Prevention of Significant Air Quality Deterioration Review

Preliminary Determination

December 2008

Facility Name: CEMEX Southeast, LLC
City: Clinchfield
County: Houston
AIRS Number: 04-13-153-00003
Application Number: 17550
Date SIP Application Received: July 16, 2007

Review Conducted by:
State of Georgia - Department of Natural Resources
Environmental Protection Division - Air Protection Branch
Stationary Source Permitting Program

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SUMMARY

The Environmental Protection Division (EPD) has reviewed the application submitted by CEMEX Southeast, LLC for a permit to construct and operate a new Portland cement production line designated as Kiln No. 6. The proposed project will consist mainly of the construction/installation of the following process equipment or operation:

- Eight belt conveyors at the existing quarry and associated material storage area;
- Kiln feed preparation with a raw mill;
- A dry process rotary kiln coupled with preheater/precalciner and calciner;
- A clinker cooler;
- A coal/pet coke mill;
- A finish mill;
- A cement storage, packaging and shipping operation; and
- Necessary materials handling, conveying and storage equipment and operation serving the equipment and operations aforementioned.

In addition to the new equipment, some existing silos will be retrofitted with baghouses and utilized either exclusively or partially in the operation of the Kiln No. 6.

Operation of the new Kiln No. 6 will result in increases in emissions from the facility. The sources of particulate mater (PM) emissions include material handing, raw mill, clinker cooler, coal mill, cement finish mill and cement packaging and shipping operations. The cement kiln with coupled preheater/precalciner and calciner will emit carbon monoxide (CO), PM, nitrogen oxides (NO_x), sulfur dioxide (SO_2), and volatile organic compounds (VOC).

A Prevention of Significant Deterioration (PSD) analysis was performed for the facility for all pollutants to determine if any increase was above the "significance" level. The CO, NO_x, PM/PM_{10}, SO_2 and VOC emissions increase were above the PSD significant level threshold.

CEMEX Southeast, LLC is located in Houston County, which is classified as "attainment" or "unclassifiable" for SO_2, $PM_{2.5}$ and PM_{10}, NO_x, CO, and ozone (VOC).

The EPD review of the data submitted by CEMEX Southeast, LLC related to the proposed Kiln No. 6 indicate that the facility will be in compliance with all applicable state and federal air quality regulations.

It is the preliminary determination of the EPD that the proposal provides for the application of Best Available Control Technology (BACT) for the control of CO, PM, NO_x, SO_2, and VOC emissions, as required by federal PSD regulation 40 CFR 52.21(j).

It has been determined through approved modeling techniques that the estimated emissions will not cause or contribute to a violation of any ambient air standard or allowable PSD increment in the area surrounding the facility. It has further been determined that the proposal will not cause impairment of visibility or detrimental effects on soils or vegetation. Any air quality impacts produced by project-related growth should be inconsequential.

This Preliminary Determination concludes that an Air Quality Permit should be issued to CEMEX Southeast, LLC for the construction and operation of the Kiln No. 6. The draft permit contains various conditions to ensure and confirm compliance with all applicable air quality regulations. A copy of the draft permit is included in Appendix A.

1.0 INTRODUCTION

On July 17, 2007, CEMEX Southeast, LLC (hereafter "CEMEX") submitted an application for an air quality permit to construct and operate a new Portland cement production line ("Kiln No. 6"). The facility is located at 2720 Highway 341 South, Clinchfield, Houston County, Georgia.

Table 1-1: Title V Major Source Status

Pollutant	Is the Pollutant Emitted?	If emitted, what is the facility's Title V status for the Pollutant?		
		Major Source Status	Major Source Requesting SM Status	Non-Major Source Status
PM	Yes	Yes		
PM_{10}	Yes	Yes		
SO_2	Yes	Yes		
VOC	Yes	Yes		
NO_x	Yes	Yes		
CO	Yes	Yes		
TRS	N/A	N/A		
H_2S	N/A	N/A		
Individual HAP	Yes	Yes		
Total HAPs	Yes	Yes		

Table 1-2 below lists all current Title V permits, all amendments, 502(b)(10) changes, and off-permit changes, issued to the existing CEMEX's Portland cement plant/facility at this site, based on a review of the "Permit" file(s) on the facility found in the Air Protection Branch office.

Table 1-2: List of Current Permits, Amendments, and Off-Permit Changes

Permit Number and/or Off-Permit Change	Date of Issuance/ Effectiveness	Purpose of Issuance
3241-153-0003-V-04-0	06/23/2006	Administrative amendment for ownership change
3241-153-0003-V-04-1	11/03/2007	Installing a fuel feed system & using alternative fuels

Based on the proposed project description and data provided in the permit application, the estimated emissions of air pollutants from the proposed new kiln are listed in Table 1-3 below:

Table 1-3: Emissions Increases from the Project

Pollutant	Baseline Years	Potential Emissions Increase (tpy)[1]	PSD Major Source Emission Level (tpy)	PSD Significant Emission Rate (tpy)	Subject to PSD Review
PM	N/A	243	100	25	Yes
PM_{10}	N/A	199[2]		15	Yes
VOC	N/A	350	100	40	Yes
NO_x	N/A	1,367	100	40	Yes
CO	N/A	2,032	100	100	Yes
SO_2	N/A	701	100	40	Yes
TRS	N/A	N/A		10	N/A
Pb	N/A	0.086		0.6	No
Fluorides	N/A	0.63		3	No
H_2S	N/A	N/A		10	N/A
SAM	N/A	N/A		7	N/A

[1] The potential emissions are the lower of the applicable emission limitations and the potential emissions estimated based on capacity. [2] Assuming 100% of PM is PM_{10}.

The definition of baseline actual emissions is the average emission rate, in tons per year, at which the emission unit actually emitted the pollutant during any consecutive 24-month period selected by the facility within the 10-year period immediately proceeding the date a complete permit application was received by EPD. The net increases were calculated by subtracting the past actual emissions (based upon the annual average emissions from 24-month time period) from the future potential emissions of the modified equipment and associated emission increases from non-modified equipment.

The Kiln No. 6 by itself is a new source without any previous or current emissions. Therefore, the Kiln No. 6 does not have "baseline years" during which the baseline average annual actual emissions were determined. The potential emission increases were calculated by subtracting the past actual emissions (based upon the annual average emissions from a chosen 24-month time period during the chosen "baseline years", which were zero for a new source like the Kiln No. 6) from the future actual emissions of the Kiln No. 6 (which were the potential emissions for a new source like the Kiln No. 6). Because the kiln No. 6 is a major PSD source/modification by itself, and will have its own annual emission limits, analysis of facility-wide emission changes was considered not necessary.

Table 1-3 lists the emission increases from the operation of the Kiln No. 6. The emission data indicate that, CEMEX's proposed modification, as specified per Georgia Air Quality Application No. 17550, is a major modification under PSD because the significant increases in potential emissions of CO, PM, NO_x, SO_2, and VOC.

Through its NSR/PSD source review procedure, EPD has evaluated CEMEX's proposal for compliance with State and Federal requirements. The findings of EPD have been assembled in this Preliminary Determination.

2.0 PROCESS DESCRIPTION

According to Application No. 17550, CEMEX has proposed to construct and operate a new Portland cement kiln (Kiln No. 6) at the existing cement plant. The Kiln No. 6 is a dry process Portland cement production line capable of producing approximately up to 1,401,600 tons of clinker and 1,927,200 tons of cement per year.

The CEMEX's permit application and supporting documentation are included in Appendix A of this Preliminary Determination and can be found online at www.georgiaair.org/airpermit.

CEMEX's proposed Kiln No. 6 Portland cement production line can be divided into three main sections: (1) kiln feed preparation, (2) clinker production, and (3) finish cement operation.

(1) Kiln Feed Preparation

The basic ingredients of Portland cement include oxides of calcium, silica, aluminum, and iron. Due to the requirement for large quantities of calcium oxide (CaO), Portland cement plants are generally located near a source of the calcareous materials. The limestone and clay required for CEMEX's new kiln is mined from an existing onsite quarry. A primary crusher(s) reduces the limestone to right sizes. Other raw materials, such as iron ore/mill scale (or other iron sources), and bauxite/fly ash (or other alumina sources), are received from offsite sources. The raw materials are stored in various storage areas including stockpiles, buildings, and silos. Then the raw materials are mixed by weighing scales according to production specification and conveyed to pre-blending silos. A raw mill fed by the pre-blending silos mixes, grinds and dries the raw materials to the desired fineness, producing a powdery material referred as dry feed/meal. The dry feed/meal is stored temporarily in silos feeding the kiln.

(2) Clinker Production

In the Kiln No. 6, clinker production involves high temperature processing/pyroprocessing in a dry process rotary kiln, where necessary chemical reactions take place to produce a black nodule-looking product referred to as "clinker". The rotary kiln consists of a tube made from steel plate, and lined with firebrick. The tube slopes slightly (1 to 4°) and slowly rotates on its axis at between 30 and 250 revolutions per hour.

CEMEX's Kiln No. 6 is a counter-current heating device, meaning material fed into the cool upper end is drawn slowly by gravity to the hot discharge end. The burners at the discharge end of the kiln produce a current of hot gases that heat the clinker, the calcined materials and raw materials in succession as the hot gases pass upward toward the feed end. In the kiln, the clinker formation occurs in a series of stages that correlate with the temperature of the raw materials and in a unit called "calciner". In the preheater/precalciner and calciner, uncombined water evaporates from raw materials. Material temperature increases to the point where calcination begins when carbon dioxide (CO_2) is liberated from the carbonate components of the raw materials. Sintering of the oxides occurs in the burning zone of the kiln. The sintering (or clinkering) reactions chemically combine calcines material with silica, alumina, and iron to form tricalcium silicate (Ca_3SiO_5), dicalcium silicate (Ca_2SiO_4), tricalcium aluminate ($Ca_3Al_2O_6$), and tetracalcium alumino-ferrite (Ca_4AlFeO_7). Following the sintering reactions, clinker is quickly cooled by contact with ambient air in a clinker cooler . Some heat transferred to the cooler air is recouped back into the process.

(3) Finish Cement Operations

The cooled clinker is stored prior to being sent to a finish mill where it is combined with gypsum and other additives as product specification requires. Then the mixed materials are ground to a fine, homogenous powder in a series of ball mills to produce the desired Portland cement. The finished Portland cement is then transferred to the cement storage silos prior to shipment off-site.

CEMEX's Kiln No. 6 has a nominal capacity of 270 tons per hour of dry feed input to the preheater/precalciner, and a nominal capacity of 160 tons per hour of clinker output from the kiln. The finish mill can produce nominally 220 tons per hour of Portland cement. Cement produced is packaged and stored as necessary, and then distributed by both truck and rail.

Fuel authorized for the kiln include natural gas, coal, petroleum coke, fuel oils, landfill gas, and other non-hazardous liquid and solid fuels such as "on-specification" used oil fuels, waste tires, plastics, filter fluff and wood wastes. A coal mill grinds approximately 219,000 tons of coal and petroleum coke annually for firing the kiln. Emissions of regulated air pollutants from firing with each fuel are determined via performance testing before the use of the fuel is authorized.

The following figure is a simplified process flow diagram of a typical preheater/precalciner dry process kiln similar to that proposed by CEMEX except the latter will not be equipped with an alkali bypass. The illustration was borrowed from a study by Trinity Consultants in 2003 for Portland Cement Association assessing pollution control strategies for Portland cement manufacturing process. The mentioned study is available at: www.cement.org/pdf_files/SN2728.pdf

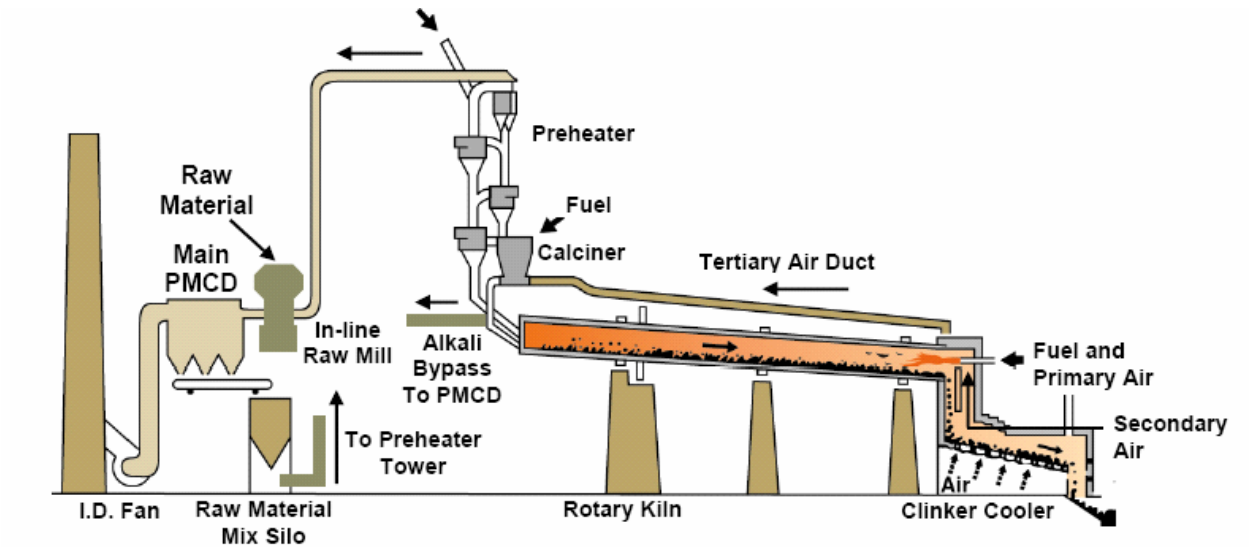

Figure 2-1. Process Diagram of Dry Process Preheater/Precalciner Cement Kiln System

The main air pollutants emitted from Portland cement manufacturing process include CO, NO_x, PM/PM_{10}, SO_2, and VOC. The major mechanisms for the formation of these pollutants are generalized (and greatly simplified) in Table 2-1.[1] Other regulated pollutants emitted at less significant quantities include hydrogen chloride (HCl), mercury (Hg), and dioxin/furan (D/F).

[1] Linero, A.A., "What's Up With Cement Plant Permitting?", In Proceedings of the 94th Annual Air and Waste Management Association Conference and Exhibition. June 2001. Orlando, Florida.

Table 2-1. Primary Mechanisms and Sources of Pollutant Formation

Pollutant	Formation Mechanism	Source
NO_x	Thermal	Kiln Burner
	Fuel Nitrogen Oxidation	Kiln, Calciner
SO_2	Oxidation of Raw Material Pyrites	Upper Preheater/Precalciner Stages
	Fuel Sulfur Oxidation	Kiln, Calciner, Coal/Pet Coke
CO and VOC	Incomplete Combustion	Calciner
	Thermal Evolution	Raw Materials
PM/PM_{10}	Crushing, Grinding, Conveyance	Crusher, Raw Mill, Coal Mill, Finish Mill, Belts, Silos, Bins
	Pyroprocessing	Kiln, Clinker Cooler

Apparently the most direct way to control most of the emissions aforementioned is by process and combustion controls coupled with a judicious selection of fuel and raw materials, with the help of production measurements that minimize fuel consumption and optimize production and pollution control. Table 2-2 summarizes in great simplicity the primary control measures for the main pollutants listed in Table 2-1.

Table 2-2. Primary Control Techniques for Main Pollutants Emitted from Cement Manufacturing

Pollutant	Formation Mechanism	Primary Control Techniques
NO_x	Thermal	Kiln Burner Design, Indirect Firing
	Thermal, Fuel Nitrogen Oxidation	Optimum Process and Raw Mix Control
		Fuel Selection, Staged Combustion in Calciner
SO_2	Oxidation of Raw Material Pyrites	Raw Material Selection
	Fuel Sulfur Oxidation	Lime Powder in Calciner, Alkalis in Kiln
CO and VOC	Incomplete Combustion	Hot Excess Air, Mixing, Residence Time
	Thermal Evolution	Raw Material Selection
PM/PM_{10}	Crushing, Grinding, Conveyance	Wet Quarrying, Wet Suppression, Process Cyclones
	Pyroprocessing	Pyroprocessing Cyclones

The primary control techniques generalized in Table 2-2 are greatly constrained by the characteristics and availability of raw materials and fuels, and equipment or process design and feasibility. Such situations lead to various add-on control equipment, as listed in Table 2-3. These techniques are available and each is in use at one or more Portland cement plants in the U.S. or Europe.

