2	PM1000
> 10 μm	24	15	2	PM1500

Table 9: CALPUFF Regional Haze Results

Year	Number of Days with Change in Extinction > 5%	98 th Percentile Change in Extinction
2001	0	1.18
2002	0	0.89
2003	0	1.05

Table 10: CALPUFF Deposition Results

Nitrogen Deposition

Area	Maximum Impact Location		Maximum Impact (g/m ² /s)	Maximum Impact ⁽¹⁾ (kg/ha/yr)	DAT ⁽²⁾ (kg/ha/yr)	Percent of DAT
	LCC X	LCC Y				
	(km)	(km)				
Sipsey	881.500	-582.675	2.39E-11	0.0076	0.010	76

Sulfur Deposition

Area	Maximum Impact Location		Maximum Impact (g/m ² /s)	Maximum Impact ⁽¹⁾ (kg/ha/yr)	DAT ⁽²⁾ (kg/ha/yr)	Percent of DAT
	LCC X	LCC Y				
	(km)	(km)				
Sipsey	882.064	-580.756	6.19E-11	0.0196	0.010	196

⁽¹⁾ Units are converted by multiplying model output by 10*3600*(hours/year)

⁽²⁾ DATs are from FLAG (2010) and <http://www.nature.nps.gov/air/Pubs/pdf/flag/nsDATGuidance.pdf>

Table 11: Class I Air Quality Impacts (maximum of both meteorological datasets)

Pollutant	Averaging Period	Maximum Project Impacts ($\mu\text{g}/\text{m}^3$)	Class I SIL ($\mu\text{g}/\text{m}^3$)	Percent of Class I SIL	Source
NO ₂	1-hour	3.85	n/a	n/a	Not proposed or codified.
	Annual	0.03	0.1	28	From 61 FR 38292 (July 23, 1996)
SO ₂	1-hour	4.63	n/a	n/a	Not proposed or codified.
	3-hour	2.18	1.0	218	From 61 FR 38292 (July 23, 1996)
	24-hour	0.43	0.2	215	From 61 FR 38292 (July 23, 1996)
	Annual	0.03	0.1	29	From 61 FR 38292 (July 23, 1996)
PM ₁₀	24-hour	0.03	0.3	12	From 61 FR 38292 (July 23, 1996)
	Annual	0.003	0.2	2	From 61 FR 38292 (July 23, 1996)
PM _{2.5}	24-hour	0.035 ⁽¹⁾	0.27	13	Guidance on Significant Impact Levels for Ozone and Particles in the Prevention of Significant Deterioration Permitting Program (EPA, April 2018)
	Annual	0.003 ⁽¹⁾	0.05	6	Guidance on Significant Impact Levels for Ozone and Particles in the Prevention of Significant Deterioration Permitting Program (EPA, April 2018)

⁽¹⁾ Direct PM_{2.5} only.

Table 12: Step 1 MERPs Analysis for Secondary PM_{2.5} and Ozone

Secondary Pollutant	Precursor	Height	Modeled Emissions (tpy)	Maximum EPA Modeled Impact for Eastern US #19 (µg/m ³)	Class I Significant Impact Level (µg/m ³)	Calculated Emission Threshold (tpy)	Project Emissions (tpy)	Ratio of Project Emissions to Emission Threshold	Potential Secondary Impact (µg/m ³)	Modeled Primary Impact ⁽¹⁾ (µg/m ³)	Total Impact (µg/m ³)	Is Total Impact > Class I SIL?
24-hour PM _{2.5}	NOx	H	500	0.05	0.27	0.27*(500/.05) = 2,700	458	458/2700 = 0.17	0.27*(0.17+0.89) = 0.29	0.035	0.29+0.03 = 0.325	Yes
	SO ₂	H	500	0.23		0.27*(500/0.23) = 587	525	525/587 = 0.89				
Annual PM _{2.5}	NOx	H	500	0.001	0.05	0.05*(500/.001) = 25,000	458	458/25000 = 0.02	0.05*(0.02+0.11) = 0.01	0.003	0.01+0.003 = 0.013	No
	SO ₂	H	500	0.005		0.05*(500/.005) = 5,000	525	525/5000 = 0.11				

⁽¹⁾ Modeled primary impacts are from AERMOD project-only results. See Table 11.

Table 13: Step 2 MERPs Analysis for Secondary PM_{2.5} and Ozone

Secondary Pollutant	Precursor	Height	Modeled Emissions (tpy)	EPA Modeled Impact at 50 km for Eastern US #19 (µg/m³)	Class I Significant Impact Level (µg/m³)	Calculated Emission Threshold (tpy)	Project Emissions (tpy)	Ratio of Project Emissions to Emission Threshold	Potential Secondary Impact (µg/m³)	Modeled Primary Impact ⁽¹⁾ (µg/m³)	Total Impact (µg/m³)	Is Total Impact > Class I SIL?
24-hour PM _{2.5}	NOx	L	500	0.055	0.27	0.27*(500/.055) = 2,455	458	458/2455 = 0.19	0.27*(0.19+0.68) = 0.234	0.035	0.234+0.035 = 0.269	No
	SO ₂	L	500	0.175		0.27*(500/0.175) = 771	525	525/771 = 0.68				

⁽¹⁾ Modeled primary impacts are from AERMOD project-only results. See Table 11.

Table 14: Cumulative SO₂ Impacts at Sipsey WA

Pollutant	Averaging Period	2008 ADEM-Predicted Increment Impacts ¹ (µg/m ³)	Maximum Predicted Impacts from 2015 PSD Permit Application ² (µg/m ³)	Maximum Predicted Impacts from Current Project (µg/m ³)	Cumulative Predicted Impacts (µg/m ³)	Class Increment (µg/m ³)
SO ₂	3-hour	14.42	0.23	2.18	16.83	25
SO ₂	24-hour	2.13	1.17	0.43	3.73	5

¹ Cumulative Class I SO₂ Analysis for the Sipsey Wilderness Area provided by ADEM to Brad Arnold (SLR) on 4/12/2018.

² ERM (2016)

APPENDIX E

CLASS II MODELING REPORT

Prevention of Significant Deterioration and Title V Permits Significant Modification Application

Nucor Steel
4301 Iverson Blvd
Trinity, AL 35673

November 2018

NUCOR STEEL DECATUR, LLC NEW GALVANIZATION LINE PROJECT

Class II Area Dispersion Modeling Report

Prepared for: Nucor Steel Decatur, LLC

November 2018

A large, stylized graphic in the bottom half of the page. It features a thick black curved line that starts from the left edge and sweeps upwards and to the right. Inside this curve, there is a white curved shape. The letters "SLR" are printed in a bold, white, sans-serif font in the bottom right corner of the graphic area.

SLR

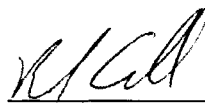
Class II Area Dispersion Modeling

Prepared for:

Nucor Steel Decatur, LLC

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This document has been prepared by SLR International Corporation. The material and data in this report were prepared under the supervision and direction of the undersigned.



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Contents

1. INTRODUCTION.....	1-1
1.1 Area Classification	1-2
2. DISPERSION MODELING PROCEDURES	2-1
2.1 Model Selection.....	2-1
2.2 Model Options.....	2-1
2.3 Urban Source Classification	2-1
2.4 Downwash	2-1
2.5 Meteorological Data Processing.....	2-2
2.5.1 On-Site Data	2-2
2.5.2 National Weather Service (NWS) Data.....	2-2
2.5.3 NWS Upper Air Data.....	2-3
2.5.4 Surface Characteristics.....	2-3
2.5.5 Seasonal Classification and Soil Moisture Determination	2-4
2.5.6 AERMET Stage 3	2-4
2.6 Emissions Inventory.....	2-4
2.6.1 New and Modified Sources	2-4
2.6.2 Existing Facility Sources.....	2-5
2.6.3 Nearby Sources	2-5
2.7 Background Concentrations	2-5
2.8 Ambient Air Boundary	2-6
2.9 Receptor Network	2-6
2.10 NO ₂ Modeling	2-6
3. Modeling Analyses	3-1
3.1 Modeled Design Concentrations.....	3-1
3.2 Significant Impact Analysis	3-1
3.2.1 Secondary Particulate and Ozone Formation	3-1
3.3 NAAQS Analysis	3-2
3.4 PSD Increment Impact Analysis.....	3-3
4. Additional Impact Analysis	4-4
4.1 Growth Analysis.....	4-4
4.2 Visibility Analysis	4-4
4.3 Soil and Vegetation Impact Analysis	4-4
5. Works Cited	5-1
Figure 1: Area Map	2
Figure 2: Local Map	2
Figure 3: Digitized Facility Structures.....	2
Figure 4: Digitized Facility Emission Units.....	2
Figure 5: Pryor Field Wind Rose	2
Figure 6: Near-Field Receptor Grids	2
Figure 7: Far-Field Receptor Grids.....	2

Figure 8: Cumulative 1-hour SO ₂ Modeling	2
Table 1: Estimated Project Emissions	4
Table 2: National Ambient Air Quality Standards	5
Table 3: Class II PSD Increments	6
Table 4: Pre-Construction Ambient Air Quality Concentrations	7
Table 5: Modeled Emission Rates and Release Parameters – Project and Existing Point Sources	8
Table 6: Modeled Emission Rates and Release Parameters – Nearby NO ₂ Point Sources	9
Table 7: Modeled Emission Rates and Release Parameters – Nearby SO ₂ Point Sources	15
Table 8: 2-Year Average SO ₂ Emissions for Ascend	18
Table 9: Background Concentrations	19
Table 10: Modeled Design Concentrations	20
Table 11: Nucor Meteorological Data Project Impacts Compared to Class II PSD SILs ⁽¹⁾	21
Table 12: Pryor Field Meteorological Data Project Impacts Compared to Class II PSD SILs ⁽¹⁾	22
Table 13: Step 1 MERPs Analysis for Secondary PM _{2.5} and Ozone	23
Table 14: Step 2 MERPs Analysis for Secondary PM _{2.5} and Ozone	24
Table 15: Step 3 MERPs Analysis for Secondary PM _{2.5} and Ozone	25
Table 16: Nucor Meteorological Data Cumulative Impacts and Comparison to the NAAQS	26
Table 17: Pryor Field Meteorological Data Cumulative Impacts and Comparison to the NAAQS	26
Table 18: Nucor Meteorological Data MAXDCONT Output for 1-hour SO ₂ Cumulative Impacts Above the Standard	27
Table 19: Pryor Field Meteorological Data MAXDCONT Output for 1-hour SO ₂ Cumulative Impacts Above the Standard	28
Table 20: Ozone Design Concentrations	29
Table 21: Cumulative Ozone Results	30
Table 22: Nucor Meteorological Data Project-Only Lead Impacts	31
Table 23: Pryor Field Meteorological data Project-Only Lead Impacts	31

1. INTRODUCTION

Nucor Steel Decatur, LLC, a subsidiary of Nucor Corporation (collectively Nucor), owns and operates a steel recycling mill in Trinity, Morgan County, Alabama (the Decatur Steel Mill). The mill is categorized under the Standard Industrial Classification (SIC) code 3312: Steel Works, Blast Furnaces (including Coke Ovens), and Rolling Mills. The mill is a major stationary source under the Title V Operating Permit Program administered by the Alabama Department of Environmental Management (ADEM) under Air Pollution Control Program, Chapter 335-3-10. The mill currently operates under Title V Permit No. 712-0037 which expires September 5, 2021.

In this permit application Nucor and the Decatur Steel Mill seek to expand the facility by adding a new galvanization line and debottlenecking the existing meltshop. The project will include the following changes at the facility:

- A new 500,000 metric tonnes per year (TPY) Galvanizing Line with a natural gas ceiling of 120 MMBtu/hour;
- A third Ladle Metallurgical Furnace (LMF) Station;
- Four new Electric Arc Furnace (EAF) transformers (two per furnace), upgrading from the current rating of 75 megavolt-ampere (MVA) to 90 MVA;
- Increase in the slab width to 68 inches;
- The addition of an eighth casting segment on both casters;
- Upgrade to the existing charge crane; and
- An increase in the annual liquid metal limit production from 3.2 million tons per year (MM tpy) to 3.6 MM tpy and an increase in the hourly limit increased from 440 tons per hour (tph) to 540 tph.

Table 1 provides a summary of the project emissions compared to the Prevention of Significant Deterioration (PSD) major modification thresholds. The following pollutants trigger PSD review and therefore a dispersion modeling analysis to demonstrate compliance with the applicable air quality standards: PM₁₀, PM_{2.5}, NO₂, SO₂, CO, and lead. Figure 1 and Figure 2 **Error! Reference source not found.** provide illustrations of the project area.

The general contents of this modeling report were discussed at the pre-protocol meeting on December 14, 2017 with ADEM, Nucor, and SLR and summarized in a modeling protocol. This modeling report defines the regulatory framework and technical methods that were used for the PSD Class II compliance demonstration that is required to support the permit application. The modeling analysis was conducted in accordance with guidance provided by ADEM and the Environmental Protection Agency (EPA) as outlined in the following documents:

- PSD Air Quality Analysis Modeling Guidelines (Alabama Department of Environmental Management, 2018).

- Guideline on Air Quality Models [published as 40 CFR 58, Appendix W] (EPA, 2017) hereafter referred to as the Appendix W; and
- The Air Quality Checklist (EPA, 2016).

Table 2 provides a list of all pollutants to be modeled, along with the applicable National Ambient Air Quality Standards (NAAQS), for each pollutant and averaging period. The applicable Class II PSD increments are listed in Table 3.

A far field, Class I area impact analysis was also performed for this project in order to demonstrate compliance with the Class I PSD increments and air quality related values (AQRVs). The far field, Class I area modeling protocol will be submitted under separate cover.

1.1 AREA CLASSIFICATION

Morgan County, Alabama is currently classified as attainment or unclassifiable for all NAAQS, therefore is subject to PSD review. As part of PSD, the pre-construction ambient air quality monitoring requirement is contained in 40 CFR 52.21(m). This requires that a PSD permit application include data representative of conditions in the vicinity of the project in the year preceding receipt of the application. Appropriate air quality concentrations are summarized in Table 4.

2. DISPERSION MODELING PROCEDURES

2.1 MODEL SELECTION

SLR used the current version of the EPA-approved American Meteorological Society/EPA Regulatory Model (AERMOD) modeling system, available at the time of application submittal, to meet the dispersion modeling requirements for this analysis. AERMOD is recommended for use in modeling multi-source emissions, and can account for plume downwash, stack tip downwash, and point, area, and volume sources (EPA, 2018b).

Current version numbers of the AERMOD model and pre-processors that were used include:

- AERMAP version 18081,
- AERMET version 18081, and
- AERMOD version 18081.

Copies of the approved modeling protocols are provided in Appendix A.

2.2 MODEL OPTIONS

All model input options were set to their regulatory default values.

2.3 URBAN SOURCE CLASSIFICATION

An Auer land-use analysis, as described in 40 CFR 51 Appendix W was conducted to determine the appropriate dispersion coefficients to use in the AERMOD model. Less than 50 percent of the area within a 3 km radius of either the Pryor Field tower or the assumed Nucor meteorological monitoring tower could be classified as land use types I1, I2, C1, R2, or R3 (heavy industrial, light/moderate industrial, commercial, compact residential (single family), or compact residential (multi-family), respectively). Therefore, the URBANOPT keyword in AERMOD was not used.

2.4 DOWNWASH

The effects of plume downwash were considered for all project point sources, based on building locations and heights relative to facility emission sources. Direction-specific downwash parameters were calculated using the current version of the EPA-approved Building Profile Input Program (BPIPPRM Version 04274). Building dimensions for new structures was obtained from information provided by Nucor, while building dimensions for existing structures was obtained from a recent PSD permit application prepared for the facility (ERM, 2016).

In addition to calculating direction-specific building dimensions, the BPIPPRM program also calculates the Good Engineering Practice (GEP) stack height. All Nucor facility stack heights were checked to verify that they are within the GEP stack height limit.

The base elevation of all structures and emission units (EUs) will be set to 178 m, which was the ground-level elevation used in Nucor's 2016 PSD permit application (ERM, 2016). This is also in good agreement with the ground-level elevation shown on Google Earth. A simplified plot plan of the facility, showing the location of all structures and point source locations used in the plume downwash calculations and including structure dimensions and heights, is provided in Figure 3 and Figure 4. **Error! Reference source not found..**

2.5 METEOROLOGICAL DATA PROCESSING

Hourly meteorological data used for air quality modeling must be spatially and climatologically representative of the area of interest. Appendix W recommends a minimum of one year of site-specific meteorological data or five consecutive years from the most recent, readily available data collected at a representative National Weather Service (NWS) station. Required surface meteorological data inputs to the AERMOD meteorological processor (AERMET) include, at minimum, hourly observations of wind speed, wind direction, temperature, and cloud cover (or solar radiation and low-level vertical temperature difference data in lieu of cloud cover). The meteorological processor also requires morning upper air sounding data from a representative NWS station.

2.5.1 ON-SITE DATA

On-site surface meteorological data are not available for this facility.

2.5.2 NATIONAL WEATHER SERVICE (NWS) DATA

The nearest NWS surface observing station is located at Pryor Field (WBAN No. 53852), approximately 13 km east of the Nucor facility. Hourly average and 1-minute average Automated Surface Observing Systems (ASOS) data are available for this station.

At a meeting at the ADEM offices on December 14, 2017 ADEM indicated that they would provide processed data for use in the permit application. On April 30, 2018 ADEM provided a 5-year meteorological dataset (calendar years 2012-2016) from the Pryor Field station. This dataset included AERMOD-ready processed surface and profile files (.sfc and .pfl), merged output files from AERMET Stage 2, AERSURFACE output files, and AERSURFACE processing instructions. ADEM included surface and profile files processed with and without the ADJ-U* option in AERMET Stage 3. For reasons discussed in Section 2.5.6 SLR used the data files processed with the ADJ_U* option. A composite wind rose for calendar years 2012-2016 is provided in Figure 5.

2.5.3 NWS UPPER AIR DATA

The temperature structure of the atmosphere prior to sunrise is required by AERMET to estimate the growth of the convective boundary layer for the day. AERMET uses the 1200 Greenwich Mean Time (GMT) upper air sounding from the provided NWS upper-air observing station for this purpose.

ADEM used concurrent upper-air data from the Nashville, TN NWS surface station in their AERMET processing.