Table 2-3. Add-On Control Techniques for Main Pollutants Emitted from Cement Manufacturing

Pollutant	Add-On Control Techniques
NO_x	Selective Non-Catalytic Reduction (SNCR), Selective Catalytic Reduction (SCR)
SO_2	Hydrated Lime or Lime Slurry Injection/Spray, Wet or Dry Scrubbers
CO and VOC	Thermal Oxidation (both), Carbon Adsorption or SCR (for VOC)
PM/PM_{10}	Electrostatic Precipitation (ESP), Baghouse

CEMEX proposes to use an ammonia (NH_3) solution-injection based SNCR system in combination with staged and controlled combustion (SCC) and low NO_x burners to reduce NO_x emissions from the Kiln No. 6, and baghouses to abate PM/PM_{10} emissions from exhaust stacks serving various process and material handling operations/units associated with the new kiln. Wet suppression/water spray and other precautions are utilized as necessary to reduce fugitive PM emission from the new material handling units added to the existing on-site quarry as part of the Kiln No. 6 project. The new kiln system is also designed and operated to minimize the emissions of NO_x, CO and VOC via controlled combustion. Control of SO_2 emissions from the fuel combustion and pyroprocessing of raw materials depends on mainly "inherent scrubbing" of SO_2 by alkalis present in the kiln and raw mill, judicious selection of raw materials to limit the sulfur input, and hydrated lime injection into the process gas streams/add-on dry scrubbing as necessary.

Upon initial startup, the Kiln No. 6 will use continuous emission monitor system (CEMS) to monitor the CO, NO_x, SO_2, and VOC (as THC) emissions from the main kiln exhaust stack shared by the raw mill, the kiln, and the clinker cooler. Continuous opacity monitor system (COMS) will be used at the outlet of the main kiln exhaust stack and the finish mill stack. A PM CEMS will be used for the main kiln exhaust stack once EPA promulgates the procedural and operational requirements for the PM CEMS.

The CEMEX's permit application and supporting documentation are included in Appendix A of this Preliminary Determination and can be found online at www.georgiaair.org/airpermit.

3.0 REVIEW OF APPLICABLE RULES AND REGULATIONS

State Rules

Georgia Rule for Air Quality Control (Georgia Rule) 391-3-1-.03(1) requires that any person prior to beginning the construction or modification of any facility which may result in an increase in air pollution shall obtain a permit for the construction or modification of such facility from the Director upon a determination by the Director that the facility can reasonably be expected to comply with all the provisions of the Act and the rules and regulations promulgated thereunder. Georgia Rule 391-3-1-.03(8)(b) continues that no permit to construct a new stationary source or modify an existing stationary source shall be issued unless such proposed source meets all the requirements for review and for obtaining a permit prescribed in Title I, Part C of the Federal Act [i.e., Prevention of Significant Deterioration of Air Quality (PSD)], and Section 391-3-1-.02(7) of the Georgia Rules (i.e., PSD).

Georgia Rule (b) [391-3-1-.02(2)(b): *Visible Emissions*] is a general rule limiting the opacity of stack visible emissions from a source to less than 40%. This regulation applies to any source with stack visible emissions but is not subject to other more restrictive source specific limit for the same visible emissions.

Georgia Rule (e) [391-3-1-.02(2)(e): *Particulate Emissions from manufacturing Processes*], commonly known as the process weight rule, limits stack PM emissions from any source which is not subject to other more restrictive source specific limit for the same PM emissions. The applicable stack PM emission rate is determined using either of one of three equations, depending on the process input rate and age of the equipment.

Georgia Rule (f) [391-3-1-.02(2)(f): *Portland Cement Plants*] assumes all the applicable New Source Performance Standard (NSPS) emission limits and requirements contained in 40 CFR Part 60, Subpart F – *Standard of Performance for Portland Cement Plants*.

Georgia Rule (g) [391-3-1-.02(2)(g): *Sulfur Dioxide*] limits the sulfur content of liquid or solid fossil fuel(s) or wood residue burned by a new fuel-burning source constructed or extensively modified after January 1, 1972. The limitation is based on the type of the fossil fuel(s) (liquid, solid or wood residue) and the heat input rate of the source. With a heat input rate greater than 250 MM BTUs/hr, CEMEX's Kiln No. 6 is subject to the following fuel sulfur content requirements:

- 0.8 pounds of SO_2 per million BTU of heat input derived from liquid fossil fuel or derived from liquid fossil fuel and wood residue;

- 1.2 pounds of SO_2 per million BTU of heat input derived from solid fossil fuel or derived from solid fossil fuel and wood residue;

- When different fossil fuels are burned simultaneously, the applicable SO_2 emission standard expressed as pounds of SO_2 per million BTU of heat input shall be determined by proration using the following equation:

$$a = \frac{y(0.80) + z(1.2)}{y + z}$$

Where:

y = percent of total heat input derived from liquid fossil fuel:
z = percent of total heat input derived from solid fossil fuel:
a = the allowable SO_2 emission in pounds per million BTUs.

In no case the Permittee shall burn any fuel that contains more than 3% sulfur by weight even after employing SO_2 emission control.

Georgia Rule (n) [391-3-1-.02(2)(n): *Fugitive Dust*], commonly known as the fugitive dust rule, requires the Permittee to take all reasonable precautions to prevent fugitive dust emissions from any operation, process, handling, transportation or storage facility prone to such emissions, and lists a number of such precautions. In addition, Georgia Rule (n) limits the opacity of such fugitive emissions to less than 20%.

Because the emission standards/limits under pertinent NSPS, National Emission Standards for Hazardous Air Pollutants (NESHAP)/Maximum Achievable Control Technology (MACT) or NSR/PSD rules are more stringent than those in the aforementioned rules, these SIP rules are subsumed by the pertinent federal rules accordingly.

Federal Rule - PSD

The regulations for PSD in 40 CFR 52.21 require that any new major source or modification of an existing major source be reviewed to determine the potential emissions of all pollutants subject to regulations under the Clean Air Act. The PSD review requirements apply to any new or modified source that belongs to one of 28 specific source categories having potential emissions of 100 tons per year or more of any regulated pollutant, or to all other sources having potential emissions of 250 tons per year or more of any regulated pollutant. The PSD review requirements also apply to any modification of a major stationary source that results in a significant net emission increase of any regulated pollutant.

Georgia has adopted a regulatory program for PSD permits, which the Unites States Environmental Protection Agency (EPA) has approved as part of Georgia's State Implementation Plan (SIP). This regulatory program is located in the Georgia Rules at 391-3-1-.02(7). This means that Georgia EPD issues PSD permits for new major sources pursuant to the requirements of Georgia's regulations. It also means that Georgia EPD considers, but is not legally bound to accept, EPA comments or guidance. A commonly used source of EPA guidance on PSD permitting is EPA's Draft October 1990 New Source Review Workshop Manual for Prevention of Significant Deterioration and Nonattainment Area Permitting (NSR Workshop Manual). The NSR Workshop Manual is a comprehensive guidance document on the entire PSD permitting process.

The PSD regulations require that any major stationary source or major modification subject to the regulations meet the following requirements:

- Application of BACT for each regulated pollutant that would be emitted in significant amounts;
- Analysis of the ambient air impact;
- Analysis of the impact on soils, vegetation, and visibility;
- Analysis of the impact on Class I areas; and
- Public notification of the proposed plant in a newspaper of general circulation

Definition of BACT

The PSD regulation requires that Best Available Control Technology (BACT) be applied to all regulated air pollutants emitted in significant amounts. Section 169 of the Clean Air Act defines BACT as an emission limitation reflecting the maximum degree of reduction that the permitting authority (in this case, EPD), on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such a facility through application of production processes and available methods, systems, and techniques. In all cases BACT must establish emission limitations or specific design characteristics at least as stringent as applicable New Source Performance Standards (NSPS). In addition, if EPD determines that there is no economically reasonable or technologically feasible way to measure the emissions, and hence to impose and enforceable emissions standard, it may require the source to use a design, equipment, work practice or operations standard or combination thereof, to reduce emissions of the pollutant to the maximum extent practicable.

EPA's Draft New Source Review Workshop Manual (NSR Workshop Manual), dated October 1990 includes the EPA guidance on the 5-step top-down process for determining BACT. In general, Georgia EPD requires PSD permit applicants to use the Top Down process described in the NSR Workshop Manual in the BACT analysis, which EPD reviews. The five steps of a top-down BACT review procedure identified by EPA per BACT guidelines are listed below:

Step 1: Identification of all control technologies;
Step 2: Elimination of technically infeasible options;
Step 3: Ranking of remaining control technologies by control effectiveness;
Step 4: Evaluation of the most effective controls and documentation of results; and
Step 5: Selection of BACT.

The following is a discussion of the applicable federal rules and regulations pertaining to the equipment that is the subject of this preliminary determination, which is then followed by the top-down BACT analysis.

New Source Performance Standards (NSPS)

40 CFR Part 60, Subpart A - *General Provisions*, imposes generally applicable provisions for initial notifications, initial compliance testing, monitoring, and recordkeeping requirements for equipment at the facility subject to a specific NSPS standard, as indicated by the pertinent NSPS standard.

40 CFR Part 60, Subpart Y - *Standards of Performance for Coal Preparation Plants* applies to all the coal processing operations/coal mill and associated storage and conveying systems (existing and new) at CEMEX, excluding the conveying system transfer points which are used to convey coal from the coal mill to the kiln and therefore subject to the NESHAP MACT standard for Portland cement manufacturing industry, i.e., 40 CFR Part 63, Subpart LLL. Subpart Y establishes process/source specific PM and visible emission limits, and record keeping, reporting, testing, compliance demonstration and reporting requirements for each of affected process units/sources.

40 CFR Part 60, Subpart OOO – *Standards of Performance for Nonmetallic Mineral Processing Plants* applies to the on-site limestone quarry and associated crushing, storage and conveying operations, excluding the conveying system subject to 40 CFR Part 63, Subpart LLL. Subpart OOO establishes process/source specific PM, visible and fugitive emissions limits, and record keeping, testing, compliance demonstration and reporting requirements for each of the affected sources.

40 CFR Part 60, Subpart IIII - *Standards of Performance for Stationary Compression Ignition Internal Combustion Engines* applies to the new emergency stationary diesel engine/generator serving the Kiln No. 6. This NSPS standard requires the engine to be certified for compliance with the applicable emission standards by the manufacturer, and operated only during emergency power generation and maintenance check and readiness testing. Subpart IIII also limits the annual operating time for maintenance check and readiness testing, and establishes current and future fuel requirements for sulfur content and cetane index and/or aromatic content. The Permittee is required to keep engine specification, operation and fuel records to demonstrate compliance with this standard.

All the affected sources subject to 40 CFR Part 63, Subpart LLL: *National Emission Standards for Hazardous Air Pollutants from the Portland Cement Manufacturing Industry* are exempt from the otherwise applicable NSPS requirements contained in 40 CFR Part 60, Subpart F – *Standard of Performance for Portland Cement Plants.* This means that the whole Kiln No. 6 cement manufacturing line, from the raw material handling to cement shipment, shall comply with the NESHAP MACT requirements in Subpart LLL instead of the applicable NSPS requirements in Subpart F.

National Emissions Standards For Hazardous Air Pollutants (NESHAP)

40 CFR Part 63, Subpart A, *General Provisions*, imposes general requirements for initial notifications, initial compliance testing, monitoring, and recordkeeping. CEMEX's Kiln No. 6 shall comply with the applicable general provisions because cement manufacturing process and the new emergency stationary diesel engine/generator serving the Kiln No. 6 are subject to 40 CFR Part 63 Subparts LLL and ZZZZ respectively. Both Subparts LLL and ZZZZ contain tables listing the applicable provisions of 40 CFR Part 63, Subpart A.

40 CFR Part 63, Subpart LLL - *National Emission Standards for Hazardous Air Pollutants from the Portland Cement Manufacturing Industry* applies to CEMEX's Kiln No. 6 because it is a major source for hazardous air pollutant (HAP) emissions. This Part 63 NESHAP MACT standard establishes process/source specific emission limits for PM, VOC (expressed as total hydrocarbon, i.e. THC), mercury (Hg), dioxins/furans (D/F), and visible emissions. In addition to limit the HAP emissions such as Hg and D/F, Subpart LLL also limits emissions of other solid and gaseous HAP compounds by limiting the PM and THC emissions because portions of such emissions are EPA-listed hazardous air pollutants. Subpart LLL requires CEMEX to comply with the applicable emission limits on and after the initial startup of the cement production. To further reduce emissions, Subpart LLL also establishes operational requirements for the use of cement kiln dust (CKD), fly ash, fuel and control equipment. Subpart LLL also specifies process/source specific emissions testing, monitoring, record keeping, reporting, and compliance demonstration requirements.

40 CFR Part 63, Subpart ZZZZ: *National Emission Standards for Hazardous Air Pollutants for Stationary Reciprocating Internal Combustion Engines* applies to the new emergency stationary diesel engine/generator serving the Kiln No. 6. Subpart ZZZZ limits the use of the generator to emergency and limited use (>100 hours per year) situations only, and requires an initial notification for the startup of the source.

CEMEX will not use any wastes defined as "hazardous wastes" in 40 CFR Part 63, Subpart EEE – *"National Emission Standards for Hazardous Air Pollutants from Hazardous Waste Combustors",* therefore, Subpart EEE does not apply to CEMEX's Kiln No. 6.

State and Federal – Startup and Shutdown and Excess Emissions

Excess emission provisions for startup, shutdown, and malfunction are provided in Georgia Rule 391-3-1-.02(2)(a)7. Excess emissions from the cement manufacturing line, especially from the in-line kiln/raw mill, clinker cooler or finishing mill, coal mill and associated material conveying, storage, weighing, packaging, and storage systems would most likely results from a malfunction of the associated emission control equipment. The facility cannot anticipate or predict malfunctions. However, the facility is required to minimize emissions during periods of startup, shutdown, and malfunction.

Federal Rule – 40 CFR 64 – Compliance Assurance Monitoring

Under 40 CFR 64, the *Compliance Assurance Monitoring* Regulations (CAM), facilities are required to prepare and submit monitoring plans for certain emission units with the Title V application. The CAM Plans provide an on-going and reasonable assurance of compliance with emission limits. Under the general applicability criteria, this regulation applies to units that use a control device to achieve compliance with an emission limit and whose pre-controlled emissions levels exceed the major source thresholds under the Title V permitting program. Although other units may potentially be subject to CAM upon renewal of the Title V operating permit, such units are not being modified under the proposed project and need not be considered for CAM applicability at this time.

The PM/PM_{10} emissions units with control at the Kiln No. 6 are either CAM exemptions per 40 CFR 64.2(b)(1)(i) for being subject to a post 11/15/1990 NESHAP, i.e., 40 CFR Part 63, Subpart LLL which include monitoring requirements and have emission limitations or standards for which a 40 CFR Part 70 or 71 permit specifies a continuous compliance determination method, or subject to CAM requirements during Title V permit renew for not being a larger Pollution Specific Emission Units (PSEUs) with post-control emissions above 100 tpy.

CO and VOC emissions from the Kiln No. 6 are not subject to CAM requirements because the kiln system does not use any designated add-on control devices as defined in 40 CFR 64.1 to comply with the applicable CO and VOC emission limits.

The kiln uses a SNCR and a hydrated lime injection system to control the NO_x and SO_2 emissions respectively to comply with specific emission limits. Both pollutants are not subject to any post 11/15/1990 NSPS or NESHAP standard. Therefore, the kiln is a large PSEU with post control NO_x and SO_2 emissions greater than 100 tpy. However, per 40 CFR 64.2(b)(1)(vi), the NO_x and SO_2 emissions from the kiln are exempt from CAM for having the NO_x and SO_2 limitations with continuous compliance determination via NO_x and SO_2 CEMS.

4.0 CONTROL TECHNOLOGY REVIEW

The proposed project will result in emissions of a number of air pollutants, including CO, fluorides, lead (Pb), PM, NO_x, SO_2 and VOC. However, only emissions levels for CO, PM, NO_x, SO_2 and VOC are high enough to trigger PSD review. This section describes in details each piece of equipment with CO, PM, NO_x, SO_2 and/or VOC emissions, identifies possible control technologies for the pollutants involved, and determine source and emission-specific BACT.

4.1 Fugitive PM Emissions from the New Quarry Belt Conveyors

Because the potential PM emissions from the Kiln No. 6 have triggered PSD applicability, and NSR rule requires quantifiable fugitive emissions form this source to be included in the PSD applicability analysis, the fugitive PM emissions from the new belt conveyors are evaluated for BACT. According to the application No. 17550, the total PM and PM_{10} fugitive emissions from the modified part of the existing on-site quarry including the eight new belt conveyors and other associated materials handling operations and roads were estimated at 23 and 4.82 tons per year respectively based on AP 42.

Limestone and clay are quarried from the existing onsite open pit limestone and clay quarry. Equipment involved in the quarry operations includes drillers, primary crushers, front loaders, trucks, belt conveyers, stackers, associated storage buildings and stockpiles. Due to the nature of the operations and equipment design, the only emissions from the quarry operations are fugitive dusts. Fugitive dust sources generally involve the re-entrainment of settled dusts by wind, machine movement, and material transport. Sources of such fugitive emissions include mainly drilling, blasting, crushing and material conveying and storage processes (belt conveyors, stockpiles, loading and unloading, traffic, etc.). Wind-blown dusts from the working area such as stockpiles and paved and unpaved roads also contribute to the fugitive PM emissions.

Of geographical and seasonal factors, the primary variables affecting the fugitive PM emissions are wind and material moisture content. Wind parameters vary with geographical location, season, and weather. It can be expected that the level of the fugitive emissions will be greater during periods of high winds. The material moisture content also varies with geographical location, season, and weather.