2.5.4 SURFACE CHARACTERISTICS

Final processing of the meteorological data requires assigning appropriate surface characteristics including surface roughness length (z_0), Bowen Ratio (B_0) and albedo (r). Surface characteristics were assigned following guidance provided in the current version of the AERMOD Implementation Guide (AIG) (EPA, 2018c).

The AIG recommends that the surface characteristics be determined based on digitized land cover data. EPA has developed the AERSURFACE processor (EPA, 2013) that was used to determine the site characteristics based on digitized land cover data in accordance with the recommendations from the AIG discussed above. AERSURFACE incorporates look-up tables of representative surface characteristic values by land cover category and seasonal category. The current version of AERSURFACE provided by EPA (version 13016) supports the use of land cover data from the United States Geological Survey (USGS) National Land Cover Data 1992 archives (NLCD92).

ADEM provided data processed with Pryor Field NLCD92 surface characteristics. As noted by ADEM (2018b), surface characteristics at airports may be different from those at an application site. To account for this, ADEM required that Nucor process the Pryor Field/Nashville data using surface characteristics representative of the Nucor site, run AERMOD with both datasets (the ADEM-processed dataset using Pryor Field surface characteristics and the Nucor-processed dataset using Nucor surface characteristics), and report the highest concentration from the two datasets for each modeled pollutant and averaging period.¹

Per ADEM' request, an analysis of the surface characteristics analyses is provided in the modeling protocol. Review of the surface characteristics indicates that Pryor Field is not adequately representative of the current facility, therefore duplicate AERMOD runs were performed using meteorological data processed at both the facility and NWS site. The most conservative results were used for establishing significant impacts and compliance with air quality standards.

AERSURFACE requires that the meteorological tower location be input so that appropriate surface characteristics in the vicinity of the tower can be obtained from the NLCD92 data file. For purposes of running AERSURFACE, SLR assumed that the Nucor "tower" is located near the approximate center of the mill. This location is the same as was used for the 2016 permit application (ERM, 2016).

¹ This was discussed at the pre-protocol meeting on December 14, 2017 with ADEM, Nucor, and SLR.

2.5.5 SEASONAL CLASSIFICATION AND SOIL MOISTURE DETERMINATION

In AERSURFACE, the various land cover categories are linked to a set of seasonal surface characteristics. As such, AERSURFACE requires specification of the seasonal category for each month of the year. The following five seasonal categories are offered by AERSURFACE:

- Midsummer with lush vegetation;
- Autumn with un-harvested cropland;
- Late autumn after frost and harvest, or winter with no snow;
- Winter with continuous snow on ground; and
- Transitional spring with partial green coverage or short annuals.

To determine the Bowen ratio, the land use values are linked to three categories of surface moisture corresponding to average, wet, and dry conditions. The surface moisture conditions for the site may vary depending on the meteorological data period for which the surface characteristics are applied. As recommended in the AERSURFACE User's Guide, the surface moisture condition for each month should be determined by comparing precipitation for the period of data to be processed to the 30-year climatological record. "Wet" conditions are selected if precipitation was in the upper 30th percentile, "dry" conditions if precipitation was in the lower 30th percentile, and "average" conditions if precipitation was in the middle 40th percentile.

As indicated in Section 2.5.2 ADEM provided AERSURFACE processing instructions on April 30, 2018. These included recommendations for assigning each month of the year to the proper season as well as the appropriate soil moisture condition to assume for each calendar year processed. These values were used as input to AERSURFACE, along with the NLCD92 data.

2.5.6 AERMET STAGE 3

ADEM's AERMET Stage 2 output, along with the AERSURFACE output files processed with Nucor surface characteristics, were input to AERMET Stage 3 to produce model-ready surface and profile files for calendar years 2012 through 2016. Given that NWS data do not include turbulence measurements, use of the ADJ_U* option is appropriate.

2.6 EMISSIONS INVENTORY

2.6.1 NEW AND MODIFIED SOURCES

As described in Section 1, the project consists of construction of a new galvanizing line (Galvanizing Line #2). Emissions from this source will be collected and vented through a single stack. For modeling purposes it was assumed that the new galvanizing line will operate for 8,760 hours per year at its maximum potential to emit.

In addition, the project will result in net emissions increases from several existing sources:

- Melt Shop Baghouses 1 and 2;

- North Caster Steam Vent; and
- South Caster Steam Vent.

Emissions from the Melt Shop Baghouses and North/South Caster Steam Vents are vented through individual stacks and were modeled as point sources that operate 8,760 hours per year. The emission rates were set equal to their post-project potential to emit minus the most recent 2 years of actual emissions (i.e., future potentials minus current actuals).

Emission rates and release parameters for all project sources are provided in Table 5 and **Error! Reference source not found.** Descriptions of how modeled source locations, release parameters, and emission rates were derived are provided below. An illustration showing the location of all Nucor emission sources that were included in the modeling is provided in Figure 4. The source location and stack parameters for the new Galvanizing Line stack were provided by Nucor. Source locations and stack parameters for existing sources were obtained from the previous PSD permit application (ERM, 2016).

2.6.2 EXISTING FACILITY SOURCES

For those pollutants with project-only impacts above the SILs, cumulative modeling was performed to demonstrate compliance with the applicable air quality standards. As discussed in Section 3.2 project-only modeling indicates that impacts due to the net increase in emissions were less than the applicable PM₁₀ and PM_{2.5} SILs, but above the 1-hour NO₂ and SO₂ SILs. Emission rates and release parameters for all existing Nucor sources that were included in the cumulative impact analysis are provided in Table 5. For modeling purposes it was assumed that each EU will be operated full time (8,760 hours per year, 24 hours per day) at maximum allowable emission rates.

2.6.3 NEARBY SOURCES

Appendix W requires that the cumulative impact analysis include nearby sources, which are those sources located in the vicinity of the project source and that are not adequately represented by ambient monitoring data. Nearby sources cause a significant concentration gradient in the vicinity of the project and are explicitly included in the modeled source inventory. An off-site source inventory for 1-hour SO₂ and 1-hour NO₂ was provided by ADEM (see Table 6 and Table 7).² ADEM also provided 2-year averaged actual SO₂ emissions for the nearby Ascend facility (see Table 8**Error! Reference source not found.**).³ This data was used as provided by ADEM.

2.7 BACKGROUND CONCENTRATIONS

Background ambient air quality concentrations are added to model-predicted impacts to determine the cumulative potential ambient air quality impact in the vicinity of the facility being modeled. Background concentrations are current levels of ambient air pollution, external to the facility's own impacts and

² Email from Jennifer Youngpeter (ADEM) to Brad Arnold (SLR) re: Nucor Decatur Offsite Modeling Inventory Request. April 19, 2018.

³ Email from Jennifer Youngpeter (ADEM) to Brad Arnold (SLR) FW: 2-year Average Actual Emissions - Ascend. May 7, 2018.

those of nearby sources, which are the result of non-modeled point, area, and mobile sources of air pollution. The background concentrations used in this analysis are provided in Table 9.

2.8 AMBIENT AIR BOUNDARY

A drawing showing the ambient air boundary relative to the facility is provided in Figure 1. Access roads into the facility, as well as a north-south rail spur on the east side of the property, are posted to prevent trespassing on these roads, and the plant property is regularly patrolled by Nucor personnel.

2.9 RECEPTOR NETWORK

Cartesian receptor grids centered on the facility were defined using the Universal Transverse Mercator (UTM) Zone 16, NAD83 coordinate system. The grids were designed to accurately resolve the highest predicted pollutant impacts while at the same time allowing for reasonable execution time. The grids consist of a set of nested receptors placed at:

- 100-meter resolution along the ambient air boundary⁴.
- 100-meter resolution extending to a distance of approximately 1 km from the ambient air boundary.
- 250-meter resolution extending to approximately 5 km from the ambient air boundary.
- 500-meter resolution extending to approximately 10 km from the ambient air boundary.
- 1,000-meter resolution extending to approximately 20 km from the ambient air boundary.

Receptor elevation and scale heights were obtained using the AERMAP terrain processor. The digital terrain dataset provided as input to AERMAP were National Elevation Dataset (NED) digital terrain data at 1/3 arc-second resolution, which is equivalent to approximately 10 meters in the project area. To assure that the correct hill height scale for each receptor was chosen, the NED data file provided to AERMAP included a buffer of approximately 10 km beyond the receptor grid area. Drawings showing the receptor grid are provided in Figure 6 and Figure 7.

2.10 NO₂ MODELING

The Tier 2 approach available in AERMOD, ARM2, was used to estimate 1-hour and annual average NO₂ impacts. ARM2 was applied prior to comparing modeled 1-hour and annual impacts to any standards or thresholds using the default upper and lower limits.

⁴ There is a rail spur that runs through the Nucor facility and ends on an adjacent property. The entrance and exit of the rail spur on the Nucor property is patrolled by Nucor personnel to preclude public access.

3. MODELING ANALYSES

3.1 MODELED DESIGN CONCENTRATIONS

The model design concentration is the ranking of the model-predicted ambient air quality concentrations (model output) used for comparison to applicable ambient air quality thresholds (e.g., significant impact levels) and standards (e.g., NAAQS, PSD increments). The ranking of the modeled design concentrations are provided in Table 10.

3.2 SIGNIFICANT IMPACT ANALYSIS

Maximum predicted project impacts⁵ due to the net change in emissions are compared to the PSD Class II SILs for NO₂, SO₂, direct PM_{2.5}, PM₁₀, and CO in Table 11 and Table 12. The results of this analysis demonstrate that the project has the potential for significant impacts for 1-hour NO₂ and 1-hour SO₂. For the remaining pollutants that are less than or equal to the applicable SIL, no further analyses will be required. Only those receptors with impacts above the SILs (on a pollutant and averaging period basis) were used in the cumulative modeling. The areal extent of these receptors defines the SIA, which is then used to determine the nearby sources that need to be included in cumulative NAAQS and increment modeling. The significant impact area (distance from the facility) for 1-hr NO₂ for each meteorological data set is approximately 12,315 meters. For 1-hr SO₂ the distance is 16,392 meters using the Pryor field meteorological data set and 15,160 meters using the Nucor meteorological data set.

3.2.1 SECONDARY PARTICULATE AND OZONE FORMATION

The analysis of project emissions for the secondarily-formed pollutants, i.e., secondary PM_{2.5} and ozone, is required by Appendix W. Secondary PM_{2.5} and ozone are formed from the emissions of precursor pollutants, i.e., VOC, SO₂, and NO_x. Following guidance from ADEM⁶, the following three steps were used:

1. The lowest MERP values from the eastern and central US were used;
2. The highest impacts from a nearby source were used; and
3. The impacts from the most representative source were used.

The Eastern US Source #19 was chosen as the most representative source over the closest source (Central US Source #3) since its precursor emission rates most closely match the Nucor project emission rates for each of the analyzed precursor pollutants. The relatively close proximity of the source also makes it broadly representative of the project area in terms of climate, land use, and regional emission sources.

The above steps indicate that:

⁵ All project impacts will be assessed with both meteorological datasets discussed in Section 2.5. The dataset that generates the highest impact was used for that pollutant/averaging period for comparison to all thresholds and ambient standards.

⁶ Megan Travis (ADEM) to Brad Arnold (SLR) "Tier 1 MERPs Demonstration Example" on September 27, 2018.

1. Project impacts would have significant secondary impacts for all pollutants and averaging periods based on step 1 (see Table 13);
2. Project impacts will not have significant primary and secondary impacts for annual $PM_{2.5}$ based on step 2 (see Table 14).
3. Project impacts will not have significant primary and secondary impacts for 24-hour $PM_{2.5}$ based on step 3 (see Table 15). Each step of the analysis indicates the significant ozone impacts may be expected.

3.3 NAAQS ANALYSIS

As a result of the significant impact analyses performed above, it was determined that a cumulative impact analysis is required for 1-hour NO_2 and 1-hour SO_2 . The cumulative modeling was performed only for those receptors where the significant impact level is exceeded on a pollutant and averaging period basis. Compliance with the NAAQS was based on the total estimated air quality concentration, which is the sum of the following:

- Project emissions at their proposed potential to emit emission rates (Table 5);
- Emissions from all nearby sources, modeled at their permitted emission rates or 2-year average of actual emission rates (see Table 6, Table 7, Table 8); and
- Background concentrations (see Table 9).

The results of the cumulative analysis are provided in Table 16 and Table 17 and demonstrate compliance with the 1-hour NO_2 ambient standard. The 1-hour SO_2 cumulative analysis results in model-predicted impacts above the ambient standard. For those receptors with cumulative impacts above the ambient standard, the MAXDCONT analysis option in AERMOD was used to perform a culpability analysis to determine the project impacts at the time and place of modeled impacts above the standard. The results of this analysis are summarized in Table 18 and Table 19 and demonstrate that the project (and total facility) impacts are well under the SIL during any modeled violation of the 1-hour SO_2 ambient standard.

For ozone, the estimated impacts due to project emissions were calculated in Section 3.2.1 and are added to nearby monitoring data to determine cumulative ozone concentrations. The closest ozone monitor (AIRS ID 01-103-0011) is located approximately 15 km to the southeast of the Nucor facility. The monitor's location allows it to capture the influence of local and regional sources and their resultant ozone formation and destruction. The monitored ozone design values for the prior three years are provided in Table 20 and cumulative results provided in Table 21, which demonstrates that compliance with the ambient standard will be maintained.

Modeled impacts due to project emissions only were also compared to the ambient standard for lead as shown in Table 22 and Table 23. One month impacts were conservatively used to compare to the 3-month rolling standard and demonstrate project impacts well below the ambient standard.

3.4 PSD INCREMENT IMPACT ANALYSIS

No 1-hour NO₂ or SO₂ increments have been promulgated.

4. ADDITIONAL IMPACT ANALYSIS

4.1 GROWTH ANALYSIS

The growth analysis consists of a projection of the associated industrial, commercial, and residential growth that is likely to occur in the area due to the proposed project, and an estimate of the emissions generated by that associated growth. Since the project is expected to have negligible industrial, commercial, and residential growth, this analysis was satisfied and addressed by the air quality analysis described in Section 3.

4.2 VISIBILITY ANALYSIS

The visibility analysis is being conducted as part of the PSD Class I ambient air impact analysis.

4.3 SOIL AND VEGETATION IMPACT ANALYSIS

Secondary ambient air quality standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. The values of these standards are less than or equal to the primary standards listed in Table 2. By virtue of the air quality compliance demonstration for the primary standards, the secondary standards are necessarily protected.

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FIGURES

Figure 1 Area Map

Figure 2 Local Map

Figure 3 Digitized Facility Structures

Figure 4 Digitized Facility Emission Units

Figure 5 Pryor Field Wind Rose

Figure 6 Near-Field Receptor Grids

Figure 7 Far-Field Receptor Grids

Figure 8 Cumulative 1-hour SO₂ Modeling

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Table 1: Estimated Project Emissions

Pollutant	Actual Meltshop Emissions (tpy)	Future Meltshop Emissions (tpy)	Project Meltshop Emissions (tpy)	New Galv Line Emissions (tpy)	EAF Fugitive Emissions Increase (tpy)	LMF Fugitive Emissions Increase (tpy)	Caster Fugitive Emissions Increase (tpy)	Baghouse Dust Silo Emissions Increase (tpy)	Total Project Emissions Increase (tpy)	PSD Major Mod Threshold (tpy)	PSD Major? (Y/N)
TSP	385	429	44.7	3.92	7.24	1.552	0.181	0.060	57.6	25	Yes
PM ₁₀	385	429	44.7	3.92	4.20	0.900	0.105	0.060	53.8	15	Yes
PM _{2.5}	385	429	44.7	3.92	3.11	0.667	0.078	0.060	52.5	10	Yes
NO _x	333	756	423	35.22	--	--	--	--	458	40	Yes
SO ₂	105	630	525	0.31	--	--	--	--	525	40	Yes
CO	2,437	4,140	1,703	4.33	--	--	--	--	1707	100	Yes
VOC	95	234	139.1	0.28	--	--	--	--	139.4	40	Yes
Lead (Pb)	0.07	3.60	3.53	0.000	--	--	--	--	3.529	0.6	Yes

Table 2: National Ambient Air Quality Standards

Pollutant	Averaging Period	Primary National Ambient Air Quality Standards (NAAQS)	Secondary National Ambient Air Quality Standards (NAAQS)
NO ₂	1-hour	100 ppm (188 µg/m ³) the 98 th percentile of the daily maximum 1-hour average concentration must not exceed this value	None
	Annual	0.053 ppm (100 µg/m ³)	Same as Primary
SO ₂	1-hour	75 ppb (196 µg/m ³) the 99 th percentile of the daily maximum 1-hour average concentration must not exceed this value	None
	3-hour	None	0.5 ppm (1,300 µg/m ³) not to be exceeded more than once per year
	24-hour	None	
	Annual	None	
PM ₁₀	24-hour	150 µg/m ³ not to be exceeded more than once per year on average over 3 years ¹	Same as Primary
	Annual	None	None
PM _{2.5}	24-hour	35 µg/m ³ the 98 th percentile concentration must not exceed this value	Same as Primary
	Annual	12 µg/m ³ annual mean, averaged over 3 years	15 µg/m ³ annual mean, averaged over 3 years
CO	1-hour	35 ppm (40,000 µg/m ³) not to be exceeded more than once per year	None
	8-hour	9 ppm (10,000 µg/m ³) not to be exceeded more than once per year	None
Lead (Pb)	3-month rolling average	0.15 µg/m ³	Same as Primary

¹ Or the H6H for a 5-year meteorological dataset

Table 3: Class II PSD Increments

Pollutant	Averaging Period	Class II Increment ¹ ($\mu\text{g}/\text{m}^3$)
NO ₂	1-hour	None
	Annual	25
SO ₂	1-hour	None
	3-hour	512
	24-hour	91
	Annual	20
PM ₁₀	24-hour	30
	Annual	17
PM _{2.5}	24-hour	9
	Annual	4
CO	1-hour	None
	8-hour	None
Lead (Pb)	3-month rolling average	None

¹ From ADEM Admin Code r.335-3 dated June 9, 2017.

Table 4: Pre-Construction Ambient Air Quality Concentrations

Pollutant	Averaging Period	Concentration ($\mu\text{g}/\text{m}^3$ or as noted)
NO ₂	1-hour	31 ⁽¹⁾
	Annual	7.5 ⁽¹⁾
SO ₂	1-hour	11 ⁽¹⁾
PM ₁₀	24-hour	24 ⁽¹⁾
PM _{2.5}	24-hour	15 ⁽¹⁾
	Annual	7.9 ⁽¹⁾
CO	1-hour	100 ⁽¹⁾
	8-hour	100 ⁽¹⁾
Ozone	8-hour	63 ppb ⁽¹⁾

⁽¹⁾ Received by ADEM on July 26, 2018.