The moisture content of the material processed can have a substantial effect on fugitive emissions from the quarry processes. Surface wetness causes fine particles to agglomerate on or to adhere to the faces of larger stones, with a resulting dust suppression effect. However, as new fine particles are created by crushing and abrasion as the moisture content is reduced by evaporation, this suppressive effect diminishes and may disappear. Wet suppression systems (spray nozzles) can maintain relatively high material moisture contents throughout the processes and thus effectively control PM emissions along the processes. Depending on the geographical and climatic conditions, the moisture content of mined rock can range from nearly zero to several percent. Typically, wet material contains more than 1.5% water.

CEMEX's existing onsite quarry is an outdoor operation with large open pits and frequent moving work areas/quarrying zones. The machineries involved such as drillers, crushers, and belt conveyors are designed to relocate from time to time along the quarrying zone. Therefore, the two common PM control technologies requiring fixed foundations and enclosures to capture the PM emissions, i.e., wet scrubbing and fabric filtration/baghouse are technically infeasible for the machineries involved. The only feasible PM control technology is wet suppression, i.e., regular spray of water via spray nozzles, sprinkles and/or water truck water cannons to maintain the moisture of the materials to more than 1.5% and prevent PM from becoming airborne.

Fugitive BACT Determination

Based on the nature of the sources and equipment involved, EPD has determined that CEMEX's proposal to use wet suppression/water spray to minimize the fugitive PM emissions from the modified part of the existing onsite quarry, mainly new conveyors and added roads and associated materials handling operations constitutes BACT. The corresponding emission limit for the BACT is 10% opacity for visible emissions from any fugitive PM sources, and no visible emissions from any process buildings and wet operations. Specific operating, monitoring, testing, record keeping, and reporting requirements are contained in this PSD permit to ensure the implement of the BACT. Some of these requirements are assumed from NSPS Subpart OOO.

4.2 PM Emissions from the Kiln No. 6's Materials Handling, Mixing, Grinding, In-line Kiln/Raw Mill, Coal Mill, Finishing Mill, Cement Packaging and Shipping Operations

Either generated or disturbed mechanically by process equipment or formed during chemical reactions involved, and consequently entrapped in the exhaust gas streams, PM/PM_{10} are emitted from various raw materials, solid fuels and process material handling and processing operations, include loading and unloading, conveying and storage, weighing, mixing, grinding, pyroprocessing, combustion, packaging and shipping. Exhaust gas streams in particular from the in-line kiln/raw mill, clinker cooler, coal mill and finish mill contain large quantity of PM/PM_{10} generated by the entrapment in the process gaseous streams of the powdery materials or ashes from fuel combustion, especially from coal and solid fuel burning, and to less degree, sulfate particulates from neutralization/alkali scrubbing reactions. Excluding those generated from fuel combustion, most of the process PM/PM_{10} emissions are finely dispersed solids as either part of the raw materials, intermediate or final products, and can be returned to the process once captured.

Control of such PM/PM_{10} emissions is achieved by the collection of the particles from the process exhaust/ventilation stack discharging gas streams and by the prevention of generation of particles from fugitive emission sources. Among Portland cement manufacturing plants, commonly used PM/PM_{10} emission control/capture devices for stack/ventilation exhaust gas streams are fabric filters (baghouses) and electrostatic precipitators (ESPs).

ESPs use an electrostatic field to charge particulate matter contained the gas streams. The charged particulates then mitigate to grounded collecting surfaces/plates due to electrostatic attraction. The collected particles are then dislodged by vibrating or rapping the collector surface, and subsequently collected in a hopper at the bottom of the ESP.[2] ESPs are capable of very high collection efficiencies, even for very small particles.

Fabric filter collectors (also known as baghouses) are one of the most efficient means to separate particulate matter from a gas stream. Baghouses are capable of maintaining mass collection efficiencies of greater than 99% down to a particle size approaching 0.3 µm in most applications. In baghouses, gas streams are passed through a felted or woven fabric, causing PM/PM10 in the gas streams to be collected/captured on the surface of the fabric by sieving and other capturing mechanisms including impaction, Brownian diffusion, and electrostatic attraction.

Baghouses and ESPs are considered equivalent for PM control and both can achieve a typical control/removal efficiency of 99% or better. ESPs and baghouses are used extensively as control devices for the modern dry process kiln systems at Portland cement plants, where raw mill, preheater/precalciner, calciner, kiln, clinker cooler, sometimes even coal mill and finish mill, could share a common baghouse or ESP. Baghouses are used almost exclusively to control PM emissions from other material processing operations as long as the PM emissions can be captured reasonably by a ventilation/exhaust system(s) that makes the operations involved a point source(s) with defined exit point(s).

[2] EPA Handbook: Control Technologies for Hazardous Air Pollutants, EPA/625/6-91/014, June 1991.

Inertial separators (cyclonic and Venturi scrubbers) can have efficiencies over 90% within narrow particle size ranges. Inertial separators have not been demonstrated as effective controls at cement plants, but they are used extensively as process devices to recover product (meal) at cement plants. The use of cyclones as process devices at cement plants serves to enhance the overall control efficiency of the system by reducing large abrasive particles in the process gas streams.

The PM/PM_{10} control efficiency of a wet scrubber (spraying or packed bed) is higher than that of a cyclone, but not as high as that of a baghouse or ESP due mainly to short-circuiting. Wet scrubbing is known for creating wastewater and sludge disposal problems, straining water supply, and requiring substantially additional energy for pumping water and propelling cooled exhaust air stream out the stacks.

Unlike wet scrubbers that turn captured particulate matter into slurry or sludge, baghouses and ESPs capture/collect particulate matter dry and as they are, allowing the return of the captured materials to the process material flow without additional processing. Therefore, baghouses and ESPs are widely used among cement plants and other industries readily reusing the captured materials.

Control technologies identified as technically feasible for the control of the PM/PM_{10} emissions from the CEMEX's Kiln No. 6 are ranked by their control efficiency in Table 4.2-1 below:

Table 4.2-1: Ranking of PM/PM_{10} Control Technology for Portland Cement Plant

Control Technology Ranking	Control Technology	Control Efficiency
1	Baghouse, ESP	>99%
2	Wet Scrubbing	<99%
3	Cyclone and Venturi Scrubbers	>90%

The baghouse and ESP are considered equivalent as the most efficient/top technology for controlling the PM/PM_{10} emissions from Portland cement manufacturing plants. Coupled with a properly designed and designated capture system(s), properly designed, maintained and operated baghouses or ESPs can readily reduce such PM emissions by more that 99%, and therefore are widely used among cement manufacturing plants and other industries with similar PM/PM_{10} emission sources. A review of previous BACT determinations and various permits issued to Portland cement plants country wide indicated that both ESPs and baghouses are considered as BACT for PM/PM_{10} emission controls for cement plants. However, twice as many cement plants are using baghouses instead of ESPs as BACT. One of the reasons for the popularity of baghouses is to avoid ESP trips caused by process CO spikes.

PM BACT Determination

CEMEX proposed to use a number of baghouses to control the PM/PM_{10} emissions from the in-line kiln/raw mill and from other ventilated/exhausted process units along the Kiln No. 6 cement production line. In all cases, the collected fines will be returned to the production process.

EPD has determined that CEMEX's proposal of using baghouses to control the emissions of PM/PM_{10} from raw materials handling and preparation, coal/solid fuel grinding, preheater, calciner, kiln, clinker cooler, finish mill, cement storage, packaging and shipping processes constitutes BACT.

The BACT emission limit is no greater than 0.153 and 0.129 lbs per ton of clinker respectively for PM and PM_{10} from the main kiln stack serving the in-line raw mill, the kiln and the clinker cooler. This limit is equivalent approximately to a PM loading of 0.008 grains per dry standard cubic foot (gr/dscf) in the exhaust gas stream and at the low end of the previous BACT limits for the similar sources. Since it usually takes between 1.5 to 1.8 tons of dry feed to produce one ton of clinker, depending on the composition of the dry feed and the operation of the kiln, the PM limit of 0.153 lbs per ton of clinker is as stringent as, and could be more stringent than the MACT limit of 0.1 lb of PM per ton of dry feed under 40 CFR Part 63, Subpart LLL. Because the process/exhaust air stream from the main kiln stack could have relatively more sulfate fine-grains due to the use of locally quarried raw materials (limestone and clay) with relatively high sulfur contents, EPD considers this limit to be stringent on case-by-case basis.

The BACT limits for PM and PM_{10} emissions from the rest of the baghouse-controlled sources/stacks at the Kiln No. 6 are 0.010 and 0.0085 gr/dscf respectively. Visible emissions from any stacks controlled the baghouses are limited to no more than 10% opacity.

Pertinent monitoring, testing, compliance demonstration and reporting requirements for PM and visible emissions for the affected sources subject to 40 CFR Part 63, Subpart LLL will be adapted as BACT requirements for the same sources. This adoption is reasonable because these MACT requirements are more updated, detailed, and/or stringent than those established during previous BACT determinations for the similar sources. In addition, the Permittee will be required to perform daily checkup of visible emissions and keep checkup logs under the State rules.

The BACT requires the use of a continuous opacity monitor system (COMS) for the new kiln main exhaust stack and the finish mill stack. In lieu of operating the COMS, the Permittee can opt to operate baghouse leakage detection systems (BLDS) to ensure the proper function of the baghouse(s) involved, as allowed by Subpart LLL. The BACT assumes the requirement for the use of a PM CEMS for main kiln stack once the U.S. EPA promulgates the procedural requirements for the operation of the PM CEMS under Subpart LLL. The PM CEMS will enhance the monitoring and compliance with the PM emission limit involved by providing real time continuous sampling of PM emissions.

The initial performance testing involves the use of Methods 5, 9 and/or COMS as applicable to determine the PM and visible emissions from each of the stacks. Please note that Subpart LLL requires testing on the PM and visible emissions from the main kiln stack every 5 years from the initial performance testing, which will in turn ensure compliance with BACT.

4.3 CO Emissions from Preheater/Precalciner, Calciner and Kiln

Because the CO emissions from the Kiln No. 6 have triggered PSD applicability, the CO emissions are evaluated for Best Available Control Technology (BACT).

As other Portland cement plants, the Kiln No. 6's CO emissions are from two independent sources: (1) incomplete fuel combustion in the kiln and calciner; and (2) incomplete oxidation/combustion of carbonaceous materials in the dry feed/raw meal introduced to the preheater/precalciner. For cement manufacturers, emissions of CO represent a waste of fuel, and also indicate reducing conditions within the kiln that must be avoided at all costs since it causes destruction of the clinker mineral structure. For this reason, the exhaust gas is continually analyzed for O_2, CO, NO_x and SO_2 at most of the cement manufacturing plants.

In a modern preheater/precalciner dry process cement kiln such as the Kiln No. 6, approximately 40 to 50% of the fuel is fired in the kiln burner and the remaining in the calciner. The CO generated in the kiln results from the kiln operating conditions dictated by the production of quality clinker, and more specifically by the amount of excess oxygen/air available at the back of the kiln (where the gases exit the kiln). As the gases exit the kiln and enter the calciner, CO levels become a function of calciner design and the degree to which staged combustion is used to control NO_x. More aggressive staged combustion creates reducing conditions (for less NO_x formation) in the low stages of the calciner that will increase CO levels. On the other hand, the CO can be oxidized back to CO_2 by using secondary or tertiary combustion air prior to the bottom cyclone of the preheater/precalciner. Such oxidation is the function of the calciner design that decides the residence time and turbulence after introducing the secondary or tertiary combustion air. Therefore, more NO_x control via more reducing conditions in the combustion will increase CO levels, and vice versa.

In addition, the use of ammonia-solution based SNCR for NO_x control will adversely affect the oxidation of CO to CO_2 because both reactions will compete for OH^* radicals required for reduction of CO and NO_x. One study revealed that a molar ratio of NH_3 to NO_x of 0.4 increased CO emissions by up to 0.5 pounds per ton of clinker. When such ratio increased to 0.8 and 1.0, the CO emissions were increased by up to 1.0 and 1.5 pounds per ton of clinker respectively.[3]

In modern preheater/precalciner dry process cement kilns such as the Kiln No. 6, raw meal/dry feed is introduced to the exhaust gas stream from the preheater/precalciner and preheated through a series of cyclones (stages). In the heating process, organic materials naturally occurring in the feed (kerogen and bitumen) are progressively heated and begin to degrade. Significant fraction of such materials is oxidized to CO_2, with the rest as short-chain VOC's and CO. The amount of CO generated from such pyrolitic process depends on the nature of the organics present in the feed materials. Light hydrocarbon species typically produce more VOC and less CO in the kiln preheater gas, and vice versa. Depending on the geological strata of the feed materials, the composition and content of the organic materials in the kiln feed (meal) may vary significantly.

Further more, the rate of conversion of feed carbon to CO_2 is influenced by the temperature profile of the preheater/precalciner, the organic content of the kiln feed, and the composition of the organics in the kiln feed. The temperature of the preheater stages is defined by the kiln and mixer designs (C_3S, silica, etc.) and cannot be modified sufficiently to complete oxidation of CO and VOC in the preheater/precalciner.

In addition to the equipment design and materials characteristics affecting CO emissions, the typical operating conditions in a well-operated cement kiln create a great deal of variability in CO emission. These conditions include material flushes, build up, blockage, false air, poor material burnability, and changes in fuel and feed characteristics. These factors require constant adjustments in kiln operations to maintain a smooth running plant and uniform clinker quality. These adjustments are accomplished through a series of computerized control loops that automatically adjust fuel and feed rate, fan speeds, and other operating parameters. The process operates best if the adjustments are made in small increments to avoid excessively overshooting or undershooting the set point of the burning zone temperature and kiln gas composition, in a fashion of built in time lag. Drastic control measures can be taken, including the shutdown of the kiln, on expense of energy cost, wear and tear on the plant, and poor clinker quality.

Review of literature, the BACT/LAER Clearinghouse, and permits issued to similar cement plants by other states indicates that proper equipment design and process operation (i.e., good combustion practice) represents BACT for CO emissions from Portland cement kilns. Properly controlled combustion in the kilns minimizes CO formation by ensuring that temperatures and O_2 availability are adequate for complete combustion. A properly designed and operated cement kiln acts as a thermal oxidizer, capable of converting 95% of the CO generated to CO_2.

In conclusion, maximum CO emissions can be achieved by the combination of following approaches:

- Relatively low carbonaceous matter and hydrocarbons in the raw materials;
- Good combustion at the main kiln burners and calciner;
- Addition of tertiary air from the kiln hood and clinker cooler; and
- Sufficient residence time from proper design of calciner size and duct lengths to complete burnout.

[3] Erpelding, R.M., *Latest Development in NO_x Reduction Technology in the Cement Industry.* Cement Plant Environmental Handbook, 2003.

In addition to proper plant design, plant operation and raw material selection, add-on controls can achieve further reduction of CO emissions. Such controls would involve some type of thermal oxidation from CO to CO_2 in clean gas streams with minimal amounts of PM. The oxidation technology includes direct flame incineration/oxidation and energy-saving catalytic oxidation. Thermal oxidation can also control VOC emissions via combustion and turn organic compounds/hydrocarbons into basically water and CO_2. Because of the presence of chlorides, phosphorus compounds, sulfur, and metals, which could foul the catalysts, catalytic oxidation is technically infeasible for control of CO and VOC in cement plants.

To date, two thermal oxidizers have been installed in the U.S. In 1998, TXI Corporations, LP (TXI) in Texas installed a Regenerative Thermal oxidizer (RTO), a wet scrubber, and a baghouse on a kiln for CO and VOC emission reduction in order to avoid a PSD review during a plant expansion.[4] The RTO was not considered as BACT by Texas Commission on Environmental Quality (TCEQ) and had a control efficiency of 75%. The CO emission limit for the RTO exhaust is 1.56 lbs./ton of clinker.

The only other RTO application in cement manufacturing process in the U.S. is at the Holcim Plant in Dundee, Michigan. The main purpose of the two RTOs is for the control of relatively high VOC emissions from two wet cement kilns using raw materials containing high levels of kerogen. The units replaced existing carbon injection systems for VOC control and did not go through PSD/BACT analysis.

Using RTO or other thermal oxidizers to reduce CO (and VOC) emissions from cement kiln incurs high cost. The current cost of controlling CO with a similar RTO system is estimated approximately between $5,800 (95% control) to $9,900 (79% control) per ton of CO removed.[4,5,6]

Table 4.3-1: Ranking of Control Technology for CO Emissions from Preheater Cement Kiln

Control Technology Ranking	Control Technology	Control Efficiency
1	Direct Flame Thermal Oxidation	75 – 95%
2	Good Combustion Practices, kiln Design, calciner fly ash injection, and Raw Material Selection/Management	Vary

CO BACT Determination

EPD has determined, based on the cost estimations, that the RTO system discussed above is economically infeasible as BACT for controlling the CO emissions from the Kiln No. 6.

EPD has determined that CEMEX's proposal to use a combination of good combustion practices, proper kiln design, and judicious selection of raw materials to assure an acceptable input carbon level to minimize the emissions of CO constitutes BACT. Based on the BACT limits and the available emission testing results from similar sources, Division has decided that the BACT limit for the CO emissions is 2.9 pounds of CO per ton of clinker on 30-day rolling average, as tested and monitored by a CO CEMS installed at the kiln No. 6 exhaust stack. At least four cement plants in Florida and a recently issued PSD permit by EPD for Houston American Cement Plant (HAC) in Georgia have the same BACT CO emission limit. Considering that CEMEX will use the locally quarried limestone and clay containing relatively higher carbonaceous materials than those available in Florida, EPD considers this BACT limit is more stringent than the Florida limits.

[4] Texas Commission on Environmental Quality. *Construction Permit Amendment – Review Analysis and Technical Review, Permit No. 1360A/PSE-TX-632MI. September, 2005.*

[5] Houston American Cement Plant, Georgia SIP Air Permit Application No. 17509, June 25, 2007.

[6] CEMEX Southeast, Georgia SIP Air Permit Application No. 17550, July 16, 2007

4.4. VOC Emissions from Preheater/Precalciner, Calciner and Kiln

Because the potential VOC emissions from the Kiln No. 6 exceed the PSD significant level of 40 tons per year, the VOC emissions are evaluated for Best Available Control Technology (BACT).

As with CO, VOC emissions result mainly from two independent sources: (1) incomplete fuel combustion in the kiln and calciner; and (2) volatilization or oxidation of carbonaceous materials in the raw feed/meal introduced to the preheater/precalciner.

In modern preheater/precalciner dry process cement kilns such as the Kiln No. 6, dry feed is introduced to the exhaust gas stream from the preheater/precalciner and preheated through a series of cyclones (stages). In the heating process, organic materials naturally occurring in the feed (kerogen and bitumen) are progressively heated and begin to degrade. Significant fraction of such materials is oxidized to CO_2, with the rest as short-chain VOC compounds and CO. The amount of VOC generated from such pyrolitic process depends on the nature of the organics present in the feed materials. Light hydrocarbon species typically produce more VOCs and less CO in the kiln preheater gas, and vice versa. Depending on the geological strata of the raw materials, the composition and content of the organic materials in the kiln dry feed (meal) may vary significantly.

Further more, the rate of conversion of feed/meal carbon to CO_2 is influenced by the temperature profile of the preheater/precalciner, the organic content of the kiln feed, and the composition of the organics in the kiln feed. The temperature of the preheater stages is defined by the kiln and mix designs (C_3S, silica, etc.) and cannot be modified sufficiently to complete oxidation of CO and VOC in the preheater/ precalciner.

Review of literature, BACT/LAER Clearinghouse and PSD permits issued to similar cement plants in the U.S. indicates that proper equipment design and operation (i.e., good combustion practice) represents most of BACT requirements for VOC emissions from Portland cement kilns. Properly controlled combustion in the kilns minimizes VOC formation by ensuring that temperatures and available oxygen are adequate for complete combustion. In addition to proper kiln system design, plant operation and raw material selection, add-on controls can achieve further reduction of VOC emissions. Such add-on controls involve some type of thermal oxidation from organic compounds to CO_2 and water in clean gas streams with minimal amounts of particulate matters. The oxidation technology includes direct flame incineration/oxidation and energy-saving catalytic oxidation. Because of the presence of chlorides, phosphorus compounds, sulfur, and metals, which could foul the catalysts, catalytic oxidation is technically infeasible for control of VOC in cement plants.

To date, two thermal oxidizers have been installed in the U.S. In 1998, TXI Corporations, LP (TXI) in Texas installed a Regenerative Thermal oxidizer (RTO), a wet scrubber, and a baghouse on a kiln for CO and VOC emission abetment in order to avoid PSD review during a plant expansion. The RTO was not considered as BACT by Texas Commission on Environmental Quality (TCEQ).

The only other RTO application in cement manufacturing process in the U.S. is at the Holcim, Inc. in Dundee, Michigan. The main purpose of the two RTOs are for the control of relatively high VOC emissions from two wet cement kilns using raw materials containing high levels of kerogen. The units replaced existing carbon injection systems for VOC control and did not go through PSD or a BACT analysis. The VOC emission limit for the plant is 13 pounds per ton of clinker.

Using RTO or other thermal oxidizers to reduce VOC emissions from cement kiln incurs high cost. The cost control of VOC emission is estimated more than $40,000 per ton of VOC removed.[4,5,6]

Table 4.4-1: Ranking of Control Technology for VOC Emissions from Preheater/Precalciner Kiln

Control Technology Ranking	Control Technology	Control Efficiency
1	Direct Flame Thermal Oxidation	79 – 95%
2	Good Combustion Practices, Kiln Design, Calciner Fly Ash Injection & Raw Material Selection/Management	Vary

VOC BACT Determination

EPD has determined that CEMEX's proposal to use a combination of good combustion practices, plant/equipment design, and judicious selection of raw material to minimize the emissions of VOC constitutes BACT. Considering the relatively high carbonaceous materials locally quarried by CEMEX, EPD proposes that the BACT limit for the VOC emissions is 0.5 pounds of total hydrocarbons (THC) per ton of clinker expressed as propane on dry basis corrected to 7% oxygen, on 30-day rolling average, as tested and monitored by a THC CEMS installed on the Kiln No. 6 exhaust stack. This BACT limit is within the low range of BACT limits imposed on recently permitted cement plants in the country. It should be noted that because of using raw materials essentially free of organic matter, cement plants in Florida were permitted with BACT VOC/THC emission limits in the range of 0.12 to 0.15 lb/ton of clinker.

The conversion of VOC to THC is necessary because the THC CEMS is based on EPA Method 25A using a flame ionization detector that is typically calibrated with propane, and "counts" the number of carbon atoms passing through the analyzer. According to U.S. EPA, if gas stream is complex (i.e., gas streams have multiple compounds, unknown compounds and/or variable proportions), then results from Method 25A should be reported on as THC on "as propane" basis.

Please note that in the case of CEMEX, the proposed THC BACT limit of 0.5 lb/ton of clinker will be approximately 30 parts per million dry volume (ppmdv) based on the characteristics of the exhaust gas stream from CEMEX's Kiln No. 6 stack. This limit is below the 50 ppmdv THC limit in 40 CFR Part 63, Subpart LLL for existing Portland cement kilns. As a new kiln, the proposed Kiln No. 6 will be subject to the more stringent THC limit of 20 ppmdv under 40 CFR Part 63, Subpart LLL[7], i.e., approximately 0.33 lb/ton of clinker in the case of the Kiln No. 6. After an in-depth review of 40 CFR Part 63, Subpart LLL and associated background documents, EPD has concluded that to comply with this limit via any technically feasible add-on control techniques, the lowest cost estimation would be over $40,000 for each ton of THC removed via a RTO system. This cost is too high to for the RTO to be considered as economically feasible for BACT.

On the same day promulgating the current 20 ppm THC limit, U.S. EPA announced that it would reconsider this limit because of the petition from the cement manufacturing industry, and make a decision later in 2008. The current THC limit remains in effect till U.S. EPA announces the decision on the reconsideration. Meanwhile, affected new sources such as the Kiln No. 6 shall, in addition to complying with other applicable VOC limits in this permit, comply with the current 20 ppmdv Subpart LLL THC emission limit on and after startup of the production, with or without the help of any add-on control, depending on the actual THC emission level.[8]

4.5 NO_x Emissions from Preheater/Precalciner and Kiln

NO_x is formed as a result of reactions occurring during fuel combustion in the preheater/precalciner, calciner, and cement kiln. NO_x is produced mainly through two mechanisms during combustion: (1) fuel NO_x, and (2) thermal NO_x.

[7] §63.1343(c) of 40 CFR Part 63, Subpart LLL

[8] National Emission Standards for Hazardous Air Pollutants From the Portland Cement Manufacturing Industry: Notice of Reconsideration, Federal Register/Vol. 71, No. 244/Wednesday, December 20, 2006.

Fuel NO_x is formed due to the oxidation of nitrogen or its compounds contained in fuel. In general, approximately 60% of fuel nitrogen is converted to NO_x during combustion. The resulting NO_x emissions are primarily affected by the fuel nitrogen content and excess air/oxygen in the flame. Nitrogen in the kiln feed may also contribute to NO_x emissions but to a much smaller extent.

In general, substituting a fuel with one with higher heating value will reduce NO_x emissions in part because fuel/heating efficiency is increased and less total fuel is consumed. Increasing fuel efficiency has the same result. A modern dry-process cement kiln with preheater/precalciner and calciner such as the Kiln No. 6 is the most fuel efficient Portland cement manufacturing process.

Thermal NO_x is the most significant NO_x source in kiln combustion. The rate of thermal conversion from N_2 in the combustion air to NO_x is controlled by both excess O_2 in the flame and the temperature of the flame. In general, NO_x levels increase with the higher flame temperatures that are typical in the kiln burning zone.

In a preheater/precalciner kiln, fuel combustion occurs at two locations and each follows a separate mechanism in the formation of NO_x, i.e., thermal NO_x dominates in the kiln burning zone and fuel NO_x dominates in the precalciner. For this reason, the effects of process operation on final NO_x levels are complex and do not necessarily conform to conventional understanding of combustion as defined through steam generating boilers. Study of various cement kilns also has shown that actual NO_x emissions are highly site specific.

Cement kilns are distinct from conventional combustion sources such as steam boilers in that the combustion chamber is a confined space that is refractory lined. This radiates energy back into the flame, thereby increasing the flame temperature. At given excess air levels, a confined flame will usually produce higher NO_x emissions than an open flame such as a boiler fire box. In the rotary kiln section, fuel combustion increases material temperature to a level to allow calcined meal/feed to become viscous (liquid) and form calcium silicates/clinkers. This temperature depends on cement type and meal properties and is in excess of 2,550°F.

NO_x levels from kiln firing are also strongly related to fuel type, location of fuel introduction, flame shape, and peak flame temperature. At higher peak flame temperatures, more thermal NO_x is formed. Flame shape is also related to the percentage of primary air used in combustion in the kiln. High levels of primary air increase NO_x formation by providing excess O_2 in the hottest portion of the flame. A long flame and low primary air volume can minimize NO_x formation in the main kiln. However, in order to obtain high quality clinker with the best microstructure, a relatively short, strong, and steady flame is necessary. In addition, too long of a flame may also cause kiln rings and lead to incomplete fuel combustion.

A secondary firing zone is the precalciner vessel where fuel such as pulverized coal or petroleum coke is burned in situ with the preheated raw meal. The calciner can also be designed to introduce fly ash and non-hazardous solid waste through the calciner burner. Under these conditions, heat released by fuel oxidation is extracted by meal decarbonization. The efficient use and transfer of energy reduces the peak temperature in the vessel. Normal temperatures are between 1,650° and 1,800°F. This lower temperature and operation at reduced excess air levels reduces the formation of NO_x. Thermal NO_x is minimized and fuel NO_x predominates.

As a non-virgin non-hazardous solid fuel, tires may also be used in either a whole or shredded form that can be injected via an air lock/gate system into the material inlet of the kiln. The tires provide additional heat to the calcination process as well as a localized reduction zone around the tire fuel that assists in NO_x reduction. A tire gasification system is also available to produce a combustible gas that would be injected into the kiln inlet or calciner. The portion of the tires that does not gasify will form a coke/residue material. This material will be fed into the kiln inlet in the same manner as shredded or whole tires and

provide additional heat input while incorporating the ash into the clinker. Air is supplied to the tire gasification system via the tertiary air from the clinker cooler and/or ambient air.

NO_x emissions can be affected by both fuel firing scenarios and heat input ratios. Fuels higher in volatiles such as fuel oils, coal, and some non-hazardous liquids and solids can increase the free radical pool, allowing for more reduction in NO_x generated by the main burner of the kiln. Additionally, tires injected via the mechanism described above can create localized reducing zones around the fuel as it combusts. These reducing zones can also enhance the reduction of NO_x by the creation of additional reduction zones in comparison to highly reactive fuels. The heat input ratio can also play an important role in NO_x emissions. The more fuel fired in the high heat burning zone through the main kiln burner, the higher the overall NO_x per unit of heat input. The more fuel that can be utilized in the precalciner or calciner at lower temperatures while still maintaining the needed temperature profile in the burning zone, the less the overall NO_x per unit of heat input. In modern kilns this ratio is typically 60% in the precalciner and/or calciner and 40% in the kiln main burner. Slight variations as described above may occur as more fuel is needed in the main burner to maintain the needed burning zone temperature.

The heat input percentages can occasionally fluctuate slightly as more or less heat is need in the precalciner or calciner region or burning zone for the kiln main burner, as dictated by raw materials or quality control characteristics. Regardless of the fuel firing scenario or fuels used, overall heat input to the kiln remains fairly constant in comparison to kiln feed rate. Theoretically, constant heat inputs are needed for the overall process of clinker formation with uniformly predictable variations for raw material deviations, heat exchange rates, and other conditions experienced under normal kiln operating conditions.

NO_x formed in the main kiln combustion passes through the precalciner and the gases are cooled slowly in the preheater/precalciner cyclones. NO_x formation is an endothermic process and as gases cool, NO_x tends to revert to N_2 and O_2. This decomposition process is rapid at elevated temperatures but decreases at temperatures below approximately 1,300°F. In effect, if the flue gases can be slowly cooled to 1,300°F over an extended period, a progressive decrease in NO_x concentration occurs. This process occurs in the preheater/precalciner after other combustion radicals (OH-, H+, O-, etc.) have been eliminated.

In addition, the burner design, as it affects flame shape, and the fuel to air ratio, can mitigate the formation of thermal NO_x. In most modern dry process cement plants, low-NO_x burners are used.

In general, the starting point to control NO_x is to avoid its formation in the high temperature combustion zone near the main kiln burner via mainly "indirect firing" achieved by proper design of the kiln system. The basic principle of "indirect firing" is to minimize primary air (that carries the coal to and through the main kiln burner) and to utilize more secondary air (from the kiln clinker cooler) as combustion air. This practice minimizes fuel consumption (by increasing system heat efficiency) and high temperature combustion (by creating low temperature combustion zones) and in turn reduces the NO_x formation.

Available technologies for reducing NO_x emissions from a dry rotary preheater/precalciner cement kiln system like CEMEX's are discussed below:

Indirect firing systems (a low NO_x technology) can be used on the precalciner and rotary kiln burner systems. This technology fires pulverized solid fuels such as coal and petroleum coke using a dense phase conveying system that limits the volume of air necessary to transport fuel to the burner. This design reduces primary air injected with fuel.

The indirect-firing process allows the flame to be fuel rich, which reduces the oxygen available for NO_x formation. In some cases it can also result in higher flame temperatures because the heat release occurs with less combustion gases (i.e., excess air).

Indirect firing with a low NO_x burner attempts to create two combustion zones, primary and secondary, at the end of the main burner pipe. In the high-temperature primary zone, combustion is initiated in a fuel-

rich environment in the presence of a less than stoichiometrical oxygen level. The submolar level of oxygen at the primary combustion site minimizes NO_x formation. The presence of CO in this portion of the flame also chemically reduces some of the NO_x that is formed.

In the secondary zone, combustion is completed in an oxygen-rich environment. The temperature in the secondary zone is much lower than in the first; therefore, lower NO_x formation is achieved as combustion is completed.

Low NO_x burners in general are not as effective when used on the rotary kiln section of a preheater/precalciner kiln system because gases containing the thermal NO_x formed in the main kiln section are gradually cooled as they move through the system, resulting in NO_x reduction (as previously discussed). As the gases pass through the precalciner burning zone and preheater cyclones, NO_x are further reduced. NO_x contained in the alkali bypass gases, however, would not be subject to this reduction.

Semi-direct firing technology separates pulverized fuel from the coal mill sweep air using a cyclone separator. The fuel is then metered from a collect bin to the kiln burner pipe. The exhaust gases of the cyclone are used to transport the fuel from the bin discharge. Advantages in the design are that a portion of the sweep air can be returned to the coal mill or exhausted to the atmosphere and that minor variations in fuel delivery rate are eliminated. The major advantage for NO_x abatement is that the volume of primary air can be marginally reduced (i.e., 20 to 25% of combustion air). The system is similar to mill recirculation but can include partial sweep air discharge.

Semi-direct firing reduces NO_x in a way similar to indirect firing; however, primary air volume will be higher than indirect firing, and would not reduce NO_x emissions below that achieved by indirect firing.

Mill air recirculation reduces primary air usage by returning a portion of the coal mill sweep air (30 to 50%) to the coal mill inlet. By returning sweep air, the volume of air used to convey pulverized fuel to the burner pipe is reduced. The amount of the return air possible depends on the mill grinding rate (i.e., percent of utilization), volatile content of fuel, moisture in the fuel, grindability of the fuel, and the final conveying air temperature achieved. The reduction in primary air allows the use of low NO_x burner technology that further reduces NO_x formation.

The use of mill air recirculation can achieve primary combustion air between 15 and 25% but is highly variable. Kilns operating with a hard burning mix do not typically achieve high NO_x reductions. Also, recirculation is not possible for fuels containing high free moisture (i.e., fuels stored outdoors exposed to weather).