Table 5: Modeled Emission Rates and Release Parameters – Project and Existing Point Sources

Model ID	Project?	Source Description	Location (UTM Zone 16, NAD83)			Exhaust Direction	Capped?	Emission Rates (grams/second)												Modeled Stack Exit Parameters			
			UTM E (m)	UTM N (m)	Elevation (m)			NO _x		SO ₂				CO		PM _{2.5}		PM ₁₀		Height (m)	Temp (K)	Velocity (m/s)	Diameter (m)
								1-hr	Ann	1-hr	3-hr	24-hr	Ann	1-hr	8-hr	24-hr	Ann	24-hr	Ann				
MSB1	Yes	Meltshop Baghouse 1	492168.8	3832865.8	178.0	Vert	No	7.08E+00	6.08E+00	9.63E+00	9.63E+00	9.63E+00	7.55E+00	2.56E+01	2.56E+01	6.43E-01	6.43E-01	6.43E-01	6.43E-01	45.7	394.3	14.4	7.9
MSB2	Yes	Meltshop Baghouse 2	492299.2	3832831.7	178.0	Vert	No	7.08E+00	6.08E+00	9.63E+00	9.63E+00	9.63E+00	7.55E+00	2.56E+01	2.56E+01	6.43E-01	6.43E-01	6.43E-01	6.43E-01	45.9	394.3	20.8	6.6
GALV2	Yes	New Galv Line	493208.4	3832901.0	178.0	Vert	No	1.01E+00	1.01E+00	8.89E-03	8.89E-03	8.89E-03	8.89E-03	1.25E-01	1.25E-01	1.13E-01	1.13E-01	1.13E-01	1.13E-01	64.9	444.3	6.4	1.8
NCS	Yes	North Caster Steam Vent	491939.3	3832965.8	178.0	Vert	No									9.08E-03	1.07E-02	1.22E-02	1.45E-02	16.8	324.8	16.8	1.4
SCS	Yes	South Caster Steam Vent	491958.2	3832918.4	178.0	Vert	No									9.08E-03	1.07E-02	1.22E-02	1.45E-02	39.9	324.8	16.8	1.1
GALVLINE	No	Existing Galv Line	493207.2	3832758.6	178.0	Vert	No	8.32E-01		7.56E-03										64.9	444.3	6.4	1.8
SETF	No	Southeast Tunnel Furnace	491904.5	3832911.5	178.0	Vert	No	1.34E+00		5.67E-03										48.8	883.2	6.7	1.8
SWTF	No	Southwest Tunnel Furnace	491844.5	3832927.4	178.0	Vert	No	6.26E-01		2.65E-03										35.1	993.2	6.7	1.2
NETF	No	Northeast Tunnel Furnace	491908.3	3832965.2	178.0	Vert	No	1.34E+00		5.67E-03										48.8	823.7	6.7	1.8
NWTF	No	Northwest Tunnel Furnace	491857.1	3832978.0	178.0	Vert	No	6.26E-01		2.65E-03										35.1	824.8	6.7	1.2
DLF	No	Delivery Furnace	491791.1	3832994.8	178.0	Vert	No	8.95E-01		3.78E-03										25.9	989.3	6.7	1.5
PL1B1	No	Pickle Line #1 Boiler #1	491502.9	3833138.4	178.0	Vert	No	4.16E-02		6.30E-04										20.0	516.5	7.3	0.4
PL1B2	No	Pickle Line #1 Boiler #2	491503.8	3833143.4	178.0	Vert	No	4.16E-02		6.30E-04										20.0	516.5	7.3	0.4
PL2B1	No	Pickle Line #2 Boiler #1	493338.8	3833136.1	178.0	Vert	No	2.22E-01		1.26E-03										20.0	516.5	7.3	0.4
PL2B2	No	Pickle Line #2 Boiler #2	493338.8	3833139.9	178.0	Vert	No	2.22E-01		1.26E-03										20.0	516.5	7.3	0.4

Table 6: Modeled Emission Rates and Release Parameters – Nearby NO ₂ Point Sources												
Model ID	Stack No.	Source Description	UTM E (m)	UTM N (m)	Elevation (m)	Exhaust Direction	Capped?	1-hr NO ₂ Emission Rates (grams/second)	Height (m)	Temp (K)	Velocity (m/s)	Diameter (m)
7120009_1	1	19 Resin Line Dowtherm Boiler	496200.0	3833300.0	181.1	Vert	No	1.93E-01	47.2	533.0	0.1	0.9
7120009_2	2	15-2 Resin Line Dowtherm Boiler	496200.0	3833300.0	181.1	Vert	No	1.54E-01	33.5	533.0	0.1	0.6
7120009_3	3	90 MMBtu/hr Boiler (Boiler No. 3)	496176.0	3833396.0	181.1	Vert	No	4.09E+00	13.4	586.0	10.7	1.4
7120009_4	4	Boiler No. 1 (55 MMBtu/hr)	496176.0	3833404.1	179.8	Vert	No	2.43E+00	13.4	566.0	14.7	0.9
7120009_5	5	Boiler #6 (122.6 MMBtu/hr Boiler NSPS Source)	496177.0	3833379.9	181.1	Vert	No	1.54E+00	13.4	450.0	12.3	1.3
7120009_6	6	Boiler (VDF/PVDF)	496200.0	3833300.0	185.0	Vert	No	2.52E-01	3.4	464.0	9.2	0.6
7120009_7	7	Building 74 Resin Line Heater	496200.0	3833300.0	185.9	Vert	No	5.03E-01	18.3	533.0	18.7	0.5
7120069_1	1	Thermal Oxidizer (CFA1)	497774.0	3831623.0	181.7	Vert	No	6.13E+00	26.3	641.0	12.2	1.5
7120069_2	2	Thermal Oxidizer (CFA2)	497774.0	3831599.1	181.7	Vert	No	3.18E+00	26.3	634.0	14.3	1.5
7120069_3	3	Thermal Oxidizer (CFA3)	497783.0	3831579.1	181.7	Vert	No	5.85E+00	27.4	630.0	16.5	1.5
7120069_4	4	Baghouse (CFA-4)	497720.0	3831700.0	182.9	Vert	No	6.51E-01	22.9	402.0	17.7	1.3
7120078_1	1	Boiler #1	493035.0	3831566.9	189.6	Vert	No	2.05E-01	10.4	472.0	16.5	0.6
7120078_2	2	Boiler #2	493035.0	3831566.9	189.6	Vert	No	2.05E-01	10.4	472.0	16.5	0.6
7120078_3	3	Boiler #3	493035.0	3831566.9	189.6	Vert	No	5.92E-01	10.4	472.0	16.5	0.6
7120078_4	4	Boiler #4	493035.0	3831566.9	189.6	Vert	No	2.05E-01	10.4	472.0	16.5	0.6
7120078_5	5	Boiler #5	493035.0	3831566.9	189.6	Vert	No	2.05E-01	10.4	472.0	16.5	0.6
7120063_1	1	20.9 MMBTU/HR BOILER	502094.0	3824727.1	178.3	Vert	No	3.78E-01	7.6	464.0	10.7	0.8
7120063_2	2	10.45 MMBTU/HR BOILER	502102.0	3824712.9	178.3	Vert	No	1.89E-01	6.1	522.0	10.7	0.5
7120063_3	3	10.45 MMBTU/HR BOILER	502100.0	3824712.9	178.3	Vert	No	1.89E-01	6.1	522.0	10.7	0.5
7120050_1	1	7.14 MMBtu/hr First Thermal Oil Heater	501150.0	3830879.9	179.8	Vert	No	1.29E-01	4.9	741.0	10.6	0.5
712SDFU_1	1	25.328 MMBtu/hr Bryan Natural Gas-Fired Boiler	501850.0	3826580.1	176.8	Vert	No	3.19E-01	9.4	311.0	10.4	0.6
7120091_1	1	Source #22: 15 MMBtu/hr QuikWater Water Heater No. 1	495550.0	3829950.0	182.9	Vert	No	1.83E-01	12.8	497.0	2.1	1.0
7120091_2	2	Source #37: 16.329 MMBtu/hr Cleaver Brooks Boiler No. 6	495550.0	3829950.0	182.9	Vert	No	2.05E-01	10.2	477.0	12.1	0.6
7120091_3	3	Source #31: 16.329 MMBtu/hr Cleaver Brooks Boiler No. 5	495550.0	3829950.0	182.9	Vert	No	1.99E-01	11.9	489.0	8.7	0.6
7120091_4	4	Source #30: 16.329 MMBtu/hr Cleaver Brooks Boiler No. 4	495550.0	3829950.0	182.9	Vert	No	1.99E-01	11.9	489.0	8.7	0.6

Table 6: Modeled Emission Rates and Release Parameters – Nearby NO ₂ Point Sources												
7120091_5	5	Source #21: 25.1 MMBtu/hr Cleaver Brooks Boiler No. 3	495550.0	3829950.0	182.9	Vert	No	3.06E-01	11.9	489.0	8.7	0.6
7120091_6	6	Source #20: 25.1 MMBtu/hr Cleaver Brooks Boiler No. 2	495550.0	3829950.0	182.9	Vert	No	3.06E-01	11.9	489.0	8.7	0.6
7120091_7	7	Source #19: 25.1 MMBtu/hr Cleaver Brooks Boiler No. 1	495550.0	3829950.0	182.9	Vert	No	3.06E-01	11.9	489.0	8.7	0.6
7120091_8	8	Source #32: 18 MMBtu/hr Kemco Water Heater No. 2	495550.0	3829950.0	182.9	Vert	No	2.19E-01	12.8	497.0	2.1	1.0
712WFDF_1	1	12.55 MMBtu/hr. Cleaver Brooks NGF Boiler No. 1	496080.0	3829560.1	179.2	Vert	No	1.52E-01	7.6	366.0	3.6	0.6
7120006_1	1	Tire Fabric Pre-Dip Unit I (Multi-Stage Unit) Exhausts	503600.0	3828200.0	175.3	Vert	No	3.45E-01	14.6	422.0	2.3	0.6
7120006_2	2	Dupont TORVEX Catalytic Reactor System for control of Dip Unit II (Modular)	503600.0	3828200.0	175.3	Vert	No	4.26E-01	32.0	422.0	0.6	1.0
7120006_3	3	Single End Dip Unit	503600.0	3828200.0	175.3	Horiz	No	7.91E-01	7.6	522.0	9.2	0.6
7120079_1	1	Unit 1A	498039.0	3831857.9	187.8	Vert	No	3.93E+00	45.7	361.0	12.5	5.8
7120079_2	2	Unit 1B	498039.0	3831888.9	187.8	Vert	No	3.93E+00	45.7	361.0	12.5	5.8
7120079_3	3	Unit 1C	498039.0	3831950.9	187.8	Vert	No	3.93E+00	45.7	361.0	12.5	5.8
7120080_1	1	Unit 1A	494144.0	3833154.1	187.8	Vert	No	3.93E+00	45.7	361.0	12.5	5.8
7120080_2	2	Unit 1B	494195.0	3833154.1	187.8	Vert	No	3.93E+00	45.7	361.0	12.5	5.8
7120080_3	3	Unit 1C	494246.0	3833154.1	187.8	Vert	No	3.93E+00	45.7	361.0	12.5	5.8
7120002_1	1	#1 Px Unit EB-103 Reboiler (Stack actually shared with EB104 Reboiler)	494653.0	3833115.0	167.6	Vert	No	2.87E-01	54.3	555.0	6.2	1.5
7120002_2	2	#1 Px Unit EB101	494653.0	3833115.0	167.6	Vert	No	4.44E-01	45.7	553.0	6.8	1.8
7120002_3	3	Boiler AB6351B (249 MMBTU/hr)	494412.0	3833252.9	167.6	Vert	No	8.62E+00	15.4	475.0	13.7	2.0
7120002_4	4	#1 & #2 Px Flare (KM-503)	494653.0	3833115.0	167.6	Vert	No	7.38E-01	65.0	555.0	28.9	1.2
7120002_5	5	#2 Px Unit KB101 Reboiler (173.6 MMBTU/hr)	494150.0	3833179.9	167.6	Vert	No	1.31E+00	62.5	489.0	14.9	2.4
7120002_6	6	#2 Px Unit KB102 Reboiler (170.2 MMBTU/hr)	494170.0	3833189.9	167.6	Vert	No	9.32E-01	61.3	439.0	15.5	2.0
7120002_7	7	#2 Px Unit KB401 Reboiler (110 MMBTU/hr)	494110.0	3833179.9	167.6	Vert	No	1.09E+00	25.9	555.0	5.8	1.3
7120002_8	8	Marine Loading Flare	494653.0	3833115.0	167.6	Vert	No	1.06E+00	7.6	322.0	22.3	0.8
7120002_9	9	NDC Flare	494653.0	3833115.0	167.6	Vert	No	3.02E-01	65.0	322.0	5.0	0.6
7120002_10	10	NDC Ox Metals Recovery Unit Baghouses AM8908 A-D	494653.0	3833115.0	167.6	Vert	No	1.47E-01	38.1	366.0	17.1	1.1

Table 6: Modeled Emission Rates and Release Parameters – Nearby NO ₂ Point Sources												
7120002_11	11	Hot Oil Furnace Stack AB8103 (ndc pt 20)	494653.0	3833115.0	167.6	Vert	No	8.76E-01	43.0	658.0	0.2	2.4
7120002_12	12	400 MMBTU/HR BOILER (AB-8301)	494400.0	3833250.0	167.6	Vert	No	1.92E+00	30.5	447.0	20.2	2.1
7120010_1	1	Common Coker Boilers 1 (Z007), 2 (Z008), and Boiler 8 (X053)	498089.4	3832561.3	173.1	Vert	No	2.63E+01	57.9	566.0	5.9	3.2
7120010_2	2	Boiler Nos. 4, 5, and 6 Stack (Z004, Z005, Z006)	498191.1	3832678.0	173.1	Vert	No	2.66E+01	57.9	430.0	7.7	3.2
7120010_3	3	C Hydrogen Plant	498319.0	3832467.0	173.1	Vert	No	4.51E+00	18.3	556.0	17.7	0.6
7120010_4	4	B Hydrogen Plant	498291.0	3832492.9	173.1	Vert	No	4.51E+00	18.3	531.0	17.6	0.6
7120010_5	5	A Hydrogen Plant	498000.0	3832300.0	173.1	Vert	No	1.70E+00	18.3	406.0	17.0	0.6
7120010_6	6	536.9 MMBtu/hr Natural Gas, Liquid, and Heavy Liquid Fired Boiler (Boiler No. 7)	498130.0	3832669.9	173.1	Vert	No	1.61E+01	57.9	432.0	16.6	2.4
7120010_7	7	Boiler R-1 Stack	498000.0	3832300.0	173.1	Vert	No	4.54E-01	7.6	646.0	18.2	1.2
7120052_1	1	T72 Heater	498330.0	3832050.0	176.8	Vert	No	3.04E-01	9.4	475.0	3.8	0.7
7120052_2	2	9.5 MMBTU/hr NG and Purge Styr Monomer Fired Therminol Boiler Stack	498396.0	3831851.1	176.8	Vert	No	1.68E-01	9.1	783.0	6.4	0.5
7120052_3	3	13 MMBTU/hr Oil, NG, and Purge Styr Monomer Fired Therminol Boiler Stack	498330.0	3832090.1	177.4	Vert	No	2.33E-01	15.2	505.0	4.1	0.8
7120061_1	1	35.7 MMBTU/hr Boilers (2)	496230.0	3832040.0	192.0	Vert	No	1.07E+00	49.1	495.0	1.4	1.3
7120061_2	2	73.8 MMBTU/hr NG Fired Boiler with No. 2 Backup	496229.0	3832037.1	192.0	Vert	No	1.27E+00	25.9	441.0	16.0	0.9
7120072_1	1	Steam Methane Reformer #2	499007.0	3832020.0	171.0	Vert	No	2.29E-01	19.8	500.0	11.5	0.6
7120072_2	2	Steam Methane Reformer (w/ SNCR)	499007.0	3832020.0	171.0	Vert	No	2.85E+00	18.3	511.0	13.0	1.5
7120072_3	3	Low Pressure Boiler	499007.0	3832020.0	171.0	Vert	No	3.78E-01	18.3	511.0	13.0	1.5
7120097_1	1	3 4.1 MMBtu/hr Steam Boilers	494878.4	3833074.2	187.5	Vert	No	1.49E-01	3.0	311.0	1.3	0.2
7120097_2	2	Three (3) 41-MMBTU/hr Heaters (Process Lines 1 and 2)	494878.4	3833074.2	187.5	Vert	No	2.00E+00	40.2	503.0	11.5	0.9
7120026_1	1	99 MMBtu/hr Boiler w/ Natural Gas or No. 2 Fuel Oil	503103.4	3829236.1	175.9	Vert	No	1.22E+00	16.8	320.0	14.3	1.1
7120026_2	2	99 MMBtu/hr Boiler w/ Natural Gas or No. 2 Fuel Oil	503098.4	3829233.9	175.9	Vert	No	1.22E+00	16.8	320.0	14.3	1.1
7120026_3	3	99 MMBtu/hr Boiler w/ Natural Gas or No. 2 Fuel Oil	503092.9	3829231.9	175.9	Vert	No	1.22E+00	16.8	320.0	14.3	1.1
7120026_4	4	Drying Operations	503098.7	3829295.9	175.9	Vert	No	5.67E-01	24.4	333.0	38.1	1.1