This technology applies to coal/coke direct-fired kilns not currently using a fuel-rich primary combustion technology, i.e., indirect or semi-direct firing system.

Mid-kiln firing (MKF) is a potential NO_x reduction technology involving injection of solid fuel into the calcining zone of a rotating long kiln using a specially designed feed injection mechanism. The technology is applicable to conventional wet process and long dry kilns. The fuel used is generally whole tires, although containerized waste fuels have also been used at some plants. Fuel is injected near the mid-point of the kiln, once per kiln revolution, using a system consisting of a "feed fork," pivoting doors, and a drop tube extending through the kiln wall.

Another form MKF has been used for certain preheater/precalciner kiln systems. Whole tires are introduced into the riser duct using a specially designed drop chute with air lock or thermal suspension. This creates an additional secondary firing zone in which the solid fuel is burned in contact with the partially calcined meal. Combustion is initiated in the riser duct (located midway between the calciner and rotary kiln sections of the kiln system) and is completed within the rotary kiln section in a reducing atmosphere away from the high temperatures of the main kiln burner. NO_x formation is inherently lower

in this area, and NO_x formation may be further reduced due to improvements in fuel efficiency and the shifting of fuel burning requirements (e.g., less fuel must be burned at the main kiln burner).

In general, MKF is a staged combustion technology allowing part of the fuel to be burned at a calcination temperature of 600° to 900°C, which is much lower than the clinker burning temperature of 1,200 to 1,480°C, thus reducing thermal NO_x formation. By adding fuel in the main flame at mid-kiln, MKF changes both the flame temperature and flame length, and thus may reduce thermal NO_x formation by burning part of the fuel at a lower temperature and by creating reducing conditions at the solid waste injection point that may destroy some of the NO_x formed upstream in the kiln burning zone. MKF may also produce additional fuel NO_x depending upon the nitrogen content of the fuel. The additional fuel NO_x, however, is typically insignificant relative to thermal NO_x formation. The discontinuous fuel feed from MKF can also result in increased CO. To control CO emissions, the kiln may require an increase in combustion air, which can decrease production capacity.

Test data showing NO_x reduction levels for long dry and wet kilns were compiled for the EPA in the report *"NO_x Control Technology for the Cement Industry"* (EC/R Inc., 2000). Tests conducted on three wet process kilns using MKF technology showed an average reduction in NO_x emissions of 40%, with a range from 28 to 59%.

Multi-staged combustion (MSC)/staged and controlled combustion (SCC) in calciner is a combustion technology currently used with preheater/precalciner kilns to reduce NO_x generation by all major kiln vendors. MSC/SCC, which includes the use of two or more staged air, feed, or fuel burning locations to create low NO_x burning zones, is supplied by one or more vendors as NO_x control technology on modern preheater/precalciner cement kilns. MSC/SCC is also considered a common technology as it has been used for many years throughout the cement industry.

MSC/SCC takes place in and around the calciner and is accomplished in several ways depending on the system design. The purpose of staged combustion is to burn fuel in two stages, i.e., primary and secondary. Staged air combustion suppresses the formation of NO_x by operating under fuel-rich, reducing conditions (less than stoichiometrical oxygen) in the flame or primary zone where most of the NO_x is potentially formed. This zone is followed by oxygen-rich conditions in a downstream, secondary zone where CO is oxidized at a lower temperature with minimal NO_x formation. By burning a portion of the fuel in the calciner burner instead of the main kiln burner, MSC/SCC spreads the thermal load in the pyroprocessing system and thus allows much of the combustion to occur at temperatures of the calciner that are much lower than that near the main kiln burner. This reduces the potential for thermal NO_x formation. Significant fuel NO_x formation in the calciner is still possible.

MSC/SCC also introduces exhaust gas from the kiln to calciner. Such gas contains relatively low excess air/oxygen and high temperature that is lower than required to sinter cement but higher than required to calcine raw materials, and reduces the formation of thermal NO_x.

In summary, MSC/SCC allows fuel, air and raw material introduction to the calciner to be "staged" in such a way that it can destroy thermal NO_x from the kiln and discourage the formation of thermal NO_x in the calciner.

The following discussion explains the mechanism for reduction of NO_x by MSC/SCC:

Calcinations of limestone occur at approximately 900°C and liberate CO_2 to produce lime in the following endothermic reaction:

$$CaCO_3 \rightarrow CaO + CO_2$$

Fuel, such as coal, is heated and burned releasing hydrocarbon radicals. These, in turn, catalytically react with NO to form hydrogen cyanide:

$CHi^* + NO \rightarrow HCN + \ldots\ldots$

Where: i = 1,2,3

Ammonia-like radicals are also released during fuel burning. Under reducing conditions and the presence of raw meal/kiln dry feed they catalytically destroy NO:

$NHi^* + NO \rightarrow N_2 + \ldots\ldots$

This mechanism suppresses formation of NO by the pyrolyzed fuel nitrogen and employs that nitrogen to further reduce NO_x in reactions that at first look much like two add-on NO_x control technologies, i.e., "selective non-catalytic reduction (SNCR)" or 'selective catalytic reduction (SCR)" does, as discussion in the following sections.

Other reactions involving CO or hydrogen are also catalytically driven and destroy NO_x in this reducing atmosphere rich in CO and lean in oxygen. In the subsequent burning of soot and char, the NO_x reducing reactions proceed much more slowly and some of the remaining fuel nitrogen can still form significant amounts of additional NO_x.

Research and actual emission monitoring on preheater/precalciner cement kilns have shown that MSC/SCC technology applied to the area of the calciner works to effectively lower NO_x emissions. Although potential disadvantages to MSC/SCC may exist, experience has shown that when included as part of the kiln system design, it will reduce NO_x emissions with minimal process problems. The MSC/SCC control option is capable of reducing NO_x emissions by 10 to 50%, depending on the site-specific kiln operating parameters (i.e., fuel nitrogen content, kiln feed burnability, excess air, etc.).

MSC/SCC can have limitations under specific conditions that affect the potential NO_x control effectiveness. In kiln systems that use a mix with high sulfur to alkali molar ratio, the volatility of sulfur is increased due to the strong reducing conditions in MSC/SCC and the relatively low excess oxygen available in the system. Operationally, this could cause severe preheater plugging due to significant sulfur deposition associated with MSC/SCC operation. As a result, the required conditions needed for optimum MSC/SCC operation (low excess oxygen), conflict with the goal of preventing sulfur deposition and minimizing operational problems. These problems have been documented in Europe and at U.S. cement production facilities. A high sulfur/alkali molar feed ratio prevents the achievement of maximum NO_x reduction using MSC/SCC.

Available add-on control technologies for NO_x include selective non-catalytic reduction (SNCR) and selective catalytic reduction (SCR).

SNCR involves injecting an ammonia (NH_3)-containing solution into the process to reduce NO_x. The solution may be supplied in the form of anhydrous ammonia, aqueous ammonia, or urea. The injection point shall have the optimum temperature range of 800° to 1,090°C, such as preheater tower. Residence time, turbulence, oxygen content, and a number of other factors specific to the given gas stream are also important for the success of SNCR. Because the optimum temperature range must be present for a sufficient time period to allow the reaction to occur, SNCR is only a viable technology on some preheater or precalciner kiln designs.

SCNR destroys NO_x by a two-step process as follows:

Step 1: Ammonia reacts with available hydroxyl radicals (OH^*) to form amine radicals (NH_2^*) and water:

$NH_3 + OH^* \rightarrow NH_2^* + H_2O$

Step 2: Amine radicals combine with nitrogen oxides to form nitrogen and water:

$NH_2^* + NO \rightarrow N_2 + H_2O$

The equations suggest that, theoretically, SNCR will function best in an oxidizing atmosphere.

However, in a reducing atmosphere, CO competes with ammonia for available hydroxyl radicals:

$CO + OH^* \rightarrow CO_2 + H^*$

This phenomena will require the optimization of the operation of the kiln system and SNCR to minimize the emissions of both pollutants.

At temperatures lower than 800°C, reaction rates are slow, and there is potential for significant amounts of ammonia to exit or "slip" through the system. This ammonia slip may result in a detached visible plume at the relevant stack, as the ammonia will combine with sulfates and chlorides in the exhaust gases to form inorganic condensable salts, which can become a significant source of condensable PM emissions that cannot be controlled with a baghouse or ESP. Ammonium sulfate aerosols would be a concern under upcoming programs to deal with regional haze. In addition, there may be health and safety issues with on-site ammonia generation.

At temperatures within the optimal temperature range, the above reactions proceed at normal rates. However, as noted in the literature as well as by vendors, a minimum of 5 ppm ammonia slip may still occur as a side effect of the SNCR process.

At temperatures above 1,090°C, the necessary reactions do not occur. In this case, the ammonia or urea reagent will oxidize and result in even greater NO_x emissions. In addition, SNCR secondary reactions can form a precipitate, resulting in preheater fouling and kiln upset. Ammonia reagent may react with sulfur in kiln gases to form ammonium sulfate. Ammonium sulfate in the preheater can create a solids buildup. Ammonium sulfate in the kiln dust recycle stream may adversely affect the kiln operation.

The optimal temperature window for SNCR occurs somewhere in the preheater system, as illustrated in Figure 4.5-1. Fluctuations in the temperature various points in the preheater are common during normal cement kiln operation. Therefore, selecting one zone for SNCR application in the preheater cannot reliably assure consistent results. Alternatively, selecting multiple zones of injection significantly increases complexity to an already complex chemical process.

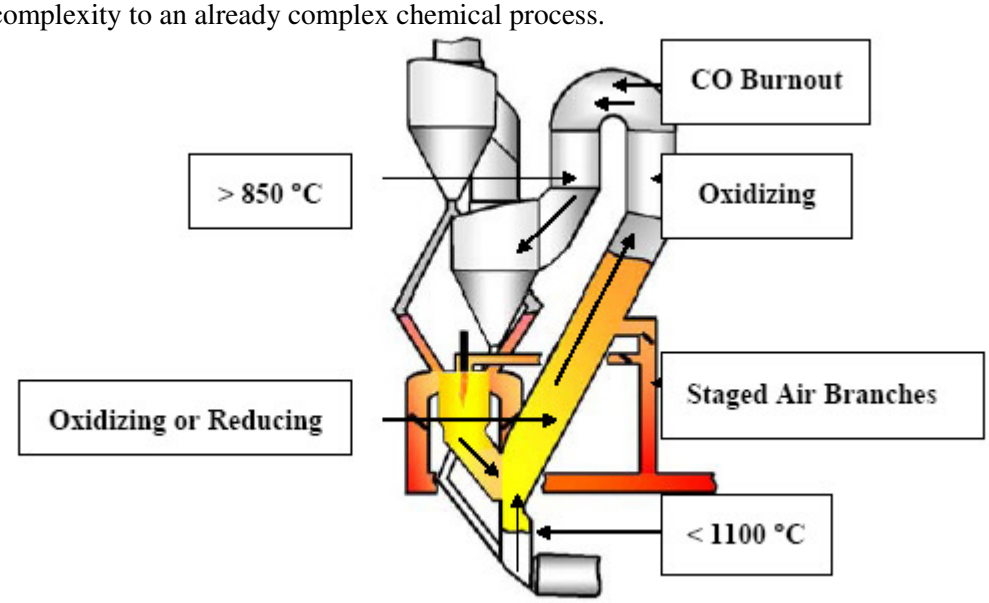

Figure 4.5-1: Temperature and oxidizing atmosphere windows for SNCR in an Air Stage Calciner

Because raw materials can contain naturally occurring carbon (i.e., bitumen and kerogens), pyrolysis of such organics in the preheater tower produces CO, and results in a reducing atmosphere. The current control practice is to limit oxygen at the calciner exit to reduce NO_x. SNCR requires an oxidizing atmosphere and the two conditions are opposed in theory, as discussed above. CO emissions are expected to increase as NO_x is reduced. Data from preliminary testing in Europe and at Suwannee American Cement (SAC) in Branford, Florida (a dry process kiln similar to the Kiln No. 6) on MSC/SNCR systems indicated a possible increase in CO emissions of 5 to 20%. SAC's testing tried to determine the effectiveness of SNCR and the required reagent injection rate. The short-term data indicated no significant conflict with the reducing atmosphere. Some ammonia slip was noted during the testing but only for small periods while the raw mill was down, even during periods with no ammonia injection. Further long-term operations are needed to completely understand the ammonia cycle and ammonia slip. The testing has initially indicated that SNCR can be successfully applied without the formation of a visible plume. It should be noted that CO emissions showed a moderate increase during the testing.

In addition, ammonia emitted as gas in the plume will react with SO_2 or HCl in the condensed water vapor plume forming a highly visible plume under certain weather conditions. A similar plume has been noted as result of naturally occurring ammonia in the kiln feed at a number of cement plants.

SNCR in combination with MSC/SCC has been demonstrated as a means of reducing NO_x. Although SNCR and MSC/SCC can in theory conflict, testing and operations at SAC have shown that the use of MSC/SCC can help to reduce the initial NO_x that is subsequently reduced by SNCR. Any reduction in initial concentration of NO_x prior to introduction to the SNCR will result in a minimization of reagent used by the SNCR to reduce the NO_x. This results in cost savings and makes the SNCR a more effective means of reducing NOx emissions. Low NO_x burners and kiln firing rates can also be used in conjunction with SNCR to help reducing the NO_x subsequently reduced by SNCR. In the testing conducted at SAC, SNCR in conjunction with low NO_x burners and MSC/SCC, resulted in NO_x emissions blow 1.95 lb per ton of clinker. Another advantage of using the SNCR in conjunction with SCC is that SNCR allows running in an oxidizing condition that helps to avoid buildup in the riser duct. This allows having a much more stable operation in the kiln and fewer process upsets.

In summary, the requirements for SNCR include adequate amounts of ammonia, an optimum temperature range (i.e., 800° to 1,090°C) and the presence of an oxidizing atmosphere. At the low flue gas temperature the reaction rate is slow and ineffective. Ammonia introduced will not react and will be lost as gas, known as "ammonia slip" which, under certain atmospheric circumstances, could form visible plume at the stack. When the gas stream contains relatively high concentration of SO_2 due to the use of high sulfur raw materials, some of the ammonia will react with SO_2 in the conditioning tower, forming ammonium sulfate $(NH_4)_2SO_4$, a submicron aerosol uncontrollable by baghouses or ESPs. This aerosol may form a visible plume at the stack, and the visible emissions could be significant when the sulfur contents in the raw materials are relatively high.

It is worth noting that ammonia in the gas stream competes with CO for available hydroxyl radicals, resulting in increases in CO emissions. It has been reported that increasing the molar ratio of NH_3 to NO_x increased CO emissions up to 1.5 lbs./ton of clinker, and the CO increases were proportional to the ratio. Therefore, in addition to the "ammonia slip" and ammonium sulfate submicron aerosol emissions, SNCR's effect on CO emissions should also be taken into consideration during the establishment of the extent of using SNCR to reduce NO_x, i.e., the level of NH_3/NO_x ratio. These considerations should balance CO, NO_x, NH_3 and SO_2 emissions on a case-by-case basis, and establish relevant emission standards accordingly.

SCR uses ammonia in the presence of a catalyst to reduce NO_x. The catalyst is typically vanadium pentoxide, zeolite, or titanium dioxide. The SCR process has been proven to reduce NO_x emissions from combustion sources such as incinerators and boilers used in electric power generation plants but not in cement kilns.

As illustrated in Figure 4.5-2, in a SCR, the process/exhaust gas is injected with anhydrous ammonia and passed through a catalyst bed to initiate the catalytic reaction, reducing NO_x in the gas to nitrogen and water. The catalyst is not consumed in the process. The critical temperature range required for this reaction is 300°C to 450°C, which is higher than the typical cement kiln ESP or baghouse exit gas temperature. SCR can be beneficial as well where VOC reductions are also necessary or as a dioxin/furan control strategy.

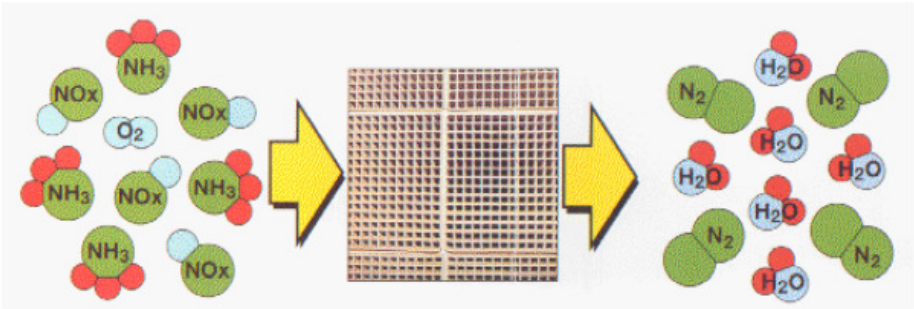

Figure 4.5-2: NO_x & NH_3 in kiln flue gas react over SCR's catalyst bed and covert to N_2 & water.

SCR requires the catalyst to be placed prior to the gas conditioning tower (dirty side) or after the PM control device (clean side) to prevent bed blockage/fouling. Placing SCR at the preheater exit satisfies the temperature requirements, but subjects the catalyst to the re-circulating dust load and potential fouling. Location at the baghouse exit requires reheating of the gases to the required temperature for catalyst activation.

Installation of the catalyst before the PM control device (i.e., dirty side) increases the potential for fouling from meal/re-circulating dust load, but requires a less significant reheating of the gas stream. The most prohibitive disadvantage of the SCR in this location is fouling of the SCR catalyst. The high dust loading in cement kiln gases may plug the catalyst and render it ineffective. Minor impurities in the gas stream, such as compounds or salts of sulfur, arsenic, calcium, and alkalis, may poison the catalyst very rapidly, strongly affecting the efficiency and system availability and increasing the waste catalyst disposed.

Continual fouling of the SCR catalyst would render it inoperative as a NO_x control option. Ammonia injected to a fouled SCR would pass unreacted through the system (i.e., ammonia slip). The unreacted ammonia would combine with sulfates and chlorides in the exit gases, forming inorganic condensable salts, which result in a detached visible plume and a significant increase in condensable PM_{10} emissions. In addition, SCR on power plants have been shown to convert SO_2 to SO_3 as a secondary reaction. SO_3 will react with CaO between preheater stages forming gypsum ($CaSO_4$), which can plug the tower and cause kiln shutdown.

Installation of the SCR after the PM control device (i.e., clean side) reduces the potential for fouling from meal/re-circulating dust load, but requires significant reheating of the gas stream. This can be significant if combined with wet scrubbing prior to the SCR. SO_2 removal is required to prevent conversion of SO_2 to SO_3 in the catalyst bed which would increase SO_3 emission if the SCR were the last system in the gas train.

Placement of the SCR between the baghouse or ESP and wet scrubber would not reduce the SO_3 emissions if the SO_3 hydrates and condenses in the scrubber quench. H_2SO_4 aerosols are submicron and therefore not collected in wet scrubbers designed for SO_2 removal.

SCR systems are currently being installed on electric utility boilers in North America for NO_x control. These systems use up to three catalyst beds with ammonia gas injection before each bed. Temperature is controlled by placing the reactor beds between the boiler outlet and air heater. For most applications the boilers are base load units with little or no load variation. This allows a stable temperature profile for

optimum function and injection of ammonia. Ammonia is typically generated by the thermal decomposition of urea in a water solution under pressure.

The application of SCR on cement kilns is fundamentally different form utility boilers due to their differences in gas composition, dust loading, and chemistry. EPA's *"Alternative Control Techniques (ACT) Document for NOx Emissions from Cement Manufacturing"* (pages 6-32, 6-36, and 6-37), acknowledges that there are no installations of SCR technology in cement plants in the United States, though concluding that SCR technology is technically feasible based on technology transfer from utility boiler and gas turbine applications. The ACT document indicates a control efficiency of 80% for SCR.

Currently no full-scale application of SCR on a Portland cement plant exists in North America. Until recently the only known full scale SCR at a cement plant was at the Solnhofer Portlant Zementwerke in Bavaria, Germany. The first known self-funded commercial SCR at a cement plant is located at the Radici Cementeria di Monselice (CM) in Italy. The German SCR mentioned above is experimental and has had some operational problems concerning catalyst deactivation and fouling. Currently the German SCR is still testing for long-term catalyst optimization. The application of SCR to "dirty side" kiln gases is still in an experimental stage.

The most serious issues yet to be resolved for SCR are catalyst life, poisoning of the catalyst, fouling of the bed, system resistance, ability to correctly inject ammonia at proper molar ratio under non-steady state conditions, and creation of detached plume. Additionally, inexperience with SCR limits the availability of such a technology without long-term testing to determine the applicability and long-term reductions of NO_x associated with the production of Portland cement.

There is much debate in the industry regarding the relative merits of SNCR versus SCR. Similar very low NO_x emissions are possible with either technology. The most interesting details regarding the installation at CM relate to the NH_3 consumption and slip. Use of SCR directly minimizes detached plume formation potential and fine particulate precursor emissions. Similar or better results can be achieved with more proven technologies such as SNCR or staged combustion. The use on "clean side" application may be technically feasible but has a high energy cost to reheat the gases.

In summary, the control efficiency of both SNCR and SCR are comparable, and ranked at the top among all the NO_x control technologies discussed above. The control efficiencies of the rest technologies vary based on such factors as equipment design, raw materials, fuels, combustion and operating parameters, and are difficult to be placed.

NO_x BACT Determination

Based on the preceding discussion, the technically feasible options for controlling of NO_x emissions from CEMEX's dry process preheater cement kiln system are considered to be:

- SNCR
- SCR
- Indirect Firing and Low NO_x Burners
- Mid-Kiln (Riser Duct) Firing
- MSC/SCC

CEMEX proposed in the application to use combination of SNCR, Indirect Firing, Low NO_x Burners and SCC as BACT for controlling the NO_x emissions from the Kiln No. 6.

Considering scarce application, potential operational problems, and high cost associated with the use of SCR to control NO_x emissions from Portland cement plants, EPD has eliminated SCR from BACT consideration, and determined that CEMEX's proposed combination of SNCR, Indirect Firing, Low NO_x Burners and SCC technologies to minimize NO_x constitutes BACT. This combination of the NO_x control

technologies was determined in 2003 by the State of Florida as BACT for a dry process kiln that is similar to the Kiln No. 6 in both design and size. The NO_x emission limit for the BACT is 1.95 lb/ton of clinker based 30-day rolling average, as measured by NO_x CEMS. This limit is identical to that contained in PSD permits issued recently to four similar cement plants by the State of Florida and the limit in the recently issued PSD permit by EPD to HAC. The emission rate average time is appropriate to account for the variability in NO_x emissions from cement kilns and is consistent with EPA's NO_x State Implementation Plan (SIP) call guidance for cement kilns. Conditions in this permit will establish the relevant operational, work practice, monitoring, testing, record keeping, compliance demonstration and reporting requirements for the BACT, which include but not limited to, raw material and fuel usage plans and records, firing rate requirements and records, SNCR operating records, and use of a NO_x CEMS for performance testing and continuous compliance monitoring.

4.6 SO_2 Emissions from Preheater/Precalciner and Kiln

SO_2 can be generated from organic or pyritic sulfur compounds in the raw material fed to the preheater/precalciner of the cement kiln and from sulfur contained in the fuels firing the kiln system. It is generally agreed that very little of the fuel sulfur is released from the stack as SO_2. The SO_2 emissions from fuel sulfur are generally adsorbed by powdery alkalis species (potassium and sodium) in raw materials in the calciner or lower sections of the preheater/precalciner and are cycled back to the kiln with the majority of the sulfur exiting the kiln in the clinker. Thus, the majority of SO_2 emissions from a modern preheater/precalciner cement kiln are from the sulfur compounds in the raw materials.

Information published by the Portland Cement Association indicates that 15-40% of the pyritic sulfur in the raw feed may be converted to SO_2. Some fraction of the SO_2 is subsequently adsorbed by alkalis species (potassium and sodium) in kiln feed/raw meal in the upper stages of the preheater/precalciner and/or in the raw mill, and is subsequently reintroduced to the pyroprocessing/kiln sulfur cycle. The remainder enters into the pyroprocessing/kiln system and becomes part of the sulfur cycle in that system. Based on the pyritic content of the raw materials and the continuous SO_2 emission monitoring data, it appears that 10-12% or less of the pyritic sulfur in the raw feed is released to the atmosphere as SO_2.

The in-line preheater/precalciner kiln/raw mill system as CEMEX's offers ideal conditions for adsorption of SO_2 from the kiln (from both the fuel and sulfur compounds in the mix) due to the high amount of free CaO and a temperature of approximately 1,650ºF in the calciner. In addition to the fraction of the SO_2 adsorbed by alkalis species (potassium and sodium) in kiln feed/raw meal, the majority of the absorbed SO_2 is converted to calcium sulfate through the following reactions:[9]

$$CaO + SO_2 \rightarrow CaSO_3$$

$$CaSO_3 + \frac{1}{2} O_2 \rightarrow CaSO_4.$$

At 1,045°C, the formation and decomposition reactions for $CaSO_4$ are at equilibrium at normal excess oxygen levels. As materials move through the high temperature region in the kiln, the $CaSO_4$ can break down per the above reaction and release SO_2, or it can fuse/react with the alkali sulfates and other species to form stable compounds that depart with the clinker.

The operation of the raw mill also has an effect on SO_2 emissions. When the raw mill is in operation, the hot kiln gases containing SO_2 pass through the raw mill to dry the raw materials as they are ground and blended. Due to the intimate mixing of the kiln exhaust gases and the powdery alkaline raw materials, a significant amount of the SO_2 in the kiln gases is absorbed in the dry feed via neutralization. When the raw mill is not operating (approximately 10% of the time in a typical modern Portland cement plant), the kiln gases bypass the raw mill and go directly to the kiln/raw mill/cooler baghouse. Under this operating

[9] An Overview of the Formation of SO_x and NO_x in Various Preprocessing Systems, Peter Nielson and Ove Lar Jepssen, F. L. Smith Co.

scenario, SO_2 emissions might increase, depending on the sulfur balance and sulfur cycle in the preheater/precalciner and pyroprocessing system. The averaging time for SO_2 emission standard should factor in the effect of the raw mill on SO_2 emissions and normal fluctuations in the sulfur cycle in the preheater/precalciner and pyroprocessing/kiln system.

The application submitted by CEMEX named the adsorption of SO_2 by the raw feed/meal in the preheater/precalciner, calciner, the kiln and the running raw mill as "inherent dry (SO_2) scrubbing". Sodium sulfate and potassium sulfate from absorption of SO_2 from fuel combustion are also incorporated into the clinker and in the dust collected by the baghouse (in CEMEX, all the baghouse dusts could be recycled to the process). Because of the abovementioned "inherent dry scrubbing" and the fact that sulfur input to the kiln system from fuel is less than the sulfur introduced in the feed material, SO_2 emissions from the main kiln stack are quite insensitive to use of higher sulfur fuels such as petroleum coke.

In summary, the control of fuel SO_2 is generally not an issue in modern kilns. Limiting fuel sulfur makes little difference in emissions. Generally, severe operational problems such as coating formation and blockages will occur due to use of high sulfur fuels before significant SO_2 emissions occur.[10]

The generic sulfur circulation includes a bypass for sulfur removal as alkali sulfate salts. When a kiln system is low in alkali and meal sulfur, a bypass may not be included in the design, such as the Kiln No. 6. The sulfur circulation and pathway in dry process preheater/precalciner Portland cement kiln and raw mill system are illustrated in Figure 4.6-1.

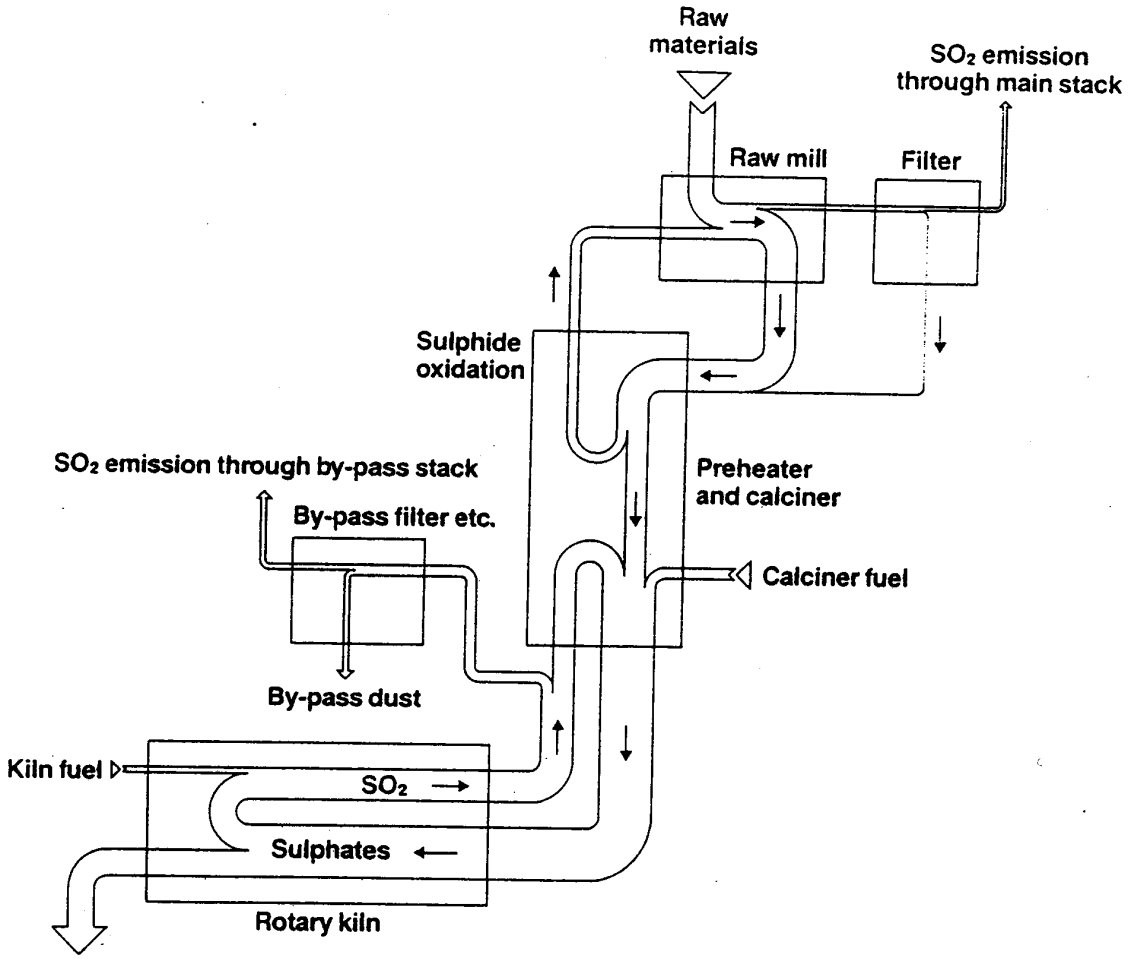

Figure 4.6-1: Sulfur Circulation & Pathway in Dry Process Preheater Cement Kiln System

[10] Presentation. Waste Management Technologies in Japanese Cement Industry. Taiyeho Cement, Taiyeho Engineering, CTI/Industry Joint Seminar, February 2004.

Besides the "inherent dry scrubbing", additional reduction of the SO_2 emissions can be achieved by other available control or process technologies. These techniques include the following:

- Absorption
- Adsorption
- Low sulfur fuels
- Low sulfur raw materials.

Absorption/Wet Scrubbing can be an effective add-on control technology for SO_2 removal via the use of an aqueous alkaline solution to turn gaseous SO_2 into water soluble or insoluble sulfates via neutralization. A wet scrubber has been shown to provide SO_2 control in excess of 90% under optimal operating conditions. Adsorption control devices include packed towers, plate or tray columns, Venturi scrubbers, and spray chambers.

Packed towers are columns filled with packing material that provide a large surface area. The large surface area allows for good contact between the liquid/scrubbing solution and the gas. Packed towers can achieve higher removal efficiencies, handle higher liquid rates, and have lower water consumption requirements than other types of gas absorbers. However, packed towers may also have high pressure drops, high instances of clogging and fouling, and high maintenance costs because of the packing material.

Plate, or tray, tower scrubbers are vertical cylinders where the gas and liquid come in contact in steps on trays or plates. The liquid enters at the top of the column and flows across each plate and through a downspout to the plates below. The gas stream flows upward through holes in the plates, bubbles into the liquid, and passes to the plate above. Plate towers are easier to clean and can handle large temperature fluctuations better than packed towers. However, at high gas flow rates, plate towers exhibit larger pressure drops and have higher liquid holdups.

Venturi scrubbers have a "converging-diverging" flow channel. The cross-sectional area of the channel decreases then increases along the length of channel, which increases the waste stream velocity and turbulence that improves the gas-liquid contact. The liquid droplets are then separated from the gas stream in an entrainment section. Venturi scrubber control efficiency is increased by increasing the pressure drop, which leads to higher operating costs.

Spray towers use a spray distribution system to deliver liquid droplets through a countercurrent gas stream under the influence of gravity. The droplets contact the pollutants in the gas stream. The required contacting power is derived from an appropriate combination of liquid pressure and flow rate. Spray towers are easy to operate and maintain and have low energy requirements. However, they have the least effective mass transfer capability of the absorbers and have high water recirculation rate requirements.

Wet scrubbing can also remove PM, some VOC, and acidic gases to various extent. Application of a wet scrubber requires passing the exhaust gases through a primary PM control produce a calcium sulfate ($CaSO_4$) as byproduct, typically referred to as synthetic gypsum. However, in practice, not all cement plants using wet scrubbing have been successful in obtaining useable synthetic gypsum. If the cement plants can reclaim the scrubber sludge as synthetic gypsum and reincorporate it in the finish grinding process as synthetic gypsum, the overall environmental benefits associated with a wet scrubber can be considerable.