Table 6: Modeled Emission Rates and Release Parameters – Nearby NO ₂ Point Sources												
7120026_5	5	13 MMBtu/hr Boiler w/ Natural Gas or No. 2 Fuel Oil	503200.0	3829100.1	175.9	Vert	No	2.02E-01	12.2	602.0	8.9	0.6
7120026_6	6	13 MMBtu/hr Boiler w/ Natural Gas or No. 2 Fuel Oil	503200.0	3829100.1	175.9	Vert	No	2.02E-01	12.2	602.0	8.9	0.6
7120031_1	1	20.412 MMBtu/hr Cleaver Brooks NGF Boiler (NSPS-Dc)	503200.0	3829300.0	171.0	Vert	No	2.57E-01	12.2	494.0	7.6	0.7
7120031_2	2	Combustion Emissions (Finish Product Line 2)	503200.0	3829300.0	171.0	Vert	No	1.98E-01	9.1	316.0	10.3	0.8
7120031_3	3	Combustion Emissions (Finish Product Line 3)	503200.0	3829300.0	171.0	Vert	No	1.98E-01	9.1	316.0	10.3	0.8
7120031_4	4	32.659 MMBtu/hr Cleaver Brooks Boiler Stack	503200.0	3829300.0	171.0	Vert	No	4.12E-01	12.2	474.0	11.5	0.7
7120031_5	5	Combustion Emissions (Finish Product Line 1)	503200.0	3829300.0	171.0	Vert	No	2.49E-01	12.2	365.0	20.1	1.3
7120064_1	1	350 Hp clark recip engine (installed 1957)	502800.0	3835300.0	175.9	Vert	No	1.34E+00	6.6	1033.0	13.3	0.3
7120064_2	2	350 Hp clark recip engine (installed 1962)	502800.0	3835300.0	175.9	Vert	No	1.34E+00	6.6	1033.0	13.3	0.3
7120064_3	3	350 Hp clark recip engine (installed 1966)	502800.0	3835300.0	175.9	Vert	No	1.34E+00	6.6	1033.0	13.3	0.3
7120064_4	4	406 Hp waukesha recip (installed ~ 1993)	502800.0	3835300.0	175.9	Vert	No	2.24E-01	5.9	825.0	49.4	0.2
7090007_1	1	10.48 MMBtu/hr Fuel Oil Boiler #1 in Building 7291-1	534739.1	3828620.4	176.8	Vert	No		9.1	422.0	1.9	0.9
7090007_2	2	Bldg 7668	529900.0	3834500.0	174.3	Vert	No		5.0	477.0	8.1	0.5
7090007_3	3	Bldg 7668	529900.0	3834500.0	174.3	Vert	No		6.8	436.0	5.9	0.6
7090007_4	4	10.38 MMBtu/hr Boiler #2, Building 7105	536218.5	3829678.5	181.7	Vert	No		6.1	436.0	2.0	0.9
7090007_5	5	10.38 MMBtu/hr Boiler #1, Building 7105	536222.9	3829678.2	181.7	Vert	No		6.1	436.0	2.0	0.9
7090007_6	6	8.16 MMBtu/hr Boiler #2, Building 7153-2	534742.2	3828617.4	184.1	Vert	No		7.6	450.0	2.3	0.8
7090007_7	7	Building 5221-Two Natural Gas Fired Boilers (12.55 MMBtu/hr, each)	529900.0	3834500.0	185.9	Vert	No		9.8	436.0	7.4	0.5
7090007_8	8	Building 5221-Two Natural Gas Fired Boilers (12.55 MMBtu/hr, each)	529900.0	3834500.0	185.9	Vert	No		9.8	436.0	7.4	0.5
7090007_9	9	Building 7158-Engine Test Cell Stand	529900.0	3834500.0	180.4	Vert	No		1.5	977.0	8.3	0.1
7090007_10	10	Bldg 7151 engine test cell stand	529900.0	3834500.0	182.9	Vert	No		1.5	977.0	0.1	0.9

Table 6: Modeled Emission Rates and Release Parameters – Nearby NO ₂ Point Sources												
7090007_11	11	Natural Gas Boiler #3 Building 5224	529900.0	3834500.0	186.1	Vert	No		6.7	394.0	6.3	0.6
7090007_12	12	Natural Gas Boiler #2 Building 5224	529900.0	3834500.0	186.1	Vert	No		6.7	394.0	6.3	0.6
7090007_13	13	Natural Gas Boiler #1 Building 5224	529900.0	3834500.0	186.1	Vert	No		6.7	394.0	6.3	0.6
7090007_14	14	Building 7146-Unmanned Aerial Vehicle Engine Test Stand	529900.0	3834500.0	180.4	Vert	No		1.5	977.0	8.3	0.1
712S001_1	1	Replacement Boiler Cyclone Stack	497774.0	3827850.1	192.0	Vert	No	4.09E-01	6.1	533.0	9.0	0.8
7010007_1	1	Pusher Furnaces 1 & 2 [Alloys]	446100.0	3846100.1	166.1	Vert	No		18.6	427.0	23.8	2.0
7010007_2	2	BH 4 [Element 13]	446100.0	3846100.1	168.6	Vert	No		18.3	354.0	11.3	1.2
7010007_3	3	BH 1 [Element 13]	446100.0	3846100.1	167.9	Vert	No		18.3	347.0	13.9	1.2
7010007_4	4	BH 2 [Element 13]	446100.0	3846100.1	167.6	Vert	No		18.3	354.0	11.7	1.2
7010007_5	5	BH 3 [Element 13]	446100.0	3846100.1	168.2	Vert	No		18.3	354.0	11.7	1.2
7010007_6	6	BH 5 [Element 13]	446100.0	3846100.1	167.6	Vert	No		18.3	339.0	15.4	1.8
7010007_7	7	BH 6 [Element 13]	446100.0	3846100.1	167.6	Vert	No		18.3	339.0	15.4	1.8
7010007_8	8	Holding Furnace B [Element 13]	446100.0	3846100.1	171.0	Vert	No		22.3	370.0	6.9	1.2
7010007_9	9	Holding Furnace A [Element 13]	446100.0	3846100.1	170.7	Vert	No		22.3	370.0	6.9	1.2
7010007_10	10	Kiln # 3 BH [Element 13]	446100.0	3846100.1	169.5	Vert	No		18.3	360.0	6.8	1.8
7010007_11	11	Melter # 7 BH [Element 13]	446100.0	3846100.1	169.8	Vert	No		18.3	347.0	11.0	1.5
7010007_12	12	Kiln # 4 BH [Element 13]	446100.0	3846100.1	168.2	Vert	No		22.9	360.0	6.8	1.8
7010007_13	13	Melter # 8 BH [Element 13]	446100.0	3846100.1	168.2	Vert	No		25.0	394.0	16.8	1.5
7010007_14	14	Boiler # 5 [Alloys]	446100.0	3846100.1	165.5	Vert	No		15.5	432.0	0.7	0.7
7010007_15	15	Boiler # 8 [Alloys]	446100.0	3846100.1	166.1	Vert	No		6.4	423.0	28.4	0.6
7010007_16	16	Thermal Oxidizer 2 [Alloys]	446100.0	3846100.1	166.7	Vert	No		13.1	527.0	15.1	2.0
7010007_17	17	HSCCL Thermal Oxidizer 1 [Alloys]	446100.0	3846100.1	166.7	Vert	No		15.2	561.0	9.6	2.3
7010007_18	18	Melting Furnace 1a [Alloys]	446200.0	3846800.0	166.1	Vert	No		30.5	830.0	11.7	1.8
7010007_19	19	Melting Furnace 1b [Alloys]	446100.0	3846100.1	166.1	Vert	No		30.5	830.0	11.7	1.8
7010007_20	20	Melting Furnace 2 [Alloys]	446100.0	3846100.1	166.1	Vert	No		30.5	830.0	11.7	1.8
7010007_21	21	Melting Furnace 3 [Alloys]	446100.0	3846100.1	166.1	Vert	No		30.5	830.0	11.7	1.8
7010007_22	22	Melting Furnace 4 [Alloys]	446100.0	3846100.1	166.1	Vert	No		30.5	830.0	11.7	1.8
7010007_23	23	Holding Furnace 1 [Alloys]	446100.0	3846100.1	166.1	Vert	No		30.5	672.0	4.5	1.3
7010007_24	24	Holding Furnace 2 [Alloys]	446100.0	3846100.1	166.1	Vert	No		30.5	672.0	4.5	1.3
7010007_25	25	Holding Furnace 3 [Alloys]	446100.0	3846100.1	166.1	Vert	No		30.5	672.0	4.5	1.3
7010007_26	26	Holding Furnace 4 [Alloys]	446100.0	3846100.1	166.1	Vert	No		30.5	672.0	4.5	1.3
7010007_27	27	Holding Furnace 5a [Alloys]	446100.0	3846100.1	166.1	Vert	No		30.5	672.0	4.5	1.3
7010007_28	28	Holding Furnace 5b [Alloys]	446100.0	3846100.1	166.1	Vert	No		30.5	672.0	4.5	1.3
7010007_29	29	Boiler # 15 [Alloys]	446100.0	3846100.1	165.5	Vert	No		6.4	366.0	1.0	0.7

Table 6: Modeled Emission Rates and Release Parameters – Nearby NO ₂ Point Sources												
7010007_30	30	Boiler # 16 [Alloys]	446100.0	3846100.1	166.1	Vert	No		6.4	423.0	28.4	0.6
7010007_31	31	Boiler # 10 [Alloys]	446100.0	3846100.1	166.1	Vert	No		14.0	477.0	0.2	1.3
7010007_32	32	Soaking Pits [Alloys]	446100.0	3846100.1	165.8	Vert	No		18.9	482.0	13.5	1.3
7010007_33	33	Boiler # 17 [Alloys]	446100.0	3846100.1	165.8	Vert	No		15.5	366.0	1.0	0.7
7010007_34	34	Boiler # 7 [Alloys]	446100.0	3846100.1	165.5	Vert	No		15.5	432.0	0.7	0.7
7010007_35	35	11 Finish Annealers [Alloys]	446100.0	3846100.1	166.1	Vert	No		16.2	491.0	2.4	0.8
7010007_36	36	Boiler # 18 [Alloys]	446100.0	3846100.1	166.1	Vert	No		14.0	519.0	1.0	0.8
7010007_37	37	Soaking Pits 22 & 23 [Alloys]	446100.0	3846100.1	165.5	Vert	No		23.5	482.0	13.5	1.3

Table 7: Modeled Emission Rates and Release Parameters – Nearby SO₂ Point Sources

Model ID	Stack No.	Source Description	UTM E (m)	UTM N (m)	Elevation (m)	Exhaust Direction	Capped?	1-hr SO ₂ Emission Rates (grams/second)	Height (m)	Temp (K)	Velocity (m/s)	Diameter (m)
7120009_1	1	90 MMBtu/hr Boiler (Boiler No. 3)	496176.0	3833396.0	181.1	Vert	No	8.31E+00	13.4	586.0	10.7	1.4
7120009_2	2	Boiler No. 1 (55 MMBtu/hr)	496176.0	3833404.1	179.8	Vert	No	4.94E+00	13.4	566.0	14.7	0.9
7120009_3	3	Boiler #6 (122.6 MMBtu/hr Boiler NSPS Source)	496177.0	3833379.9	181.1	Vert	No	7.82E-01	13.4	450.0	12.3	1.3
7120078_1	1	Boiler #3	493035.0	3831566.9	189.6	Vert	No	2.10E-01	10.4	472.0	16.5	0.6
7120063_1	1	20.9 MMBTU/HR BOILER	502094.0	3824727.1	178.3	Vert	No	1.34E+00	7.6	464.0	10.7	0.8
7120050_1	1	5.2 MMBtu/Hr York Shipley Boiler (installed 1975)	501178.0	3830680.9	179.8	Vert	No	3.33E-01	10.5	500.0	31.4	0.3
7120033_1	1	Holding Hearth	499373.9	3831048.6	172.2	Vert	No	1.85E-01	10.1	1144.0	2.1	0.9
7120079_1	1	Unit 1A	498039.0	3831857.9	187.8	Vert	No	1.89E-01	45.7	361.0	12.5	5.8
7120079_2	2	Unit 1B	498039.0	3831888.9	187.8	Vert	No	1.89E-01	45.7	361.0	12.5	5.8
7120079_3	3	Unit 1C	498039.0	3831950.9	187.8	Vert	No	1.89E-01	45.7	361.0	12.5	5.8
7120080_1	1	Unit 1A	494144.0	3833154.1	187.8	Vert	No	1.89E-01	45.7	361.0	12.5	5.8
7120080_2	2	Unit 1B	494195.0	3833154.1	187.8	Vert	No	1.89E-01	45.7	361.0	12.5	5.8
7120080_3	3	Unit 1C	494246.0	3833154.1	187.8	Vert	No	1.89E-01	45.7	361.0	12.5	5.8
7120010_1	1	Common Coker Boilers 1 (2007), 2 (2008), and Boiler 8 (X053)	498089.4	3832561.3	175.5	Vert	No	5.00E+01	57.9	566.5	10.6	3.2
7120010_2	2	Boiler Nos. 4, 5, and 6 Stack (Z004, Z005, Z006)	498191.1	3832678.0	173.9	Vert	No	3.62E+01	57.9	458.2	10.5	3.2
7120010_3	3	A Hydrogen Plant	498000.0	3832300.0	173.1	Vert	No	2.85E-01	18.3	406.0	17.0	0.6
7120010_4	4	536.9 MMBtu/hr NG, Liquid, Heavy Liquid Fired Boiler (No. 7)	498130.0	3832669.9	173.8	Vert	No	2.05E+00	57.9	452.6	14.9	2.4
7120052_1	1	T72 Heater	498330.0	3832050.0	176.8	Vert	No	6.48E-01	9.4	475.0	3.8	0.7
7120052_2	2	13 MMBTU/hr Oil, NG, Purge Styrene Monomer Fired Therminol Boiler Stack	498330.0	3832090.1	177.4	Vert	No	1.66E-01	15.2	505.0	4.1	0.8
7120061_1	1	35.7 MMBTU/hr Boilers (2)	496230.0	3832040.0	192.0	Vert	No	9.12E-01	49.1	495.0	1.4	1.3
7120061_2	2	73.8 MMBTU/hr NG Fired Boiler with No. 2 Backup	496229.0	3832037.1	192.0	Vert	No	9.00E-01	25.9	441.0	16.0	0.9
7120026_1	1	99 MMBtu/hr Boiler w/ Natural Gas or No. 2 Fuel Oil	503103.4	3829236.1	175.9	Vert	No	6.68E-01	16.8	320.0	14.3	1.1

Table 7: Modeled Emission Rates and Release Parameters – Nearby SO₂ Point Sources

7120026_2	2	99 MMBtu/hr Boiler w/ Natural Gas or No. 2 Fuel Oil	503098.4	3829233.9	175.9	Vert	No	6.56E-01	16.8	320.0	14.3	1.1
7120026_3	3	99 MMBtu/hr Boiler w/ Natural Gas or No. 2 Fuel Oil	503092.9	3829231.9	175.9	Vert	No	6.56E-01	16.8	320.0	14.3	1.1
7090007_1	1	3.61 MMBtu/hr Boiler Bldg 6260	528189.5	3835790.5	186.5	Vert	No		13.7	422.0	5.6	0.3
7090007_2	2	2.52 MMBtu/hr Boiler #1, Building 8874	533080.6	3825373.8	176.8	Vert	No		9.1	450.0	0.3	1.2
7090007_3	3	2.52 MMBtu/hr Boiler #2, Building 8874	533079.2	3825369.9	176.8	Vert	No		9.1	450.0	0.3	1.2
7090007_4	4	3.35 MMBtu/hr Fuel Oil Boiler #2 in Building 8028-2	530939.0	3827889.2	177.4	Vert	No		9.1	427.0	0.4	0.3
7090014_1	1	1100 hp Pump #10 in Building 4567	530844.1	3832035.2	190.2	Vert	No		5.8	644.0	63.4	0.3
7090014_2	2	1100 hp Pump Engine #5 in Building 4567	530842.1	3832038.6	190.2	Vert	No		5.8	644.0	63.4	0.3
7090014_3	3	12.6 MMBtu/hr No. 2 Fuel Oil Boiler 1 in Building 4660	530506.0	3833007.1	190.2	Vert	No		7.6	491.0	2.9	0.9
7090014_4	4	12.6 MMBtu/hr No. 2 Fuel Oil Boiler 2 in Building 4660	530506.0	3833003.9	190.2	Vert	No		7.6	491.0	2.9	0.9
7090014_5	5	12.6 MMBtu/hr No. 2 Fuel Oil Boiler 3 in Building 4660	530506.0	3833000.0	190.2	Vert	No		7.6	491.0	2.9	0.9
7090014_6	6	2577 hp Pump #1 in Building 4667	530397.2	3832085.0	190.2	Vert	No		5.8	644.0	63.4	0.3
7090014_7	7	2577 hp Pump #10 in Building 4667	530472.2	3832085.0	190.2	Vert	No		5.8	644.0	63.4	0.3
7090014_8	8	2577 hp Pump #11 in Building 4667	530479.8	3832085.0	190.2	Vert	No		5.8	644.0	63.4	0.3
7090014_9	9	2577 hp Pump #12 in Building 4667	530487.4	3832085.0	190.2	Vert	No		5.8	644.0	63.4	0.3
7090014_10	10	2577 hp Pump #13 in Building 4667	530495.0	3832085.0	190.2	Vert	No		5.8	644.0	63.4	0.3
7090014_11	11	2577 hp Pump #2 in Building 4667	530411.2	3832085.0	190.2	Vert	No		5.8	644.0	63.4	0.3
7090014_12	12	2577 hp Pump #3 in Building 4667	530437.3	3832085.0	190.2	Vert	No		5.8	644.0	63.4	0.3
7090014_13	13	2577 hp Pump #4 in Building 4667	530426.5	3832085.0	190.2	Vert	No		5.8	644.0	63.4	0.3
7090014_14	14	2577 hp Pump #5 in Building 4667	530434.1	3832085.0	190.2	Vert	No		5.8	644.0	63.4	0.3
7090014_15	15	2577 hp Pump #6 in Building 4667	530441.7	3832085.0	190.2	Vert	No		5.8	644.0	63.4	0.3
7090014_16	16	2577 hp Pump #7 in Building 4667	530449.3	3832085.0	190.2	Vert	No		5.8	644.0	63.4	0.3
7090014_17	17	2577 hp Pump #8 in Building 4667	530456.9	3832085.0	190.2	Vert	No		5.8	644.0	63.4	0.3
7090014_18	18	2577 hp Pump #9 in Building 4667	530464.5	3832085.0	190.2	Vert	No		5.8	644.0	63.4	0.3
7090014_19	19	5.4 MMBtu/hr-Bldg 4675-1	530247.0	3832197.0	190.2	Vert	No		4.9	525.0	12.0	0.3
7090014_20	20	5.4 MMBtu/hr-Bldg 4675-2	530247.0	3832194.1	190.2	Vert	No		4.9	525.0	12.0	0.3
7090014_21	21	5.4 MMBtu/hr-Bldg 4675-3	530247.0	3832189.9	190.2	Vert	No		4.9	525.0	12.0	0.3