Application of a wet scrubber requires passing the exhaust gases through a PM control device first to reduce the dust load and recover meal. Next, the exhaust gas is cooled by spraying quench water or a slurried reagent (such as slaked lime or finely ground limestone) in an absorption chamber. SO_2 is scrubbed from the exhaust gas by the neutralization reaction with the slurried lime [$Ca(OH)_2$] or limestone (calcium carbonate). The $Ca(OH)_2$ or calcium carbonate reacts with the SO_2 to form synthetic gypsum ($CaSO_4$-$2H_2O$). In theory, the synthetic gypsum precipitates into small crystals that are

dewatered. The dewatered synthetic gypsum can then be used to supplement purchased gypsum in the production of cement and represents a potential beneficial reuse of byproduct materials. However, if the gypsum cannot be effectively crystallized, as has been experienced by some cement plants utilizing wet scrubbing systems, the scrubber sludge must be disposed of at considerable economic and environmental costs.

At the present time there have been six cement plants using the wet scrubbing technology for reduction of SO_2 in the U.S. Five are operational. The following describes the operations of four of these plants.

ESSROC, Nazareth, Pennsylvania – A wet scrubber was installed on a preheater kiln to reduce SO_2 by 20 to 25% to comply with a State emission limit. This old-type scrubber had an availability of 65% of kiln operating hours. Chronic fouling of demisters, piping, and nozzles occurred and the scrubbers were discontinued with conversion of the kiln to a precalciner design during an expansion project.

Holcim, Midlothian, Texas – Wet scrubbers were installed on two kiln lines in an effort to increase production and avoid PSD permitting. These more advanced units have removal efficiencies of between 70 to 90%, and are available 90% or less of the kiln run time.

TXI, Midlothian, Texas – A wet scrubber was installed as part of an upgrade of the plant from a wet kiln operation to a new preheater/precalciner line. No data are available on the performance but it is expected that it is similar to the Holcim experience. This scrubber is located between the kiln fabric filter and a RTO used for CO/VOC control. It is worth noting that based on the experience of this facility, EPA promulgated the current 20 ppm THC emission limit and the alternative standard (98% of THC removal) in NESHAP 40 CFR Part 63, Subpart LLL, the MACT standard for new Portland cement plants constructed after 2007.

Holcim, Dundee, Michigan – Two scrubbers were installed on the two wet kilns for removal of SO_2 prior to control of VOC emissions using an RTO to avoid converting SO_2 to SO_3 in the RTO, causing corrosion and a visible condensing aerosol in the combustion process. The plant installed the RTO to meet stack opacity and odor limitations and the scrubbers were required for the RTO to function properly.

On the other hand, wet scrubbing has a number of downsides:

- Impose an adverse environmental impact by generating solid waste requiring landfill disposal (if a usable synthetic gypsum cannot be produced), and require treatment and disposal of liquid blowdown containing dissolved solids (alkali salts). Changes in product quality cannot be predicted until after scrubber startup in that the quality of synthetic gypsum is site specific.

- Replenish large quantities of fresh water lost due to vaporization of the scrubbing solution has an impact on the water supply in the area.

- The static pressure drop through the wet scrubber and demister increases the electrical energy demand for the project and has an adverse impact on energy usage at the site. In addition, the need to drive and to reheat stack gases for proper atmospheric dispersion and corrosion prevention has a significant energy impact.

Addition/Injection of Wet Absorbents such as lime or hydrated lime to the kiln process gas streams can reduce SO_2 emissions in dry cement kiln systems. Various types of wet absorbent systems have been used on dry kilns, with lime slurry addition being the most effective.

Wet absorbent addition is limited to kiln systems where the lime slurry droplet can evaporate to dryness before entering the PM control device. This eliminates the use on wet kilns where flue gas temperatures are too low for rapid evaporation and flue gas moisture is near moisture saturation levels.

It should be noted that the limestone in the kiln feed and calcium oxide in kiln dust act as natural absorbents of the SO_2 emissions from fuel combustion and pyritic sulfur in the kiln feed, i.e., "inherent scrubbing". Further, good burner design and proper operation of the kiln will chemically absorb sulfur into the clinker. Additional SO_2 reduction can be achieved by absorbent addition into the kiln process/flue gas stream.

With wet absorbent addition, CaO or $Ca(OH)_2$ slurry is injected into the process gas stream. Solid particles of $CaSO_3$ or $CaSO_4$ are produced, which are removed from the gas stream along with excess reagent by a PM control device. The SO_2 removal efficiency varies widely depending on the point of absorbent addition according to the temperature, degree of mixing, properties of the absorbent (i.e., size, surface area, etc.), and retention time.

In a dry process cement kiln system, process gases contain a low concentration of water vapor at an elevated temperature and must be cooled and humidified prior to entering the baghouse or ESP. Lime or calcium hydrate slurry can be introduced with the spray cooling water. Flue gas temperatures are reduced through the heat absorbed as sensible heat from evaporation of water. These temperatures are defined by the system design, kiln heat balance, amount of air in-leakage, and radiant and convective heat losses. The conditions present are optimal for proper operation of the kiln.

For slurry injection to succeed as a SO_2 absorption control method the following conditions must occur:

- Generating spray droplets with sufficient surface area to adsorb SO_2.
- Droplets existing for sufficient time to allow absorption and reaction (typically 3 to 5 seconds).
- Droplets containing sufficient reagent to maintain excess absorbent during droplet life.
- Hydrate particle in the droplet maintaining sufficient activity to replenish dissolved solids in the liquid as SO_2 consumes reagent (i.e., particle size, reactivity, etc.)
- The droplet evaporating to dryness before entering the PM device.

A heat balance analysis for the dry process kiln has to be conducted to determine if there is sufficient sensible heat available in the gas streams to allow evaporation of injected water containing hydrate slurry.

Hydrate solids may be introduced in the conditioning water as suspended/dissolved solids. The normal solids content in the water can be as high as 5% solids by weight using air atomizing spray nozzles. The small droplets and fine hydrate particles generated allow effective absorption of SO_2 to form sulfates. Removal effectiveness can vary between 50 and 90% depending on residence time and hydrate surface area.

Lower SO_2 removal estimates have been documented in applications where the conditioning towers, duct arrangement, and PM control devices are not adequate for injection of lime slurry, resulting in wet bottoms in the conditioning towers and build up on ducts and baghouse walls. These conditions limit the hydrate slurry injection rates and the removal efficiency.

The higher SO_2 removal estimates have been documented at Greenfield installations implementing optimum designs. In these designs, larger conditioning towers and longer straight runs of ductwork are used along with control device gas distribution systems. No adverse environmental impacts are expected from the use of wet absorption at dry process cement kiln systems. Increases in energy required to operate a wet slurry injection system is minimal. Wet slurry injection is not expected to have a significant process impact when it is only used during mill-down periods and therefore added $Ca(OH)_2$ will not affect the Ca/S molar ratio significantly.

Addition/Injection of dry absorbents such as powdery lime, calcium hydrate, limestone, or soda to the process gas stream or in an add-on control device (dry scrubber) can reduce SO_2 emissions. A variety of dry absorbent systems have been used on wet and dry cement kilns.

It should be noted that the limestone in the kiln feed and calcium oxide in kiln dust act as natural absorbents of the SO_2 emissions from fuel combustion and pyritic sulfur in the kiln feed. Further, good burner design and proper operation of the kiln will chemically absorb sulfur into the clinker. Additional SO_2 reduction can be achieved by absorbent addition into the kiln process gas stream.

With absorbent addition, powdery dry CaO or $Ca(OH)_2$ is injected into the process gas stream, and reacts with SO_2 to form solid particles of $CaSO_3$ or $CaSO_4$, which are removed from the gas stream along with excess reagent by a downstream PM control device. The SO_2 removal efficiency varies widely depending on the point of absorbent injection according to the temperature, degree of mixing, and retention time.

The single known application of an add-on dry scrubber uses a Venturi reactor column to produce a fluidized bed of dry slaked lime and raw meal. As a result of contact between the exhaust gas and the absorbent, as well as the long residence time and low temperature characteristic of the system, SO_2 is efficiently absorbed by this system. An additional application injects $Ca(OH)_2$ in the gas stream after the preheater first stage cyclone.

Dry absorbent injection to flue gas streams has been used at Roanoke Cement in Troutville, Virginia and has been proposed at several new cement plants. Effectiveness and cost are specific to each application and depend on the gas stream conditions and residence time available for reaction.

Typically the molar ratio (Ca/S) for absorption is on the order of 3.0 to 15.0 and requires approximately 2 seconds for completion. For increased effectiveness, a very fine particle is required or a high Ca/S ratio. Typical removal efficiency is between 20 and 50% depending on gas stream conditions.

Powdery hydrates/absorbents needed for dry absorption would be received by truck, pneumatically conveyed to a storage silo, and then injected through nozzles into the gas stream. Complete and uniform distribution and mixing in the gas stream are necessary. The best location for injection will be determined by each facility to allow for adequate residence time for reaction.

No adverse environmental or energy impacts are expected from the use of the dry absorption at dry process cement plants in general. The process is not expected to have a significant process impact because in general it would only be used during mill-down periods to compensate the loss of the portion of the "inherent scrubbing" contributed by the raw mill, and the addition of the $Ca(OH)_2$ powder will not affect significantly the original Ca/S molar ratio in the kiln system.

Table 4.6-1 presents a summary of the cost analysis for each of the add-on control options as derived from the similar table in HAC's application.

Table 4.6-1: Cost and Impact Summary for Add-on SO_2 Control Technology

Method	% removal	SO_2 Removed, tons/yr	Capital Costs, MM $	Annualized Cost, 1000 $	Cost Effectiveness $/ton	Impacts		
						Environmental	Product	Energy
Wet Scrubbing[1]	70 (90)	522 (672)	27.46	11,956	22,900 (17,797)	Yes	No	Yes
Wet Absorbent[2]	40 (60)	28 (42)	3.17	947	33,796 (22,531)	No	No	No
Dry Scrubbing/ Absorbents[3]	33 (50)	219 (326)	2.17	1,318	5,462 (3,606)	No	No	No

1. Expected control efficiency for wet scrubbing is 70% with raw mill on (7,446 hrs/yr), 80% with the raw mill off (1,314 hrs/yr), and 90% at maximum under both circumstances.
2. Expected control efficiency for wet absorption is 40% with maximum at 60%. Wet absorbent would only be added when the raw mill is off (1,314 hours/year) due to water spray limitations.
3. Expected control efficiency for dry scrubbing is 33% with maximum at 50%.

Raw Material Sulfur Management

Limited analyses of raw materials by CEMEX have shown that Fuller's earth and clays mined locally contain measurable amounts of pyrites (FeS_2). The Fuller's earth contains approximately 3% pyrites and constitutes approximately 15% of the raw feed. The clays constitute approximately 5% of the raw feed and contain approximately 1% pyrites. The analyses further show that limestone, which constitutes approximately 78% of the raw feed to the kiln system, contain non-detectable levels of pyrites. The mill scale acquired off-site constitutes 2% of raw feed and has non-detectable levels of pyrites.[11]

As cement plants are typically constructed adjacent to, or nearby a quarry (as is the case with CEMEX), it is not practical to use the management of the sulfur content of on-site mined materials as a means of controlling SO_2 emissions. Some material management discretion is possible, such as mining around or blending materials from mining areas with higher than normal organic or pyretic sulfur. But overall, on-site raw material management is limited mainly to the fact that the facility is designed and thus depends on the on-site quarry for a majority of the raw materials. Materials imported from off-site however, can be managed to assure they have acceptable sulfur levels. A computerized raw material management system as such employed by other permitted plants can inform the operators the sulfur content of different batches of raw materials and thus allows the operator to blend the raw materials accordingly to even out the sulfur input to the kiln to certain degree.

Fuel Sulfur Management

As discussed previously, it is generally agreed that very little of the fuel sulfur is released as SO_2 from the cement kiln because of the overwhelming alkali scrubbing/neutralization processes occurring at the in-line kiln/raw mill. Once generated at the burners, the fuel sulfur cycles in the calciner and kiln with the cycle dependent upon the sulfur/alkali balance, the oxidizing/reducing conditions in the kiln and calciner and the $CaO/CaSO_4$ equilibrium. Most of the sulfur eventually reacts with alkalis (primarily sodium and potassium) to form alkali sulfates that are incorporated in the cement clinker. If the sulfur/alkali balance is too much out of balance, alkali additives can be incorporated in the mix, the sulfur content of the fuel can be reduced, or if the alkalis are in excess, a by-pass can be installed to bleed off a fraction of the kiln dust.

Conventional wisdom is that if the sulfur-alkali balance in the pyroprocessing/kiln system exceeds unity, sulfur emissions (as SO_2) will increase and/or there will be sulfur deposits in the riser duct and/or preheater. However, experienced cement producers indicate that a sulfur-alkali ratio of up to 2.0 can be maintained without increasing SO_2 emissions or experiencing sulfur deposits. This is important when petroleum coke (typically with high sulfur) is considered as a fuel.

Operating with a high sulfur-alkali ratio requires a complete burnout of the fuel under oxidizing conditions early in the kiln. This allows the fuel sulfur to form sulfate complexes in the clinker and exit the kiln with the clinker. To assure early burnout of the fuel requires pulverization of the fuel such as coal and pet coke and the presence of sufficient oxygen to assure the burnout under oxidizing conditions.

Without the early burning of high sulfur fuel under oxidizing conditions, the fuel sulfur will form salts that will volatilize in the sintering zone and return to the riser duct and calciner where they will condense and return to the sintering zone; thus creating a sulfur cycle in the kiln/calciner. In the temperature range 750-1,200°C (which includes the calcination temperature of limestone), the salts have sticky properties. Thus, if excessive sulfur is present under these conditions, plugging problems will occur at the kiln feed shelf, the riser duct and/or the calciner, causing plant operating problems well before the sulfur can break through and cause SO_2 emission problems. Thus, the release of SO_2 generated by fuel combustion is extremely unlikely as plant operating problems, potentially resulting in a plant shutdown, will occur

[11] Supplement information submitted by CEMEX on December 4, 2007

before SO_2 breakthrough. But, as discussed previously, the sulfur cycle can be managed by controlling combustion conditions.

As a result of the self-limiting mechanism for fuel sulfur to generate SO_2 emissions and combustion management practices just described, SO_2 emissions as a result of fuel sulfur are essentially nonexistent.

SO_2 BACT Determination

EPD has determined that based on the cost estimations, the wet scrubbing option is not economically feasible and the wet absorbent addition option is not technically feasible for its very limited application condition (only operable during raw mill down time) as BACT for the control of the SO_2 emissions from the Kiln No. 6.

EPD has determined that the combination of the inherent dry scrubbing in the Kiln No. 6's in-line raw mill, preheater/precalciner and kiln, the injection of hydrated lime into the process gas stream/add-on dry scrubbing, and the judicious selection of raw materials regarding to the sulfur contents constitutes BACT to minimize the SO_2 emissions. Taking into consideration the raw materials mined onsite by CEMEX contain relatively more sulfur than those used by similar plants recently permitted in Florida, EPD has decided that the BACT limit for the SO_2 emissions from the Kiln No. 6 is 1.0 pound of SO_2 per ton of clinker based on a 30-day rolling average. The SO_2 emissions will be determined and continuously monitored by a SO_2 CEMS installed at the outlet of the main kiln exhaust stack.

Please note that this BACT standard is identical to that established for a preheater/precalciner dry process kiln proposed by Houston American Cement Plant (HAC). This new kiln will be located in the vicinity of the Kiln No. 6 and fed mainly by limestone and clay obtained from an on-site quarry. HAC's kiln is almost identical to the Kiln No. 6 in both process and the emission control design except its capacity will be about 28% smaller that that of the Kiln No. 6. Because of the great resemblance between the design, operation, emissions and emission control between these two kilns, EPD has determined that both kilns shall be subject to the same emission limits/BACT standards.

Conditions in this PSD permit will establish the relevant operational, work practice, monitoring, testing, record keeping, compliance demonstration and reporting requirements for the BACT, which include but not limited to, records of raw material and fuel usage and sulfur content, records of the operation of the hydrated lime injection system, and the use of the SO_2 CEMS for performance testing and continuous compliance monitoring.

4.7 Summary of Proposed BACT Technologies and Emission Limits

Table 4.7-1 summarizes the proposed BACT technologies and corresponding emission limits by EPD for the CO, NO_x, SO_2 PM/PM_{10} and VOC/THC emissions from the Kiln No. 6.