Table 7: Modeled Emission Rates and Release Parameters – Nearby SO ₂ Point Sources												
7090014_22	22	14.2 MMBtu/hr Boiler 1 bldg 4567	530835.0	3832022.0	190.2	Vert	No		7.6	511.0	3.4	0.9
7090014_23	23	12.555 MMBtu/hr Boiler 3 bldg 4567	530834.0	3832033.0	190.2	Vert	No		7.6	472.0	1.9	0.9
7090014_24	24	Portable Boiler No. 1	530800.0	3834300.0	190.2	Vert	No		4.6	466.0	2.0	0.6
7090014_25	25	Portable Boiler No. 2	530800.0	3834300.0	190.2	Vert	No		3.7	466.0	2.0	0.6
7090014_26	26	12.6 MMBtu/hr Boiler 2 Bldg 4567	530831.0	3832030.0	190.2	Vert	No		7.6	461.0	2.9	0.9
7090014_27	27	1355 ic Pump Engine #9 in Bldg 4567	530831.6	3832042.7	190.2	Vert	No		5.8	644.0	63.4	0.3
7090014_28	28	1355 ic Pump Engine #8 in Bldg 4567	530851.9	3832042.5	190.2	Vert	No		5.8	644.0	63.4	0.3
7010007_1	1	Reverb 1 Holding well [Element 13]	445520.0	3848120.1	168.9	Vert	No		20.4	491.0	9.6	1.1
7010007_2	2	Reverb 2 Holding Well [Element 13]	445540.0	3848120.1	168.9	Vert	No		20.4	491.0	14.6	1.1
7010007_3	3	Reverb # 3 Holding Well [Element 13]	445560.0	3848120.1	168.9	Vert	No		20.4	491.0	16.2	1.2
7010007_4	4	Reverb 4 Holding Well [Element 13]	445590.0	3848120.1	169.5	Vert	No		20.4	491.0	2.7	1.7
7010007_5	5	Reverb 5 Holding Hearth [Element 13]	455600.0	3848120.1	170.1	Vert	No		20.4	491.0	7.7	1.7
7010007_6	6	Reverb 6 Holding Hearth [Element 13]	455620.0	3848120.1	171.0	Vert	No		20.4	491.0	5.3	1.7

Table 8: 2-Year Average SO₂ Emissions for Ascend

Source	2017 (TPY)	2017 Hrs/yr	2017 AVE lbs/hr		2016 (TPY)	2016 Hrs/Yr	2016 AVE lbs/hr	2016/2017 AVE SO2 (lb/hr)	Base Elevation (ft)	Stack Height (ft)	Temp (F)	Exit Velocity (ft/s)	Diameter (ft)
Boiler 5	0	0	0		213	2143	198.57	99.29	570.7	190	365	34.36	10.5
Boiler 6	195	2280	170.75		470	4599	204.5	187.63					
Total =								286.91					
Boiler 7	2	8318	0.43		116	7236	32.1	16.27	570.1	190	355	48.78	8
Coker 1	679	7661	177.27		689	7209	191.28	184.27	575.7	190	560	34.66	10.5
Coker 2	751	8476	177.27		689	7125	193.53	185.4					
Total =								396.68					

Table 9: Background Concentrations

Pollutant	Averaging Period	Background Concentration	Source/Notes
NO ₂	1-hour	31 µg/m ³	Received by ADEM on July 26, 2018.
SO ₂	1-hour	11 µg/m ³	Received by ADEM on July 26, 2018.

Table 10: Modeled Design Concentrations

Pollutant	Averaging Period	Significant Impact Analysis	NAAQS Analysis (if applicable)	PSD Increment Impact Analysis (if applicable)¹
NO ₂	1-hour	Highest-first-high	98 th percentile (H8H) daily maximum, averaged over 5-years	n/a
NO ₂	Annual	Annual maximum	Annual maximum	Annual maximum
SO ₂	1-hour	Highest-first-high	99 th percentile (H4H) daily maximum, averaged over 5-years	n/a
SO ₂	3-hour	Highest-first-high	Highest-second-high	Highest-second-high
SO ₂	24-hour	Highest-first-high	Highest-second-high	Highest-second-high
SO ₂	Annual	Annual maximum	Annual maximum	Annual maximum
PM ₁₀	24-hour	Highest-first-high	Highest-sixth-high	Highest-second-high
PM ₁₀	Annual	Annual maximum	n/a	Annual maximum
PM _{2.5}	24-hour	Highest-first-high	98 th percentile (H8H) daily maximum, averaged over 5-years	Highest-second-high
PM _{2.5}	Annual	Annual maximum	Annual maximum, averaged over five years	Annual maximum
CO	1-hour	Highest-first-high	Highest-second-high	n/a
CO	8-hour	Highest-first-high	Highest-second-high	n/a
Pb	Quarterly	Highest-first-high	Rolling highest three months over three years	n/a
Ozone	8-hour	Highest-first-high	Not modeled, see Section 3.2.1	n/a

¹ For any period other than an annual period, the applicable maximum allowable increase may be exceeded during one such period per year at any one location.

**Table 11: Nucor Meteorological Data Project Impacts Compared to Class II PSD
SILs ⁽¹⁾**

Pollutant	Averaging Period	Maximum Modeled Impact ($\mu\text{g}/\text{m}^3$)	Class II SIL ($\mu\text{g}/\text{m}^3$)	Percent of SIL
NO ₂	1-hr	18.85	7.5	251.3
	Annual	0.78	1	78.1
SO ₂	1-hr	21.84	7.8	280.0
	3-hr	12.59	25	50.4
	24-hr	4.72	5	94.4
	Annual	0.28	1	27.9
PM ₁₀	24-hr	0.59	5	11.8
	Annual	0.10	1	9.9
PM _{2.5}	24-hr	0.58	1.2	48.0
	Annual	0.10	0.3	32.8
CO	1-hr	58.05	2000	2.9
	8-hr	24.36	500	4.9

⁽¹⁾ All Class II SILs are from ADEM Admin Code r.335-3 dated June 9, 2017.

Table 12: Pryor Field Meteorological Data Project Impacts Compared to Class II PSD SILs ⁽¹⁾

Pollutant	Averaging Period	Maximum Modeled Impact ($\mu\text{g}/\text{m}^3$)	Class II SIL ($\mu\text{g}/\text{m}^3$)	Percent of SIL
NO ₂	1-hr	19.18	7.5	255.8
	Annual	0.78	1	77.6
SO ₂	1-hr	21.31	7.8	273.2
	3-hr	12.03	25	48.1
	24-hr	4.66	5	93.3
	Annual	0.26	1	26.2
PM ₁₀	24-hr	0.59	5	11.8
	Annual	0.10	1	9.9
PM _{2.5}	24-hr	0.57	1.2	47.9
	Annual	0.10	0.3	32.6
CO	1-hr	56.64	2000	2.8
	8-hr	23.53	500	4.7

⁽¹⁾ All Class II SILs are from ADEM Admin Code r.335-3 dated June 9, 2017.

Table 13: Step 1 MERPs Analysis for Secondary PM_{2.5} and Ozone

Secondary Pollutant	Precursor	Project Emissions	Central US MERPs from Table 7.1	Class II SIL	Additive Secondary Impacts	Potential Secondary Impact	Maximum Modeled Primary Impact ⁽¹⁾	Total Impact	Is Total Impact > Class II SIL?
		(tpy)	(tpy)	(ppb or $\mu\text{g}/\text{m}^3$)	(unitless)	(ppb or $\mu\text{g}/\text{m}^3$)	(ppb or $\mu\text{g}/\text{m}^3$)	(ppb or $\mu\text{g}/\text{m}^3$)	
8-hour Ozone	NOx	458	126	1	$(458/126+139/948) = 3.78$	$1*3.78 = 3.78$	0	$3.78+0 = 3.78$	Yes
	VOC	139	948						
24-hour PM _{2.5}	NOx	458	1693	1.2	$(458/1693+525/238) = 2.48$	$1.2*2.47 = 2.97$	0.58	$2.97+0.58 = 3.55$	Yes
	SO ₂	525	238						
Annual PM _{2.5}	NOx	458	5496	0.2	$(458/5496+525/839) = 0.7$	$0.2*0.7 = 0.14$	0.10	$0.14+0.1 = 0.24$	Yes
	SO ₂	525	839						

⁽¹⁾ Modeled primary impacts are from AERMOD project-only results. See Table 12. Ozone was not modeled.

Table 14: Step 2 MERPs Analysis for Secondary PM_{2.5} and Ozone

Secondary Pollutant	Precursor	Project Emissions	Central US #4	Class II SIL	Additive Secondary Impacts	Potential Secondary Impact	Maximum Modeled Primary Impact ⁽¹⁾	Total Impact	Is Total Impact > Class II SIL?
		(tpy)	(tpy)	(ppb or $\mu\text{g}/\text{m}^3$)	(unitless)	(ppb or $\mu\text{g}/\text{m}^3$)	(ppb or $\mu\text{g}/\text{m}^3$)	(ppb or $\mu\text{g}/\text{m}^3$)	
8-hour Ozone	NOx	458	207	1	$(458/207+139/8333) = 2.22$	$1*2.22 = 2.22$	0	$2.22+0 = 2.22$	Yes
	VOC	139	8,333						
24-hour PM _{2.5}	NOx	458	5,000	1.2	$(458/5000+525/741) = 0.80$	$1.2*0.80 = 0.96$	0.58	$0.96+0.58 = 1.54$	Yes
	SO ₂	525	741						
Annual PM _{2.5}	NOx	458	60,000	0.2	$(458/60000+525/14286) = 0.04$	$0.2*0.04 = 0.01$	0.10	$0.01+0.1 = 0.11$	No
	SO ₂	525	14,286						

⁽¹⁾ Modeled primary impacts are from AERMOD project-only results. See Table 12. Ozone was not modeled.

Table 15: Step 3 MERPs Analysis for Secondary PM_{2.5} and Ozone

Secondary Pollutant	Precursor	Project Emissions	Eastern US #19	Class II SIL	Additive Secondary Impacts	Potential Secondary Impact	Maximum Modeled Primary Impact ⁽¹⁾	Total Impact	Is Total Impact > Class II SIL?
		(tpy)	(tpy)	(ppb or $\mu\text{g}/\text{m}^3$)	(unitless)	(ppb or $\mu\text{g}/\text{m}^3$)	(ppb or $\mu\text{g}/\text{m}^3$)	(ppb or $\mu\text{g}/\text{m}^3$)	
8-hour Ozone	NOx	458	327	1	$(458/327+139/10000) = 1.42$	$1*1.42 = 1.42$	0	$1.42+0 = 1.42$	Yes
	VOC	139	10,000						
24-hour PM _{2.5}	NOx	458	12,000	1.2	$(458/12000+525/2609) = 0.24$	$1.2*0.24 = 0.29$	0.58	$0.29+0.58 = 0.87$	No
	SO2	525	2,609						

⁽²⁾ Modeled primary impacts are from AERMOD project-only results. See Table 12. Ozone was not modeled.

Table 16: Nucor Meteorological Data Cumulative Impacts and Comparison to the NAAQS

Pollutant/Averaging Period	Modeled Concentration ($\mu\text{g}/\text{m}^3$)	Background Concentration ($\mu\text{g}/\text{m}^3$)	Total Concentration ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)	Percent of the NAAQS (%)
NO ₂ 1-hour ⁽¹⁾⁽²⁾	134.99	31	165.99	188	88.3
SO ₂ 1-hour ⁽³⁾	208.83	11	219.83 ⁽⁴⁾	196	112.2

⁽¹⁾ Impacts based on ARM2.

⁽²⁾ 98th percentile of the maximum daily concentrations averaged over 5 years.

⁽³⁾ 99th percentile of the maximum daily concentrations averaged over 5 years.

⁽⁴⁾ Nucor project or facility does not significantly contribute to any model violation.

Table 17: Pryor Field Meteorological Data Cumulative Impacts and Comparison to the NAAQS

Pollutant/Averaging Period	Modeled Concentration ($\mu\text{g}/\text{m}^3$)	Background Concentration ($\mu\text{g}/\text{m}^3$)	Total Concentration ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)	Percent of the NAAQS (%)
NO ₂ 1-hour ⁽¹⁾⁽²⁾	137.25	31	168.25	188	89.5
SO ₂ 1-hour ⁽³⁾	210.84	11	221.84 ⁽⁴⁾	196	113.2

⁽¹⁾ Impacts based on ARM2.

⁽²⁾ 98th percentile of the maximum daily concentrations averaged over 5 years.

⁽³⁾ 99th percentile of the maximum daily concentrations averaged over 5 years.

⁽⁴⁾ Nucor project or facility does not significantly contribute to any model violation.

**Table 18: Nucor Meteorological Data MAXDCONT Output for 1-hour SO₂
Cumulative Impacts Above the Standard**

UTM Easting	UTM Northing	Rank	Cumulative Modeled Concentration ⁽¹⁾ (µg/m ³)	Paired-in-time Nucor Project Contribution (µg/m ³)	Paired-in-time Nucor Facility Contribution (µg/m ³)
496000.00	3833500.00	4 th	208.830	0.01875	0.01882
496000.00	3833750.00		195.867	0.00160	0.00165
496250.00	3833750.00		193.708	0.00228	0.00233
496000.00	3833500.00	5 th	205.470	0.00963	0.00966
496000.00	3833750.00		187.525	0.00097	0.00103
496000.00	3833500.00	6 th	203.113	0.01574	0.01579
		7 th	199.873	0.00652	0.00656
		8 th	198.090	0.01289	0.01296
		9 th	196.696	0.01331	0.01336
		10 th	193.466	0.01568	0.01574
		11 th	188.538	0.01670	0.01677
		12 th	186.821	0.02992	0.03000

⁽¹⁾ MAXDCONT threshold was set to 185 based on a background value of 11 and a standard of 196.

Table 19: Pryor Field Meteorological Data MAXDCONT Output for 1-hour SO₂ Cumulative Impacts Above the Standard

UTM Easting	UTM Northing	Rank	Cumulative Modeled Concentration ⁽¹⁾ (µg/m ³)	Paired-in-time Nucor Project Contribution (µg/m ³)	Paired-in-time Nucor Facility Contribution (µg/m ³)
496000.00	3833500.00	4 th	210.844	0.01337	0.01342
496250.00	3833750.00		201.763	0.00178	0.00182
496000.00	3833750.00		185.971	0.00297	0.00300
496000.00	3833500.00	5 th	205.831	0.01527	0.01533
496250.00	3833750.00		191.117	0.00112	0.00115
496000.00	3833500.00	6 th	202.861	0.01539	0.01546
		7 th	198.852	0.02058	0.02066
		8 th	197.376	0.01184	0.01189
		9 th	195.076	0.01530	0.01536
		10 th	190.955	0.01806	0.01812
		11 th	188.097	0.01684	0.01691
		12 th	186.595	0.03175	0.03185

⁽¹⁾ MAXDCONT threshold was set to 185 based on a background value of 11 and a standard of 196.

Table 20: Ozone Design Concentrations

Pollutant	Averaging Period	Year	4th Highest Measured Concentration (ppb)	AIRS ID
Ozone	8-hour	2015	60.0	01-103-0011
Ozone	8-hour	2016	67.0	
Ozone	8-hour	2017	63.0	
3-year average			63.3	

Table 21: Cumulative Ozone Results

Pollutant	Averaging Period	Year	4th Highest Measured Concentration (ppb)	Estimated Project Impacts (ppb)	Estimated Cumulative Impacts (ppb)	Ambient Standard (ppb)
Ozone	8-hour	3-year average	63.3	1.42	64.7	70

Table 22: Nucor Meteorological Data Project-Only Lead Impacts

Pollutant/Averaging Period	Modeled Concentration⁽¹⁾ (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Percent of the NAAQs (%)
Lead 3 month rolling average	0.0062	--	0.0062	0.15	4.1

⁽¹⁾ Project only 1 month average impact, no offsite sources or background included.

Table 23: Pryor Field Meteorological data Project-Only Lead Impacts

Pollutant/Averaging Period	Modeled Concentration⁽¹⁾ (µg/m³)	Background Concentration (µg/m³)	Total Concentration (µg/m³)	NAAQS (µg/m³)	Percent of the NAAQs (%)
Lead 3 month rolling average	0.0056	--	0.0056	0.15	3.7

⁽¹⁾ Project only 1 month average impact, no offsite sources or background included.

ADEM July 2018 protocol comments and SLR responses.

1. We recommend using the latest version of the AERMOD model and its preprocessors, if the current version of said model is out of date when the application is submitted.
 - a. Please see Section 2.1.
2. If the property isn't entirely fenced, please include an in depth description of how unfenced segments and rail spur are restricted to public access.
 - a. Please see Sections 2.8 and 2.9.
3. Please include a larger scaled and labeled plot plan of facility that clearly shows fence lines, stack locations, building locations, and building heights, preferably with a legend.
 - a. Please see Figures 2 through 4. A site engineering drawing will be provided with the application package.
4. Please include the surface characteristics analysis in the application.
 - a. Please see Section 2.5.4 and Appendix B.
5. Please include an analysis that discusses site representativeness using both on-site and airport land use.
 - a. Please see Section 2.5.4 and Appendix B.
6. Please address Air Toxics that are not covered by a MACT in the application.
 - a. Please see Section 2.6.1 and Section **Error! Reference source not found.**
7. Preconstruction monitoring should be addressed for all applicable pollutants. If needed, data should be obtained from ADEM's monitoring section.
 - a. Please see Table 4 for the updated values.
8. A disk with ALL input, output, pre and post processor files including, AERSURFACE, plot files, downwash, etc. should be included with application.
 - a. Please see Section 2.1.
9. Please remove all mention of paved and unpaved roads from protocol and application (discussion and tables), as they will not be modeled.
 - a. All mentions of paved and unpaved roads from protocol have been removed.
10. Please discuss, in depth, how emissions data from nearby Ascend facility was obtained and will be used in the analysis.
 - a. Please see Section 2.6.3.
11. Note that if maximum concentrations fall outside of the 250m spacing, additional receptors may be required.
 - a. Please see Section 2.9.
12. For NO₂ modeling, the model should assume default ratios for ARM2. If new ratios are wanted, please contact ADEM as permitting would have to approve.
 - a. Please Section 2.10.
13. A headroom analysis is no longer required.
 - a. All mention of the headroom analysis has been removed.
14. Please edit the MERPs analysis in the protocol and include equation calculations for all three sites considered. This must be approved before the application is submitted.
 - a. Please see Section 3.2.1.

15. Do not include a local visibility analysis as part of application.
 - a. All mention of local visibility analysis has been removed.
16. On Table 13: Significant Impact Levels – SO₂ 1-hour Class II concentrations – 7.8 µg/m³ should be used.
 - a. Please see Table 11.
17. The following tables should be corrected with the given current information:
 - a. Please see Table 4, Table 9, and Table 10.

**Proposed Compliance Assurance
for a Major Source Operating Permit**

RECEIVED

FEB 19 2019

ADEM AIR DIVISION

Year of Request: 2019

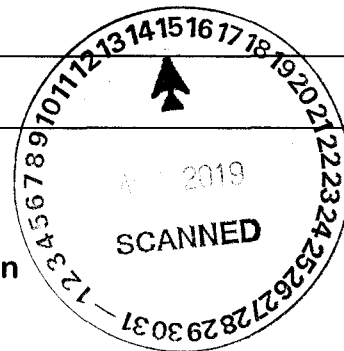
Facility Information

Permittee Name: Nucor Steel Decatur, LLC

Facility Name: Nucor Steel Decatur, LLC

MSOP No.: 712-0037

Facility Location: Decatur, AL



Responsible Official Information


Name: Michael D. Lee

Title: Vice President and General Manager

Phone No.: (256) 301-3500

Certification Statement

I hereby certify that the information given in this report, based on information and belief formed after reasonable inquiry is true, accurate, and complete.


Signature

Feb. 15, 2019
Date

February 15, 2019

Proposed Compliance Assurance for Nucor Steel Decatur Galvanizing Line and EAF Transformers – Supplement to PSD Application

Proposed Monitoring Protocol to Demonstrate NO_x Compliance for New Galvanizing Line

Nucor Decatur, LLC is proposing the construction of a 115 MM Galvanizing Line. For reduction of NO_x, Nucor is proposing to install a selective-catalytic-reduction unit (SCR) using urea feed. NO_x would be generated from the future annealing furnace (integral to the galvanizing process). The proposed unit would be similar to or the same as is currently used in the existing galvanizing line.

Nucor would also propose using a NO_x CEMs unit to demonstrate compliance with ADEM's future permit limits for NO_x/MMBtu and NO_x lb./hr. Further, said CEMs unit would be used in a feedback control loop for the feed of urea to control NO_x levels below the permit requirements.

The precise model numbers for analyzing units and CEMDAS module are not determined at this point but would be configured in a similar manner to what Nucor currently uses at its existing galvanizing line.

As a final step in the application process, as details are understood regarding actual SCR configuration and CEMs equipment, Nucor will submit a Form 110 to provide an accurate description of the control process for NO_x reduction.

Proposed Compliance Demonstration for New EAF Transformers

Nucor is proposing upgrading the current four 75 MVA transformers used for both EAFs. The upgrade detailed in the permit application consists of four each 90 MVA transformers – two per furnace. Each set of two transformers will be fed by a three cable 1,500 amp connection. A single 3,000 amp breaker will be used to limit current to both sets of two transformers. Power feed to the transformers is drawn from Nucor's sub-station and is 34,500 volts. Nucor is considering the purchase of four 123 MVA transformers in lieu of the 90 MVA transformers detailed in the permit application to provide common spares with other mills. The 123 MVA transformers would be power limited to 90 MVA with the configuration described above (34,500 volts at 1,500 amps).

To demonstrate compliance with the 90 MVA limit for the larger transformers, Nucor is proposing having a third party verify the amp rating on the 3,000 amp breaker annually. The breaker cannot be bypassed as unregulated current may damage the furnace. Ensuring the breaker meets the rating of 3,000 amps verifies the transformers will be limited to 90 MVA.

1. INTRODUCTION

1.1 BACKGROUND

Nucor Steel Decatur, LLC, a subsidiary of Nucor Corporation (collectively Nucor), owns and operates a steel recycling mill in Trinity, Morgan County, Alabama (the Decatur Steel Mill). The mill is categorized under the Standard Industrial Classification (SIC) code 3312: Steel Works, Blast Furnaces (including Coke Ovens), and Rolling Mills. The mill is a major stationary source under the Title V Operating Permit Program administered by the Alabama Department of Environmental Management (ADEM) under Air Pollution Control Program, Chapter 335-3-10. The mill currently operates under Title V Permit No. 712-0037 which expires September 5, 2021.

In this permit application, Nucor and the Decatur Steel Mill will expand the facility by adding a new galvanization line and debottlenecking the existing meltshop. The project includes the following changes at the facility:

- A new 500,000 TPY Galvanizing Line with a natural gas ceiling of 120 MMBtu/hour;
- A third LMF Station;
- Four new Electric Arc Furnace (EAF) transformers (two per furnace) upgrading from current rating of 75 MVA to 90 MVA);
- Increase in the slab width to 68 inches;
- The addition of an eighth casting segment on both casters;
- Upgrade to the existing charge crane;
- Upgrade the existing Roughing Mill motors (2) and Finishing Mill motors (5);
- Increase the sizes of the Caster Contact Cooling Tower and the Caster Non-Contact Cooling Tower; and
- An increase in the annual liquid metal limit from 3.2 million tons per year (MM TPY) to 3.6 MM TPY and an increase in the hourly limit increased from 440 tons per hour (TPH) to 540 TPH.

Nucor is pleased to announce that the project will include a \$200M investment and will result in the addition of 35 additional Nucor Team Mates.

Nucor is the leading steel producer and scrap steel recycler in North America, and is based in Charlotte, North Carolina. Nucor's goal is to take care of its customers by working to be the safest, highest quality, lowest cost, most productive and most profitable steel company in the world. They are committed to doing this while being cultural and environmental stewards in the communities where they live and work.

Nucor has a strong desire to strengthen American manufacturing, the American steel industry, and empower the American worker by providing high-quality products, high-paying jobs, and a strong sense of environmental and community stewardship in all of its steel mills and facilities. An important

3.2.2 BACT CONTROL OF CARBON MONOXIDE (CO) EMISSIONS

Step 4: Evaluate the Most Effective Controls and Document Results

The two remaining control technologies for CO are DEC and flaring of emissions. Table 1.1.2 below demonstrates that the cost for the installation of would qualify as economically infeasible. The calculation methodology used was based on the EPA Air Pollution Control Manual, Sixth Edition (EPA/452/B-02-001, January 2002). The economic evaluation indicates that the cost of CO control on a per ton basis would be \$148,148/ton. This value is well above the established acceptable \$/ton values of \$10,000-\$15,000/ton for CO. The Equipment Cost and Expendable Supplies Cost were estimated using conservative values from EPA's Air Pollution Control Technology Fact Sheet (EPA-452/F-03-019):

- Capital Cost suggested in EPA document: \$13 to \$21,000 per scfm - \$1,000/scfm used
- Annualized Cost suggested in EPA document: \$3 to \$300 per scfm - \$150/scfm used

Table 1.2.2 Economic Evaluation of CO Flare on Electric Arc Furnace

EPA Control Cost Manual Version - 5% Interest Rate with 20 Year Equipment Life

1

Line	Description of Cost	Cost Factor	Cost
1	Direct Capital Costs		
2	Purchased Equipment Costs (PEC)		
3	Equipment Cost (EC) ²	Engineering Estimate	\$2,200,000,000
4	Instrumentation	10% of EC	\$220,000,000
5	Freight	5% of EC	\$110,000,000
6	Subtotal - PEC		\$2,530,000,000
7	Installation Costs		
8	Foundation & Supports	8% of PEC	\$202,400,000
9	Handling & Erection	14% of PEC	\$354,200,000
10	Electrical	4% of PEC	\$101,200,000
11	Piping	2% of PEC	\$50,600,000
12	Insulation	1% of PEC	\$25,300,000
13	Painting	1% of PEC	\$25,300,000
14	Subtotal - Installation Costs		\$759,000,000
15	Total Direct Capital Costs (TDC)		\$3,289,000,000
16	Indirect Capital Costs		
17	Installation Costs		
18	General Facilities	5% of PEC	\$126,500,000
19	Engineering and Home Office Fees	10% of PEC	\$253,000,000
20	Process Contingency	5% of PEC	\$126,500,000
21	Total Indirect Capital Cost (TIC)		\$506,000,000
22	Project Contingency	15% of TDC+TIC	\$569,250,000

¹ EPA/452/B-02-001

² EPA-452/F-03-019

Line	Description of Cost	Cost Factor	Cost
23	Total Capital Investment (TCI)		\$4,364,250,000
24	Direct Annual Costs		
25	Expendable Supplies Costs ²	Engineering Estimate	\$330,000,000
26	Maintenance Labor + Materials	1.5% of TCI	\$65,463,750
27	Total Direct Annual Cost (TDAC)		\$395,463,750
24	Indirect Annual Costs		
25	Engineering	10% of PEC	\$253,000,000
26	Construction and Field Expenses	10% of PEC	\$253,000,000
27	Start-Up	1% of PEC	\$25,300,000
28	Contingencies	3% of PEC	\$75,900,000
29	Total Indirect Annual Costs (TIAC)		\$607,200,000
30	Capital Recovery Costs		
31	Capital Recovery Factor (5% interest rate, 20 years)		\$203,013,746
36	Total Annualized Cost		\$1,205,677,496
34	Cost Effectiveness		
35	CO Uncontrolled Emission Rate (tpy)		4,140
36	CO Controlled Emission Rate (tpy, 99% Control Efficiency)		41
37	CO Emission Reduction (tpy)		4,099
38	Cost Effectiveness (\$/ton)		\$148,148

A review of the RBLC database revealed that other steel mills have an emission limit ranging from about 1.93 - 6.0 lbs. CO/ ton of steel. No other mills have proposed or successfully implemented any controls besides DEC. The other control options have been shown to be technically or economically infeasible.

Based on a review of similar EAF melt shop applications, the proposed controls and the emission limit represent the best available control technology for the EAF.

Step 5: Select BACT

In conclusion, BACT for controlling CO emissions from the existing EAF is proposed as the use of the existing DEC to meet a CO emission rate of 2.3 lbs. /ton of steel produced, which represents the best achievable limit in the broader industry.

3.2.5 BACT CONTROL OF VOLATILE ORGANIC COMPOUND EMISSIONS

Step 4: Evaluate the Most Effective Controls and Document Results

The two remaining control strategies are scrap management plan and degreasing of scrap metal. Vapor degreasing is the process of using a boiling solvent at the bottom of a vapor degreaser to create vapor that condenses on the scrap and dissolves any soils. As the solvent cools and condenses further, it drips off the scrap and carries all dissolved solids with it. The solvent drips back into the boiling solvent at the bottom of the vapor degreaser to be recycled and used again on the next part. Table 3.2.5 below demonstrates that the cost for the installation of would qualify as economically infeasible. The calculation methodology used was based on the EPA Air Pollution Control Manual, Sixth Edition (EPA/452/B-02-001, January 2002). The economic evaluation indicates that the cost of VOC control on a per ton basis would be \$95,312/ton. This value is well above the established acceptable \$/ton values of \$10,000-\$15,000/ton for VOC. The Equipment Cost and Expendable Supplies Cost were based on vendor estimates and chemical costing. No degreasing operation of this scale could be located for firmer costing. The Equipment Cost is based on a \$25,000/1,000 ton scrap processed, and is a very conservative estimate. The Expendable Supplies Cost assumes a less than 0.5% solvent loss and does not include heating costs for the units.

Table 3.2.5 Economic Evaluation of VOC Reduction Via Solvent Degreasing on Electric Arc Furnace

EPA Control Cost Manual Version - 5% Interest Rate with 20 Year Equipment Life

Line	Description of Cost	Cost Factor	Cost
1	Direct Capital Costs		
2	Purchased Equipment Costs (PEC)		
3	Equipment Cost (EC)	Engineering Estimate	\$80,000,000
4	Instrumentation	10% of EC	\$8,000,000
5	Freight	5% of EC	\$4,000,000
6	Subtotal - PEC		\$92,000,000
7	Installation Costs		
8	Foundation & Supports	8% of PEC	\$7,360,000
9	Handling & Erection	14% of PEC	\$12,880,000
10	Electrical	4% of PEC	\$3,680,000
11	Piping	2% of PEC	\$1,840,000
12	Insulation	1% of PEC	\$920,000
13	Painting	1% of PEC	\$920,000
14	Subtotal - Installation Costs		\$27,600,000
15	Total Direct Capital Costs (TDC)		\$119,600,000
16	Indirect Capital Costs		
17	Installation Costs		
18	General Facilities	5% of PEC	\$4,600,000
19	Engineering and Home Office Fees	10% of PEC	\$9,200,000
20	Process Contingency	5% of PEC	\$4,600,000

Line	Description of Cost	Cost Factor	Cost
21	Total Indirect Capital Cost (TIC)		\$18,400,000
22	Project Contingency	15% of TDC+TIC	\$20,700,000
23	Total Capital Investment (TCI)		\$158,700,000
24	Direct Annual Costs		
25	Expendable Supplies Costs	Engineering Estimate	\$1,000,000
26	Maintenance Labor + Materials	1.5% of TCI	\$2,380,500
27	Total Direct Annual Cost (TDAC)		\$3,380,500
24	Indirect Annual Costs		
25	Engineering	10% of PEC	\$9,200,000
26	Construction and Field Expenses	10% of PEC	\$9,200,000
27	Start-Up	1% of PEC	\$920,000
28	Contingencies	3% of PEC	\$2,760,000
29	Total Indirect Annual Costs (TIAC)		\$22,080,000
30	Capital Recovery Costs		
31	Capital Recovery Factor		\$7,382,318
36	Total Annualized Cost		\$32,842,818
34	Cost Effectiveness		
35	VOC Uncontrolled Emission Rate (tpy)		234
36	VOC Controlled Emission Rate (tpy, 99% Control Efficiency)		2.34
37	VOC Emission Reduction (tpy)		232
38	Cost Effectiveness (\$/ton)		\$95,312

None of the steel mills reviewed in this analysis have proposed or successfully implemented any controls besides scrap management. The other control options have been shown to be technically infeasible.

Step 5: Select BACT

In conclusion, BACT for controlling VOC emissions from the EAFs is proposed as the utilization of a scrap management program to meet a VOC emission rate of 0.13 lb/ton of steel. The mill will utilize a scrap management program to eliminate the purchase of scrap steel that is heavily oiled. A broker or a Nucor representative is responsible for inspecting shipments of scrap received. The scrap inspector visually inspects the shipments and determines compliance with the scrap management specifications.

3.2.7 BACT CONTROL OF GREENHOUSE GAS EMISSIONS

Step 4: Evaluate the Most Effective Controls and Document Results

The two remaining options are CCS and good design and operating practices.

The most technically feasible option for CO₂ capture for both the EAF and Galvanizing Line would involve post-combustion scrubbing using an absorber column. In the case of the EAF operation Nucor would require two such scrubbers each managing approximately 1,000,000 SCFM of flue gas (combination of EAF off-gas and canopy air). Managing the smaller streams from the furnace duct would not work given the elevated temperature of the EAF off-gas. A brief description of the scrubbing process flow is as follows:

1. Flue gas is scrubbed in a counter-flow absorber column with a scrubbing liquid (ammonia or other).
2. Scrubber liquid on becoming saturated with CO₂ is then pumped to a stripper column.
3. Superheated steam is used to strip CO₂ from the stripping column and the absorbent fluid is returned to the process.
4. A condensing step would be required for separation of CO₂ from condensed steam. This would involve surface condensers and knockout drums.
5. High-pressure compressors would be employed in transporting CO₂ to high-pressure storage tanks.
6. High-pressure CO₂ would be conveyed to market via a future 255-mile pipeline.

A preliminary capital estimate for this option is summarized below:

2 EA – Flue-gas scrubbers and retrofitting of existing ductwork	\$220 MM
Additional fans for added flow requirements	\$15 MM
Pumps/electrical/tanks/compressors/storage	\$80 MM
1 EA – High Pressure Boiler (200,000 lbs/hour), piping and water treatment systems	\$20 MM
2 EA – CO ₂ Stripping Columns and ancillary	\$180 MM
1 EA – 255-mile x 4" high pressure CO ₂ line (\$150/foot)	\$202 MM
Total Estimated Capital	\$717 MM

As a basis in comparison the estimated capital required for CO₂ scrubbing of the EAF off-gas would approach the asset value of the Decatur steel mill. It is estimated that direct operating costs would average \$180 MM/year. Natural gas for boiler operation alone would be \$10MM/year to operate a 200,000 lb/hour boiler. This is clearly an excessive cost.

In addition to the extremely high costs for CCS, it should be recognized that a large portion of these costs are energy related. The two largest energy requirements of carbon capture post-combustion are the energy required to regenerate the solvent and the energy to compress the captured CO₂ to typical

pipeline pressures. Satisfying these high additional energy requirements create significant additional CO₂ emissions and emissions of other conventional pollutants.

These significant additional requirements for steam and electricity require fossil fuels to be combusted either on or off site. These energy demands of CCS contribute to its significant cost and generate negative environmental consequences through the extra criteria pollutant emissions.

In conclusion, CCS is deemed to be both economically and environmentally infeasible.

As previously discussed, the EAFs are designed to operate efficiently and the facility strives to operate the units in the most effecting manners.

Step 5: Select BACT

Nucor Decatur proposes a CO₂e BACT of 504,000 TPY for the meltshop. The proposed emission limits are based on the proposed maximum production of the meltshop and the established emission factor of 280 lb/ton.

3.3 BACT ANALYSIS FOR GALVANIZING LINE (NATURAL GAS-FIRED BURNERS)

Nucor will be installing a new galvanizing furnace with natural gas-fired burners as a part of the new galvanizing line. The maximum heat input rate for the galvanizing line will be 120.0 MMBtu/hr.

3.3.1 BACT CONTROL OF OXIDES OF NITROGEN (NOX) EMISSIONS

NOx emissions from the additional galvanizing line burners primarily result from combustion by-product of the fuel.

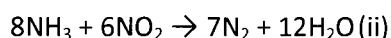
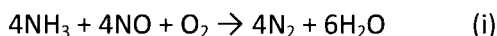
Step 1: Identify All Control Technologies

Three available technologies were evaluated to control NOx emissions from galvanizing line. They are:

- SCR
- SNCR
- ULNB with exhaust gas re-circulation

Step 2: Eliminate Technical Infeasible Options

(1) Selective Catalytic Reduction (SCR) -- In this process, ammonia (NH₃), usually diluted with air or steam, is injected through a grid system into the exhaust gas stream upstream of a catalyst bed. On the catalyst surface the NH₃ reacts with NOx to form molecular nitrogen and water. The basic reactions are as follows:



The reactions take place on the surface of the catalyst. Usually, a fixed bed catalytic reactor is used for SCR systems. The function of the catalyst is to effectively lower the activation energy of the NOx decomposition reactions. Technical factors related to this technology include the catalyst reactor design, optimum operating temperature, sulfur content of the charge, catalyst deactivation due to aging, ammonia slip emissions and design of the ammonia injection system.

Three types of catalyst bed configurations have been successfully applied to commercial sources: the moving bed reactor, the parallel flow reactor and the fixed bed reactor. The fixed bed reactor is applicable to sources with little or no particulate present in the flue gas. In this reactor design, the catalyst bed is oriented perpendicular to the flue gas flow and transport of the reactants to the active catalyst sites occurs through a combination of diffusion and convection.

Depending on system design, NOx removal of 80 - 90 percent may be achievable under optimum conditions³. The reaction of NH₃ and NOx is favored by the presence of excess oxygen. Another variable affecting NOx reduction is exhaust gas temperature. The greatest NOx reduction occurs within a

³ USEPA "ACT Document - NOx Emissions from Iron and Steel Mills", Sept., 1994

reaction window at catalyst bed temperatures between 600 °F - 750 °F for conventional (vanadium or titanium-based) catalyst types, and 470 °F - 510 °F for platinum-based catalysts.

In USEPA's "Air Pollution Control Technology Fact Sheet for Selective Catalytic Reduction, EPA-452/F-03-032" it is stated that SCR is capable of NO_x reduction efficiencies in the range of 70% to 90% and higher reductions are possible but generally not cost-effective. Effective SCR control includes an exit gas temperature in the range of 480 to 800°F and NO_x concentration from 20 ppm (>70% control) to 150 ppm (higher control efficiency). At NO_x concentrations greater than 150 ppm, the reaction rate does not increase control efficiency. This document also states that "SCR can be cost effective for large industrial boilers and process heaters operating at high to moderate capacity factors (> 100 MMBtu/hr for coal-fired boilers and >50 MMBtu/hr for gas-fired boilers)." For the galvanizing line furnace at the Decatur steel mill, it is estimated that the SCR control efficiency would be about 90%.

A review of the RLBC database for galvanizing furnaces shows that BACT for NO_x control is achieved through the use of SCR and the combination of SNCR (direct-fired section)/SCR (radiant tube section). SCR with urea as the reductant has been demonstrated to reduce uncontrolled NO_x emissions to levels at or below the current permitted emission limit of 0.067 lb/MMBtu. The capital and operating expenses associated with this control are not prohibitive and will reduce NO_x levels below what is achieved just with low-NO_x burners.

(2) Non-Selective Catalytic Reduction (NSCR) -- The NSCR system is a post-combustion add-on exhaust gas treatment system. It is often referred to as a "three-way conversion" catalyst since it reduces NO_x, unburned hydrocarbons (UBH), and CO simultaneously. In order to operate properly, the combustion process must be stoichiometric or near-stoichiometric which is not maintained in an EAF and varies widely under regular operation. Under stoichiometric conditions, in the presence of the catalyst, NO_x is reduced by CO, resulting in nitrogen and carbon dioxide. Currently, NSCR systems are limited to rich-burn IC engines with fuel rich ignition system applications. Moreover, potential problems with NSCR systems include catalyst poisoning by phosphorus and zinc (present in galvanization line). In view of the above limitations, the NSCR option is considered technically feasible for this application, but with some reservations.

(3) Ultra-low NO_x Burners and Exhaust Gas Recirculation – By combining EGR with ULNBs, NO_x control can be enhanced more than by using either technology alone. This combination reduces NO_x formation by two mechanisms. The recycled exhaust gas contains combustion products that act as inerts during combustion and lower the peak flame temperature, reducing thermal NO_x formation. To a lesser extent, EGR also reduces thermal NO_x formation by lowering the oxygen concentration in the primary flame zone. The use of these two technologies together is technically feasible.

Step 3: Rank Remaining Control Technologies by Control Effectiveness

SCR would provide the greatest NO_x reduction with an estimated control efficiency of 90%. SNCR (in conjunction with low-NO_x burners) could reach as high as 75% control. The RLBC database does not indicate any facilities utilizing a successful ULNB with EGR setup, but engineering estimates indicate that emissions would get as low as 0.10 lb/MMBtu. SCR is the most effective control technology.

Step 4 and 5:

In conclusion, for the new galvanizing line, BACT will be SCR system to control NOx emissions. Nucor Decatur will limit urea feed ahead of the SCR catalyst for flue gas temperatures in the 600 °F - 800 °F range. The NOx emission limits for the new galvanizing line will be 0.067 lb/MMBtu.

3.3.7 BACT CONTROL OF GREENHOUSE GAS EMISSIONS

Step 4: Evaluate the Most Effective Controls and Document Results

The two remaining options are CCS and good design and operating practices.

The most technically feasible option for CO₂ capture for both the EAF and Galvanizing Line would involve post-combustion scrubbing using an absorber column. Many of the components used for CO₂ CCS would be common for both applications (boiler, CO₂ storage, pipeline, tanks, etc.). A much smaller scrubber and stripper would be required for the Galvanizing line. The incremental cost to add CO₂ scrubbing capability would be roughly:

1 EA – Scrubber to address 25,000 SCFM of flue gas	\$9MM
1 EA – Stripping column and ancillary	\$8MM
Piping, tanks, compressors, condenser, storage	\$22MM
1 EA – 255-mile x 4" high pressure CO ₂ line (\$150/foot)	\$202 MM
Total incremental capital for CO₂ scrubbing for Galv. Line	\$241MM

Again, boiler operation, absorbent purchases, boiler water treatment costs, and additional operating costs are primarily captured in the EAF operating cost estimate. Incremental additional costs for scrubbing exhaust from a new galvanizing line annealing furnace are roughly \$20 MM/year.

In addition to the extremely high costs for CCS, it should be recognized that a large portion of these costs are energy related. The two largest energy requirements of carbon capture post-combustion are the energy required to regenerate the solvent and the energy to compress the captured CO₂ to typical pipeline pressures. Satisfying these high additional energy requirements create significant additional CO₂ emissions and emissions of other conventional pollutants.

These significant additional requirements for steam and electricity require fossil fuels to be combusted either on or off site. These energy demands of CCS contribute to its significant cost and generate negative environmental consequences through the extra criteria pollutant emissions.

In conclusion, CCS is deemed to be both economically and environmentally infeasible.

Use of high efficiency burners, fueled by natural gas and employing good combustion/operating practices are the remaining control technologies and represent the base case. The only option remaining is good design and operating practices.

Step 5: Select BACT

Nucor Decatur proposes a CO₂e BACT of 61,842 TPY for the new galvanizing line. The proposed emission limits are based on the proposed maximum heat capacity and the established emission factors⁴.

⁴ 40 CFR 98 Subpart C, Tables C-1 and C-2

Youngpeter, Jennifer S

From: Brad Arnold <bsarnold@slrconsulting.com>
Sent: Monday, May 6, 2019 5:56 AM
To: Youngpeter, Jennifer S
Cc: Travis, Megan L; Bacon, Leigh
Subject: Nucor Decatur Change Pages
Attachments: Class I Page 4.pdf; Class II Page 1-2.pdf; Class II Page 2-2.pdf; Class II Page 2-5.pdf; Class II Page 2-9.pdf; Class II Page 3-2.pdf; Class II Table 6.pdf; Class II Tables 17 & 18.pdf; Class II Tables 19 & 20.pdf; Class II Tables 23 & 24.pdf

Jennifer

The attached change pages for the Nucor Decatur Class I and Class II modeling reports should satisfy all of the requests from the ADEM modeling group. The FTP site will be setup today and we will share a link for the complete modeling demonstrations later today.

Thanks



Brad Arnold

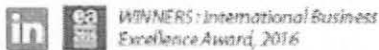
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Discussion about the Class I SIL and PSD increment analyses at Sipsey is provided in Section 2.4 and 3.2.

2.2 EMISSIONS INVENTORY

The on-site emission inventory for the Class I modeling is identical to the Class II modeling, except for the following:

- Source coordinates were transformed to the Lambert Conformal Conic (LCC) projection to be consistent with the CALMET meteorological model output; and
- Particulate emissions from the electric arc furnace were speciated for the regional haze modeling as discussed in Section 3.1.1.

2.2.1 NEW AND MODIFIED SOURCES

As described in Section 1 the project consists of construction of a new galvanizing line (Galvanizing Line #2). Emissions from this source will be collected and vented through a single stack. For modeling purposes it was assumed that the new galvanizing line will operate for 8,760 hours per year at its maximum potential to emit.

In addition, the project will result in net emissions increases from several existing sources:

- Melt Shop Baghouses 1 and 2;
- North Caster Steam Vent; and
- South Caster Steam Vent.

Emissions from the Melt Shop Baghouses and North/South Caster Steam Vents are vented through individual stacks and were modeled as point sources that operate 8,760 hours per year. The emission rates were set equal to their post-project potential to emit minus the most recent 2 years of actual emissions (i.e., future potentials minus current actuals). The resulting emissions were based on the maximum hourly emissions for comparison to short-term standards and thresholds (less than or equal to 24 hours), while annual ton per year emissions were modeled for comparison to annual standards and thresholds.

Emission rates and release parameters for all project sources are provided in Table 3. Descriptions of how the modeled source locations, release parameters, and emission rates were derived are provided below. An illustration showing the spatial layout of all project-related Nucor emission sources in the modeling is provided in Figure 3. The source location and stack parameters for the new Galvanizing Line stack were provided by Nucor based on existing information. Source locations and stack parameters for existing sources were obtained from Nucor and the previous PSD permit application (ERM, 2016).

2.2.2 DOWNWASH

The effects of plume downwash were considered for all project point sources, based on building locations and heights relative to facility emission sources. Direction-specific downwash parameters were calculated using the current version of the EPA-approved Building Profile Input Program (BPIPPRM

Table 2 provides a summary of the project emissions compared to the Prevention of Significant Deterioration (PSD) major modification thresholds. The following pollutants trigger PSD review and therefore a dispersion modeling analysis to demonstrate compliance with the applicable air quality standards: PM₁₀, PM_{2.5}, NO₂, SO₂, CO, and lead. Figure 1 and Figure 2 provide illustrations of the project area.

The general contents of this modeling report were discussed at the pre-protocol meeting on December 14, 2017 with ADEM, Nucor, and SLR and summarized in a modeling protocol. This modeling report defines the regulatory framework and technical methods that were used for the PSD Class II compliance demonstration that is required to support the permit application. The modeling analysis was conducted in accordance with guidance provided by ADEM and the Environmental Protection Agency (EPA) as outlined in the following documents:

- PSD Air Quality Analysis Modeling Guidelines (Alabama Department of Environmental Management, 2018).
- Guideline on Air Quality Models [published as 40 CFR 58, Appendix W] (EPA, 2017) hereafter referred to as the Appendix W; and
- The Air Quality Checklist (EPA, 2016).

Table 3 provides a list of all pollutants to be modeled, along with the applicable National Ambient Air Quality Standards (NAAQS), for each pollutant and averaging period. The applicable Class II PSD increments are listed in Table 4.

A far field, Class I area impact analysis was also performed for this project in order to demonstrate compliance with the Class I PSD increments and air quality related values (AQRVs). The far field, Class I area modeling protocol will be submitted under separate cover.

1.1 AREA CLASSIFICATION

Morgan County, Alabama is currently classified as attainment or unclassifiable for all NAAQS, therefore is subject to PSD review. As part of PSD, the pre-construction ambient air quality monitoring requirement is contained in 40 CFR 52.21(m). This requires that a PSD permit application include data representative of conditions in the vicinity of the project in the year preceding receipt of the application. Appropriate air quality concentrations are summarized in Table 5.

In addition to calculating direction-specific building dimensions, the BPIPPRM program also calculates the Good Engineering Practice (GEP) stack height. All Nucor facility stack heights were checked to verify that they are within the GEP stack height limit.

The base elevation of all structures and emission units (EUs) will be set to 178 m, which was the ground-level elevation used in Nucor's 2016 PSD permit application (ERM, 2016). This is also in good agreement with the ground-level elevation shown on Google Earth. A simplified plot plan of the facility, showing the location of all structures and point source locations used in the plume downwash calculations and including structure dimensions and heights, is provided in Figure 3 and Figure 4.

2.5 METEOROLOGICAL DATA PROCESSING

Hourly meteorological data used for air quality modeling must be spatially and climatologically representative of the area of interest. Appendix W recommends a minimum of one year of site-specific meteorological data or five consecutive years from the most recent, readily available data collected at a representative National Weather Service (NWS) station. Required surface meteorological data inputs to the AERMOD meteorological processor (AERMET) include, at minimum, hourly observations of wind speed, wind direction, temperature, and cloud cover (or solar radiation and low-level vertical temperature difference data in lieu of cloud cover). The meteorological processor also requires morning upper air sounding data from a representative NWS station.

2.5.1 ON-SITE DATA

On-site surface meteorological data are not available for this facility.

2.5.2 NATIONAL WEATHER SERVICE (NWS) DATA

The nearest NWS surface observing station is located at Pryor Field (WBAN No. 53852), approximately 13 km east of the Nucor facility. Hourly average and 1-minute average Automated Surface Observing Systems (ASOS) data are available for this station.

At a meeting at the ADEM offices on December 14, 2017 ADEM indicated that they would provide processed data for use in the permit application. On April 30, 2018 ADEM provided a 5-year meteorological dataset (calendar years 2012-2016) from the Pryor Field station. This dataset included AERMOD-ready processed surface and profile files (.sfc and .pfl), merged output files from AERMET Stage 2, AERSURFACE output files, and AERSURFACE processing instructions. ADEM included surface and profile files processed with and without the ADJ-U* option in AERMET Stage 3. For reasons discussed in Section 2.5.6 SLR used the data files processed with the ADJ_U* option. A composite wind rose for calendar years 2012-2016 is provided in Figure 5.

- North Caster Steam Vent; and
- South Caster Steam Vent.

Emissions from the Melt Shop Baghouses and North/South Caster Steam Vents are vented through individual stacks and were modeled as point sources that operate 8,760 hours per year. The emission rates were set equal to their post-project potential to emit minus the most recent 2 years of actual emissions (i.e., future potentials minus current actuals).

Emission rates and release parameters for all project sources are provided in Table 6 and Table 7. Descriptions of how modeled source locations, release parameters, and emission rates were derived are provided below. An illustration showing the location of all Nucor emission sources that were included in the modeling is provided in Figure 4. The source location and stack parameters for the new Galvanizing Line stack were provided by Nucor. Source locations and stack parameters for existing sources were obtained from the previous PSD permit application (ERM, 2016).

2.6.2 EXISTING FACILITY SOURCES

For those pollutants with project-only impacts above the SILs, cumulative modeling was performed to demonstrate compliance with the applicable air quality standards. As discussed in Section 3.2 project-only modeling indicates that impacts due to the net increase in emissions were less than the applicable PM_{10} and $PM_{2.5}$ SILs, but above the 1-hour NO_2 and SO_2 SILs. Emission rates and release parameters for all existing Nucor sources that were included in the cumulative impact analysis are provided in Table 6. For modeling purposes it was assumed that each EU will be operated full time (8,760 hours per year, 24 hours per day) at maximum allowable emission rates.

2.6.3 NEARBY SOURCES

Appendix W requires that the cumulative impact analysis include nearby sources, which are those sources located in the vicinity of the project source and that are not adequately represented by ambient monitoring data. Nearby sources cause a significant concentration gradient in the vicinity of the project and are explicitly included in the modeled source inventory. An off-site source inventory for 1-hour SO_2 and 1-hour NO_2 was provided by ADEM (see Table 7 and Table 8).² ADEM also provided 2-year averaged actual SO_2 emissions for the nearby Ascend facility (see Table 9).³ This data was used as provided by ADEM.

2.7 BACKGROUND CONCENTRATIONS

Background ambient air quality concentrations are added to model-predicted impacts to determine the cumulative potential ambient air quality impact in the vicinity of the facility being modeled. Background concentrations are current levels of ambient air pollution, external to the facility's own impacts and

² Email from Jennifer Youngpeter (ADEM) to Brad Arnold (SLR) re: Nucor Decatur Offsite Modeling Inventory Request. April 19, 2018.

³ Email from Jennifer Youngpeter (ADEM) to Brad Arnold (SLR) FW: 2-year Average Actual Emissions - Ascend. May 7, 2018.

those of nearby sources, which are the result of non-modeled point, area, and mobile sources of air pollution. The background concentrations used in this analysis are provided in Table 10.

2.8 AMBIENT AIR BOUNDARY

A drawing showing the ambient air boundary relative to the facility is provided in Figure 1. Access roads into the facility, as well as a north-south rail spur on the east side of the property, are posted to prevent trespassing on these roads, and the plant property is regularly patrolled by Nucor personnel.

2.9 RECEPTOR NETWORK

Cartesian receptor grids centered on the facility were defined using the Universal Transverse Mercator (UTM) Zone 16, NAD83 coordinate system. The grids were designed to accurately resolve the highest predicted pollutant impacts while at the same time allowing for reasonable execution time. The grids consist of a set of nested receptors placed at:

- 100-meter resolution along the ambient air boundary⁴.
- 100-meter resolution extending to a distance of approximately 1 km from the ambient air boundary.
- 250-meter resolution extending to approximately 5 km from the ambient air boundary.
- 500-meter resolution extending to approximately 10 km from the ambient air boundary.
- 1,000-meter resolution extending to approximately 20 km from the ambient air boundary.
- A refined 100-meter receptor grid around NO₂ and SO₂ SIL exceedances that occurred outside the initial 100-meter spaced grid.

Receptor elevation and scale heights were obtained using the AERMAP terrain processor. The digital terrain dataset provided as input to AERMAP were National Elevation Dataset (NED) digital terrain data at 1/3 arc-second resolution, which is equivalent to approximately 10 meters in the project area. To assure that the correct hill height scale for each receptor was chosen, the NED data file provided to AERMAP included a buffer of approximately 10 km beyond the receptor grid area. Drawings showing the receptor grid are provided in Figure 6 and Figure 7.

2.10 NO₂ MODELING

The Tier 2 approach available in AERMOD, ARM2, was used to estimate 1-hour and annual average NO₂ impacts. ARM2 was applied prior to comparing modeled 1-hour and annual impacts to any standards or thresholds using the default upper and lower limits.

⁴ There is a rail spur that runs through the Nucor facility and ends on an adjacent property. The entrance and exit of the rail spur on the Nucor property is patrolled by Nucor personnel to preclude public access.

1. Project impacts would have significant secondary impacts for all pollutants and averaging periods based on step 1 (see Table 14);
2. Project impacts will not have significant primary and secondary impacts for annual $PM_{2.5}$ based on step 2 (see Table 15).
3. Project impacts will not have significant primary and secondary impacts for 24-hour $PM_{2.5}$ based on step 3 (see Table 16). Each step of the analysis indicates the significant ozone impacts may be expected.

3.3 NAAQS ANALYSIS

As a result of the significant impact analyses performed above, it was determined that a cumulative impact analysis is required for 1-hour NO_2 and 1-hour SO_2 . The cumulative modeling was performed only for those receptors where the significant impact level is exceeded on a pollutant and averaging period basis. Compliance with the NAAQS was based on the total estimated air quality concentration, which is the sum of the following:

- Project emissions at their proposed potential to emit emission rates (Table 6);
- Emissions from all nearby sources, modeled at their permitted emission rates or 2-year average of actual emission rates (see Table 7, Table 8, Table 9); and
- Background concentrations (see Table 10).
- The results of the cumulative analysis are provided in Table 17 and Table 18 and demonstrate compliance with the 1-hour NO_2 ambient standard. The 1-hour SO_2 and 1-hour NO_2 cumulative analyses resulted in model-predicted impacts above the ambient standard. For those receptors with cumulative impacts above the ambient standard, the MAXDCONT analysis option in AERMOD was used to perform a culpability analysis to determine the project impacts at the time and place of modeled impacts above the standard. The results of this analysis are summarized in Table 19-1, Table 19-2, Table 20-1, and Table 20-2 and demonstrate that the project (and total facility) impacts are well under the SIL during any modeled violation of the 1-hour SO_2 and 1-hour NO_2 ambient standards.

For ozone, the estimated impacts due to project emissions were calculated in Section 3.2.1 and are added to nearby monitoring data to determine cumulative ozone concentrations. The closest ozone monitor (AIRS ID 01-103-0011) is located approximately 15 km to the southeast of the Nucor facility. The monitor's location allows it to capture the influence of local and regional sources and their resultant ozone formation and destruction. The monitored ozone design values for the prior three years are provided in Table 23 and cumulative results provided in Table 24, which demonstrates that compliance with the ambient standard will be maintained.

Modeled impacts due to project emissions only were also compared to the ambient standard for lead as shown in Table 25 and Table 26. LEADPOST was used to compare the 3-month rolling averages to the SIL and demonstrate project impacts well below the ambient standard.

Table 6: Modeled Emission Rates and Release Parameters – Project and Existing Point Sources

Model ID	Project?	Source Description	Location (UTM Zone 16, NAD83)			Exhaust Direction	Capped?	Modeled Stack Exit Parameters			
			UTM E (m)	UTM N (m)	Elevation (m)			Height (m)	Temp (K)	Velocity (m/s)	Diameter (m)
MSB1	Yes	Meltshop Baghouse 1	492168.8	3832865.8	178.0	Vert	No	45.7	394.3	14.4	7.9
MSB2	Yes	Meltshop Baghouse 2	492299.2	3832831.7	178.0	Vert	No	45.9	394.3	20.8	6.6
GALV2	Yes	New Galv Line	493208.4	3832901.0	178.0	Vert	No	64.9	444.3	6.4	1.8
NCS	Yes	North Caster Steam Vent	491939.3	3832965.8	178.0	Vert	No	16.8	324.8	16.8	1.4
SCS	Yes	South Caster Steam Vent	491958.2	3832918.4	178.0	Vert	No	39.9	324.8	16.8	1.1
GALVLINE	No	Existing Galv Line	493207.2	3832758.6	178.0	Vert	No	64.9	444.3	6.4	1.8
SETF	No	Southeast Tunnel Furnace	491904.5	3832911.5	178.0	Vert	No	48.8	883.2	6.7	1.8
SWTF	No	Southwest Tunnel Furnace	491844.5	3832927.4	178.0	Vert	No	35.1	993.2	6.7	1.2
NETF	No	Northeast Tunnel Furnace	491908.3	3832965.2	178.0	Vert	No	48.8	823.7	6.7	1.8
NWTF	No	Northwest Tunnel Furnace	491857.1	3832978.0	178.0	Vert	No	35.1	824.8	6.7	1.2
DLF	No	Delivery Furnace	491791.1	3832994.8	178.0	Vert	No	25.9	989.3	6.7	1.5
PL1B1	No	Pickle Line #1 Boiler #1	491502.9	3833138.4	178.0	Vert	No	20.0	516.5	7.3	0.4
PL1B2	No	Pickle Line #1 Boiler #2	491503.8	3833143.4	178.0	Vert	No	20.0	516.5	7.3	0.4
PL2B1	No	Pickle Line #2 Boiler #1	493338.8	3833136.1	178.0	Vert	No	20.0	516.5	7.3	0.4
PL2B2	No	Pickle Line #2 Boiler #2	493338.8	3833139.9	178.0	Vert	No	20.0	516.5	7.3	0.4

Table 17: Nucor Meteorological Data Cumulative Impacts and Comparison to the NAAQS

Pollutant/Averaging Period	Modeled Concentration ($\mu\text{g}/\text{m}^3$)	Background Concentration ($\mu\text{g}/\text{m}^3$)	Total Concentration ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)	Percent of the NAAQS (%)
NO ₂ 1-hour ⁽¹⁾⁽²⁾	280.96	31	311.96	188	165.9
SO ₂ 1-hour ⁽³⁾	208.83	11	219.83 ⁽⁴⁾	196	112.2

⁽¹⁾ Impacts based on ARM2.

⁽²⁾ 98th percentile of the maximum daily concentrations averaged over 5 years.

⁽³⁾ 99th percentile of the maximum daily concentrations averaged over 5 years.

⁽⁴⁾ Nucor project or facility does not significantly contribute to any model violation.

Table 18: Pryor Field Meteorological Data Cumulative Impacts and Comparison to the NAAQS

Pollutant/Averaging Period	Modeled Concentration ($\mu\text{g}/\text{m}^3$)	Background Concentration ($\mu\text{g}/\text{m}^3$)	Total Concentration ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)	Percent of the NAAQS (%)
NO ₂ 1-hour ⁽¹⁾⁽²⁾	312.48	31	343.48	188	182.7
SO ₂ 1-hour ⁽³⁾	210.84	11	221.84 ⁽⁴⁾	196	113.2

⁽¹⁾ Impacts based on ARM2.

⁽²⁾ 98th percentile of the maximum daily concentrations averaged over 5 years.

⁽³⁾ 99th percentile of the maximum daily concentrations averaged over 5 years.

⁽⁴⁾ Nucor project or facility does not significantly contribute to any model violation.

**Table 19-1: Nucor Meteorological Data MAXDCONT Output for 1-hour NO₂
Cumulative Impacts Above the Standard**

UTM Easting	UTM Northing	Cumulative Modeled Concentration ⁽¹⁾ ($\mu\text{g}/\text{m}^3$)	Maximum Nucor Project Contribution at Receptor ($\mu\text{g}/\text{m}^3$)	Maximum Nucor Facility Contribution at Receptor ($\mu\text{g}/\text{m}^3$)
494900.00	3833100.00	280.96	2.36	4.33
494900.00	3833000.00	226.82	2.48	4.70
494800.00	3833100.00	224.06	2.46	4.67
494700.00	3833100.00	201.91	2.63	4.97

⁽¹⁾ MAXDCONT threshold was set to 157 based on a background value of 31 and a standard of 188.

Table 20-1: Pryor Field Meteorological Data MAXDCONT Output for 1-hour NO₂ Cumulative Impacts Above the Standard

UTM Easting	UTM Northing	Cumulative Modeled Concentration ⁽¹⁾ (µg/m ³)	Maximum Nucor Project Contribution at Any Receptor-Time Pair Above NAAQS (µg/m ³)	Maximum Nucor Facility Contribution at Any Receptor-Time Pair Above NAAQS (µg/m ³)
494900.00	3833100.00	371.04	0.0069	0.49
494800.00	3833100.00	247.02		
494900.00	3833000.00	244.74		
494700.00	3833100.00	284.37		
494800.00	3833000.00	176.82		

⁽¹⁾ MAXDCONT threshold was set to 157 based on a background value of 31 and a standard of 188.

**Table 19-2: Nucor Meteorological Data MAXDCONT Output for 1-hour SO₂
Cumulative Impacts Above the Standard**

UTM Easting	UTM Northing	Rank	Cumulative Modeled Concentration ⁽¹⁾ (µg/m ³)	Paired-in-time Nucor Project Contribution (µg/m ³)	Paired-in-time Nucor Facility Contribution (µg/m ³)
496200.00	3833600.00	4TH	257.73829	0.00836	0.00839
496100.00	3833600.00		246.89444	0.00405	0.00408
496100.00	3833700.00		228.51076	0.00247	0.00252
496300.00	3833600.00		219.85031	0.01194	0.01199
496000.00	3833600.00		218.54233	0.00365	0.0037
496200.00	3833700.00		209.66703	0.00713	0.00717
496000.00	3833500.00		208.82957	0.01875	0.01882
496100.00	3833500.00		199.57284	0.01619	0.01625
496000.00	3833750.00		195.86718	0.0016	0.00165
496250.00	3833750.00		193.70794	0.00228	0.00233
496000.00	3833700.00		187.94344	0.00109	0.00116
496300.00	3833500.00		186.33649	0.04711	0.04725
496200.00	3833600.00	5TH	246.53514	0.00562	0.00566
496100.00	3833600.00		238.50542	0.00359	0.00363
496100.00	3833700.00		216.3573	0.00332	0.00337
496300.00	3833600.00		209.29128	0.00462	0.00467
496000.00	3833500.00		205.46982	0.00963	0.00966
496200.00	3833700.00		202.87202	0.00442	0.00448

UTM Easting	UTM Northing	Rank	Cumulative Modeled Concentration ⁽¹⁾ ($\mu\text{g}/\text{m}^3$)	Paired-in-time Nucor Project Contribution ($\mu\text{g}/\text{m}^3$)	Paired-in-time Nucor Facility Contribution ($\mu\text{g}/\text{m}^3$)
496100.00	3833500.00	5TH	195.56856	0.01673	0.01679
496000.00	3833600.00		193.23637	0.00271	0.00275
496000.00	3833750.00		187.52522	0.00097	0.00103
496200.00	3833600.00	6TH	235.84996	0.01141	0.01144
496100.00	3833600.00		226.88838	0.00683	0.00686
496100.00	3833700.00		205.80788	0.00148	0.00152
496000.00	3833500.00		203.11336	0.01574	0.01579
496200.00	3833700.00		197.30448	0.00291	0.00294
496300.00	3833600.00		194.53641	0.00358	0.00362
496100.00	3833500.00		190.56353	0.01298	0.01303
496200.00	3833600.00		220.63742	0.01193	0.01198
496100.00	3833600.00	7TH	209.1693	0.00521	0.00522
496100.00	3833700.00		200.06716	0.00271	0.00275
496000.00	3833500.00		199.87288	0.00652	0.00656
496200.00	3833700.00		192.94593	0.00397	0.00404
496100.00	3833500.00		188.39289	0.02885	0.02894
496200.00	3833600.00		214.78907	0.00665	0.0067
496100.00	3833600.00	8TH	198.46292	0.00464	0.00467
496000.00	3833500.00		198.09032	0.01289	0.01296

UTM Easting	UTM Northing	Rank	Cumulative Modeled Concentration ⁽¹⁾ ($\mu\text{g}/\text{m}^3$)	Paired-in-time Nucor Project Contribution ($\mu\text{g}/\text{m}^3$)	Paired-in-time Nucor Facility Contribution ($\mu\text{g}/\text{m}^3$)
496100.00	3833700.00	8TH	193.51384	0.00452	0.00457
496100.00	3833500.00		185.68292	0.04766	0.04778
496200.00	3833600.00	9TH	213.17207	0.00677	0.00681
496100.00	3833600.00		197.02026	0.00432	0.00435
496000.00	3833500.00		196.69575	0.01331	0.01336
496100.00	3833700.00		190.82369	0.00204	0.00207
496200.00	3833600.00	10TH	206.47014	0.0045	0.00452
496000.00	3833500.00		193.46647	0.01568	0.01574
496100.00	3833600.00		193.42084	0.00482	0.00486
496100.00	3833700.00		186.23507	0.006	0.00605
496200.00	3833600.00	11TH	201.21311	0.00686	0.0069
496100.00	3833600.00		189.83045	0.00739	0.00741
496000.00	3833500.00		188.53837	0.0167	0.01677
496200.00	3833600.00	12TH	197.03955	0.01273	0.01278
496100.00	3833600.00		188.43248	0.0044	0.00443
496000.00	3833500.00		186.82146	0.02992	0.03
496200.00	3833600.00	13TH	192.41821	0.00712	0.00716
496200.00	3833600.00	14TH	187.46112	0.00467	0.0047
496200.00	3833600.00	15TH	186.16788	0.01491	0.01496

UTM Easting	UTM Northing	Rank	Cumulative Modeled Concentration ⁽¹⁾ ($\mu\text{g}/\text{m}^3$)	Paired-in-time Nucor Project Contribution ($\mu\text{g}/\text{m}^3$)	Paired-in-time Nucor Facility Contribution ($\mu\text{g}/\text{m}^3$)
496200.00	3833600.00	16TH	185.07395	0.01291	0.01296

⁽¹⁾ MAXDCONT threshold was set to 185 based on a background value of 11 and a standard of 196.

Table 20-2: Pryor Field Meteorological Data MAXDCONT Output for 1-hour SO₂ Cumulative Impacts Above the Standard

UTM Easting	UTM Northing	Rank	Cumulative Modeled Concentration ⁽¹⁾ (µg/m ³)	Paired-in-time Nucor Project Contribution (µg/m ³)	Paired-in-time Nucor Facility Contribution (µg/m ³)
496100.00	3833500.00	4TH	196.86473	0.01847	0.01853
496000.00	3833500.00		210.84393	0.01337	0.01342
496200.00	3833600.00		233.31184	0.0086	0.00863
496100.00	3833600.00		217.58879	0.00588	0.00591
496000.00	3833600.00		209.56137	0.00396	0.004
496200.00	3833700.00		230.18411	0.00302	0.00305
496000.00	3833750.00		185.97138	0.00297	0.003
496100.00	3833700.00		215.67705	0.0028	0.00283
496250.00	3833750.00		201.76305	0.00178	0.00182
496100.00	3833500.00	5TH	190.15705	0.02037	0.02045
496000.00	3833500.00		205.83147	0.01527	0.01533
496200.00	3833700.00		206.75259	0.00562	0.00564
496200.00	3833600.00		225.95429	0.00547	0.0055
496000.00	3833600.00		190.60303	0.00411	0.00414
496100.00	3833600.00		209.65791	0.00343	0.00344
496100.00	3833700.00		200.76821	0.00226	0.00229
496250.00	3833750.00		191.11662	0.00112	0.00115
496100.00	3833500.00	6TH	187.80454	0.03367	0.03376

UTM Easting	UTM Northing	Rank	Cumulative Modeled Concentration ⁽¹⁾ ($\mu\text{g}/\text{m}^3$)	Paired-in-time Nucor Project Contribution ($\mu\text{g}/\text{m}^3$)	Paired-in-time Nucor Facility Contribution ($\mu\text{g}/\text{m}^3$)
496000.00	3833500.00	6TH	202.86121	0.01539	0.01546
496200.00	3833600.00		215.03092	0.00892	0.00896
496100.00	3833600.00		207.19437	0.00566	0.00568
496100.00	3833700.00		195.56353	0.00297	0.003
496200.00	3833700.00		187.39146	0.00169	0.00172
496000.00	3833500.00	7TH	198.85232	0.02058	0.02066
496100.00	3833600.00		193.49127	0.00691	0.00693
496200.00	3833600.00		202.02471	0.00673	0.00676
496100.00	3833700.00		185.93775	0.00422	0.00425
496000.00	3833500.00	8TH	197.37564	0.01184	0.01189
496200.00	3833600.00		197.53449	0.0117	0.01174
496100.00	3833600.00		191.62894	0.00764	0.00767
496000.00	3833500.00	9TH	195.07622	0.0153	0.01536
496100.00	3833600.00		187.40125	0.01045	0.01048
496200.00	3833600.00		195.3269	0.00467	0.00469
496000.00	3833500.00	10TH	190.95508	0.01806	0.01812
496200.00	3833600.00		194.03497	0.01181	0.01185
496100.00	3833600.00		186.00556	0.00422	0.00423
496000.00	3833500.00	11TH	188.09748	0.01684	0.01691

UTM Easting	UTM Northing	Rank	Cumulative Modeled Concentration ⁽¹⁾ ($\mu\text{g}/\text{m}^3$)	Paired-in-time Nucor Project Contribution ($\mu\text{g}/\text{m}^3$)	Paired-in-time Nucor Facility Contribution ($\mu\text{g}/\text{m}^3$)
496200.00	3833600.00	11TH	191.58614	0.00716	0.00718
496000.00	3833500.00	12TH	186.59524	0.03175	0.03185
496200.00	3833600.00		190.3102	0.00965	0.00968
496200.00	3833600.00	13TH	188.8165	0.01465	0.0147
496200.00	3833600.00	14TH	187.80634	0.01533	0.01538
496200.00	3833600.00	15TH	185.76766	0.01536	0.01541
496200.00	3833600.00	16TH	185.18119	0.0118	0.01184

⁽²⁾ MAXDCONT threshold was set to 185 based on a background value of 11 and a standard of 196.

Table 23: Nucor Meteorological Data Project-Only Lead Impacts

Pollutant/Averaging Period	Modeled Concentration ($\mu\text{g}/\text{m}^3$)	Background Concentration ($\mu\text{g}/\text{m}^3$)	Total Concentration ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)	Percent of the NAAQs (%)
Lead 3 month rolling average	0.0038	--	0.0038	0.15	2.5

Table 24: Pryor Field Meteorological data Project-Only Lead Impacts

Pollutant/Averaging Period	Modeled Concentration ($\mu\text{g}/\text{m}^3$)	Background Concentration ($\mu\text{g}/\text{m}^3$)	Total Concentration ($\mu\text{g}/\text{m}^3$)	NAAQS ($\mu\text{g}/\text{m}^3$)	Percent of the NAAQs (%)
Lead 3 month rolling average	0.0037	--	0.0037	0.15	2.5