Pollutant	Operation & Control	Emission Limit	Compliance Method	Averaging Time
PM	Air Heater, Raw Mill, Preheater/Precalciner, Calciner, Kiln, and Clinker Cooler/Main Kiln Stack K218 downstream of Baghouse No. C18A;	0.153 lb PM/ton clinker	Method 5	Average of three 1-hour runs
		24.5 lb/hr	CEMS	Per EPA's requirement; may substitute the Method 9 testing
PM_{10}		0.129 lb PM10/ton clinker	Methods 201 or 201A and 202	Per Methods 201 or 201A and 202
Visible	Control: Baghouse	10% opacity	COMS	6-minute block average
PM/PM_{10}	Finish Mill	0.01 gr/dscf (0.0085 gr/dscf for PM_{10})	Method 5	Average of three 1-hour runs
Visible	Control: Baghouse	10% opacity	COMS	6-minute block average
PM/PM_{10}	All other plant point sources	0.01 gr/dscf (0.0085 gr/dscf for PM_{10})	Method 5 if possible	Average of three 1-hour runs;

Pollutant	Operation & Control	Emission Limit	Compliance Method	Averaging Time
Visible	Control: Baghouse	10% opacity	Method 9 or COMS	6-minute block average
			Daily visual observation	N/A
Fugitive	All fugitive sources excluding the quarry operations; Control: Precaution measurements and wet suppression or equivalent approach(es)	10% opacity	Method 9	6-minute block average
			Daily visual observation	N/A
Fugitive	Outdoor transfer point on belt conveyors or from other fugitive sources in the modified part of the quarry operations excluding enclosed process building and wet process Control: Precaution measurements and wet suppression or equivalent approach(es)	10% opacity	Method 9	6-minute block average
			Daily visual observation	N/A
Fugitive	Fugitive emissions from enclosed buildings and wet process in the modified part of the existing onsite quarry operations	No visible emissions	Method 9	6-minute block average
			Daily visual observation	N/A
SO_2	Air Heater, Raw Mill, Preheater/Precalciner, Calciner, Kiln, and Clinker Cooler/Main Kiln Stack K218 downstream of Baghouse No. C18A; Control: Inherent dry scrubbing, raw material management, hydrated lime injection if necessary	1.0 lb/ton clinker 160.0 lb/hr	CEMS	30-day rolling average
NO_x	Air Heater, Raw Mill, Preheater/Precalciner, Calciner, Kiln, and Clinker Cooler/Main Kiln Stack K218 downstream of Baghouse No. C18A; Control: SCC, SNCR & Low NO_x burner control	1.95 lb/ton clinker 312.0 lb/hr	CEMS	30-day rolling average
NO_x (Initial Startup)	Air Heater, Raw Mill, Preheater/Precalciner, Calciner, Kiln, and Clinker Cooler/Main Kiln Stack K218 downstream of Baghouse No. C18A; Control: SCC, SNCR & Low NO_x burner control	3.0 lb/ton clinker 480.0 lb/hr	CEMS	30-day rolling average
CO	Air Heater, Raw Mill, Preheater/Precalciner, Calciner, Kiln, and Clinker	2.9 lb/ton clinker 464.0 lb/hr	CEMS	30-day rolling average

Pollutant	Operation & Control	Emission Limit	Compliance Method	Averaging Time
	Cooler/Main Kiln Stack K218 downstream of Baghouse No. C18A; Control: Good equipment design & combustion process			
VOC	Air Heater, Raw Mill, Preheater/Precalciner, Calciner, Kiln, and Clinker Cooler/Main Kiln Stack K218 downstream of Baghouse No. C18A; Control: Good equipment design and combustion processes; calciner fly ash injection	0.50 lb/ton clinker 80.0 lb/hr.	CEMS	30-day rolling average

a. Continuous monitoring data collected during periods of startup, shutdown, and malfunction may be excluded from the compliance demonstration in accordance with applicable monitoring requirements in the permit.

b. Method 201 or 201A in conjunction with Method 202 shall be used to demonstrate compliance with the relevant PM_{10} emission limits during the performance testing. As an alternative to Method 201 or 201A, the Permittee may assume that 100% of the PM emissions from the baghouses as determined via Method 5 are PM_{10} in the emission compliance demonstration. When an actual PM emission rate based on Method 5 exceeds its corresponding PM_{10} emission limit, additional Method 201 or 201A test will be required to demonstrate compliance with the PM_{10} emission limit.

c. A PM CEMS will be used for the PM emissions from the in-line kiln/raw mill after U.S. EPA promulgates procedural requirements for the application of the PM CEMS under 40 CFR, Part 63, Subpart LLL.

d. For shakedown and optimization of the SNCR system for NO_x emission control, during an "initial startup" period the NOx emissions shall not exceed 3.0 lb/ton of clinker based on a 30-day rolling average. The "initial startup" period shall begin after initial certification of the NO_x CEMS and shall end when any of the following conditions are met:

   i. The kiln system produces 75,000 tons of clinker or more in any 30-day rolling period.

   ii. The kiln system produces 150,000 tons of clinker. Or

   iii. 365 calendar days elapse after the initial certification of the NO_x CEMS.

   After the "initial startup" period ends, the NOx emissions shall not exceed 1.95 lb/ton of clinker based on a 30-day rolling average.

e. The VOC emissions shall be measured by a THC CEMS, expressed as THC as propane and corrected to 7% oxygen on a dry basis, and converted to the same unit as the emission limit.

5.0 TESTING AND MONITORING REQUIREMENTS

Testing Requirements:

The Kiln No. 6, including the new belt conveyors and associated materials handling operations at the on-site quarry, will be subject to mainly the testing requirements under federal rules including PSD/BACT, NSPS (Subparts Y and OOO), and NESHAP MACT standard (Subparts LLL). These testing requirements are emission or source/process specific, and sometimes complementary to each other.

40 CFR Part 63, Subpart LLL: This NESHAP MACT standard for Portland cement manufacturing industry requires CEMEX to conduct initial performance tests on the PM, visible, THC/VOC, D/F and Hg emissions from the in-line kiln/raw mill and clinker cooler, using Method 5 for PM, COMS for opacity, Method 23 for D/F, Method 25A for THC/VOC, and Method 29 or ASTM D6784-02 for Hg emissions respectively. When the use of COMS is not practicable, such as in the case of multiple stacks or monovents, Method 9 shall be used instead. Because the operation of the raw mill may affect the emissions, all the tests shall be conducted while the raw mill is under normal operating conditions, i.e., "raw mill on" and while the raw mill is not operating i.e., "raw mill off". The PM and visible performance tests shall be repeated every 60 months. The D/F emission test shall be repeated every 30 months. Each of the COMS and CEMS shall be certified before testing.

For other affected sources only subject to a visible emission limit of 10% opacity under Subpart LLL, including each raw material, clinker, or finished product storage bin; conveying system transfer point; bagging system; bulk loading or unloading system; and raw material dryer, CEMEX shall conduct initial performance tests to demonstrate compliance with the opacity limit using Method 9.

During the performance tests, the Permittee shall establish operating parameters that could affect the emissions and/or are required for emission calculations. These operating parameters include, but not limited to, process weight input and output rate, fuel type and usage rate, exhaust gas flow rate, exhaust gas temperature, exhaust gas oxygen content, exhaust gas moisture content, baghouse pressure drop range, ammonia solution injection rate, fly ash injection rate, and/or CKD recycle rate, whichever is necessary.

When any source change in operation(s) that may adversely affect any of the emissions involved, CEMEX shall conduct an appropriate performance test(s) for the affected emissions from the source(s) involved, and establish new operating parameter(s) that could affect the emission(s).

40 CFR Part 60, Subpart OOO: This NSPS standard requires CEMEX to demonstrate compliance with the applicable visible emission limits (expressed as opacity) using either Method 9 or Method 22, depending on the nature of the source involved. CEMEX shall follow the applicable procedures specified in Subpart OOO to conduct the fugitive emission testing/opacity. CEMEX's on-site quarry, including the new conveyors, added roads and associated materials handling operations, has no point/stack emissions.

40 CFR Part 60, Subpart Y: This NSPS standard requires CEMEX to demonstrate compliance with the applicable PM or visible emission limit for the affected coal processing units/sources associated with the Kiln No. 6 using Method 5 or Method 9 respectively.

PSD/BACT: Results of the PM, THC/VOC and visible emission performance tests aforementioned are considered adequate to demonstrate compliance with the PSD/BACT PM and/or visible emission limits for the same sources. No additional PSD/BACT tests are required for these emissions.

Certain point sources/stacks (controlled or uncontrolled) not only have visible emission limits under Subpart LLL or Subpart Y, but also have both visible and PM emission limits under PSD/BACT rules. CEMEX shall conduct Method 5 tests on each of the sources respectively if possible to demonstrate compliance with the applicable PSD/BACT PM emission limits. Such point sources may include, but not limited to, raw material, clinker and finished product storage bins; conveying system transfer points; bagging systems; bulk loading and unloading systems; raw material dryers; coal processing and conveying equipment, coal storage systems; and coal transfer and loading systems.

The Permittee shall determine PM_{10} emissions from each of the stacks/point sources of PM emissions using Method 201 or 201A in conjunction with Method 202 when no Division-approved PM_{10} emission factor(s) is available or actual PM emissions from the Method 5 test exceed the applicable PM_{10} emission limit.

Compliance with the PM_{10} emission limits is important because the ambient impacts of the potential PM_{10} emissions from the Kiln No. 6 have been assessed via computerized atmospheric dispersion modeling.

The Permittee shall conduct initial performance tests on the CO, NO_x and SO_2 emissions from the in-line kiln/raw mill and clinker cooler using certified CO, NO_x and SO_2 CEMS respectively, and establish operating parameters that may affect the emissions, such as ammonia solution-injection rate/NH_3-NO_x moral ratio, combustion temperature profile, burner setting, fly ash injection rate, and hydrated lime injection rate, in addition to the operating parameters determined during the performance tests as required by 40 CFR Part 63, Subpart LLL. Because the operation of the raw mill will affect the test results, the performance test for SO_2 emissions shall be conducted while the raw mill is "on" and "off" respectively. Because the averaging time for the CO, NO_x and SO_2 emissions is 30-day rolling, each of the performance tests shall last for at least 30 consecutive days of normal operation/production.

When any source modifications or change in operation(s) that may adversely affect the PM/PM_{10} emissions from any such source, CEMEX shall conduct a performance test on the source using Method 5, and establish new operational parameter(s) that could affect the PM/PM_{10} emissions.

Results of the performance test requirements aforementioned are considered adequate to demonstrate compliance with the applicable SIP limits for the same emissions from the same sources. No additional SIP performance tests are required.

Monitoring Requirements:

The kiln No. 6, including the new belt conveyors and associated materials handling operations at the on-site quarry operations, will be subject to mainly the monitoring requirements under federal rules including PSD/BACT, NSPS (Subpart IIII), and NESHAP MACT standard (Subparts LLL). These monitoring requirements are either emission or source/process specific or complementary to each other.

40 CFR Part 63, Subpart LLL: This NESHAP MACT standard for Portland cement manufacturing plant requires CEMEX to continuously monitor the visible and THC/VOC emissions from the in-line kiln/raw mill and clinker cooler using COMS and THC CEMS. CEMEX will be required to use a PM CEMS for the main kiln stack once U.S. EPA promulgates the procedural requirements for the use of the PM CEMS. Such monitoring is important because THC and PM emissions are considered under Subpart LLL as surrogates of the emissions of hazardous air pollutants (HAPs) from the in-line kiln/raw mill that emits almost all the HAPs.

CEMEX shall use Method 22 to periodically monitor the visible emissions from each raw material, clinker and finished product storage bin; conveying system transfer point; bagging system; and bulk loading and unloading system; and raw material dryer. The monitoring frequency may be decreased from monthly to semiannually if no visible emissions are observed in 6 consecutive monthly monitoring, and from semiannually to annually if no visible emissions are observed during the semiannual monitoring.

If visible emissions are observed during any Method 22 test, CEMEX shall conduct a 6-minute test of opacity using Method 9 within 1 hour of any observation of visible emissions.

The requirement to conduct Method 22 visible emissions monitoring shall not apply to any totally enclosed conveying system transfer point, regardless of the location of the transfer point. If any partially enclosed or unenclosed conveying system transfer point is located in a building, CEMEX may opt to conduct a Method 22 visible emissions monitoring as mentioned above.

CEMEX shall conduct daily visual emissions observations of the mill sweep and air separator PM control device of the raw mill or finish mill using Method 22. The observation shall last 6 minutes. If visible emissions are observed, CEMEX shall initiate, within 1 hour, the corrective actions specified in the site specific operating and maintenance plan. Within 24 hours of the end of the Method 22 monitoring, in which visible emissions were observed, CEMEX shall conduct a follow up Method 22 test on each stack from which visible emissions were observed during the previous test. If visible emissions are observed during the follow-up test from any stack from which visible emissions were observed during the previous test, the Permittee shall conduct a 30-minute visual opacity test on that specific stack using Method 9.

The requirements to conduct daily Method 22 testing shall not apply to any specific raw mill or finish mill equipped with a COMS or (baghouse) bag leak detection system (BLDS).

Because the formation of D/F is affected by the temperature, Subpart LLL requires continuous monitoring of the temperature of the exhaust gases from the in-line kiln/raw mill at the inlet to, or upstream of the baghouse(s) serving the in-line kiln/raw mill, using continuous temperature monitor. The temperature record is used as surrogate to the D/F emissions.

40 CFR Part 60, Subpart IIII: To ensure compliance with the 100-hour operating time limit for maintenance check and reliable testing, this NSPS standard requires the new emergency stationary diesel generator/engine serving the Kiln No. 6 to be equipped with a non-resettable hour meter to track the number of hours of various operations.

PSD/BACT: Results of the PM, THC/VOC, visible and/or fugitive emission monitoring aforementioned are considered adequate to demonstrate compliance with the PSD/BACT PM, THC/VOC, visible and/or fugitive emission limits for the same sources. No additional PSD/BACT monitoring of the same emissions is required.

CEMEX is required under pertinent PSD/BACT rules to use the same certified CO, NO_x and SO_2 CEMS used for performance tests to monitor continuously the same emissions from the same sources.

CEMEX shall perform a daily check of visible emissions (VE) from all the sources with visible emissions and retain a daily VE checkup log suitable for inspection or submittal. The daily VE check shall be conducted at least once for each day or portion of each day of operation and shall be conducted using the following procedure:

To convert the CEMS monitoring data to the mass charge/emission rates or concentrations in the same units as the relevant emission limits, CEMEX shall continuously monitor and record the following indicated parameters:

- Exhaust/flue gas stream temperature, oxygen content, and moisture content at each location where CO, NO_x, SO_2 or THC emissions are monitored by respective CEMS.

- The stack exhaust gas flow rate of the stack(s)/exhaust vent(s) with CO, NO_x, SO_2 or THC CEMS.

- The hourly rate of dry feed entering the kiln and clinker exiting from the clinker cooler.

Each monitoring system/device shall be maintained and calibrated periodically according to manufacturer's specifications or pertinent State or Federal rules.

CEMEX shall perform the following daily operation and maintenance checks on each dust suppression device :

- Visual inspection of wet suppression/water-spray control systems to ensure that the designated nozzle water spray pattern is produced (i.e., a fine, conical mist).
- Inspection of water-spray nozzles to ensure that they are properly directed.
- Inspection of water spray nozzles to ensure that none are clogged, and there is proper and adequate water flow sufficient to wet the surface area of the materials being processed.

CAM Applicability:

Compliance Assurance Monitoring (CAM) as specified in 40 CFR 64 is only applicable to emission units that: (1) have pre-control potential emissions greater than the major source threshold; (2) located at a major source; (3) use a control device to control a pollutant to comply with an emission limit for the pollutant; and (4) are not exemptions under 40 CR Part 64 for the pollutant. Such emission units are called as Pollutant Specific Emission Units (PSEUs).

Located at a major existing source and being a major source itself, the Kiln No. 6 is subject to a CAM applicability analysis to ensure that any applicable CAM requirements be established via this permit amendment.

At the Kiln No. 6, the main kiln stack shared by the in-line raw mill, the kiln coupled with preheater/precalciner and the calciner, and the clinker cooler emits CO, NO_x, PM, SO_2 and VOC, and is the only source of CO, NO_x, SO_2 and VOC emissions. To comply with the applicable emission limits, CEMEX will use a baghouse, a SNCR, and a hydrated lime injection system to control the PM, NO_x and SO_2 emissions respectively. The post control emissions of PM, NO_x and SO_2 from this stack are lager than 100 tpy. Therefore, it is the only large PSEU for PM, NO_x and, SO_2 emissions at the Kiln No. 6.

However, the PM emissions from the main kiln stack and the coal mill/cooler stack are subject to a post 11/15/1990 NESHAP standard, i.e., 40 CFR Part 63, Subpart LLL which include monitoring requirements and have emission limitations or standards for which a 40 CFR Part 70 or 71 permit specifies a continuous compliance determination method. Therefore, the PM emissions are exempt from CAM requirements per 40 CFR 64.2(b)(1)(i).

Neither CO nor VOC emissions from the main kiln stack are subject to CAM requirements because the Kiln No. 6 does not use any designated add-on CO or VOC control devices as defined in 40 CFR 64.1 to comply with the applicable emission limits.

To comply with NO_x and SO_2 emission limits, the kiln uses a SNCR and a hydrated lime injection system. Both pollutants are not subject to any post 11/15/1990 NSPS or NESHAP standard. Therefore, the kiln is a large PSEU with post control NO_x and SO_2 emissions greater than 100 tpy. Since the kiln uses NO_x and SO_2 CEMS, it is exempt from CAM per 40 CFR 64.2(b)(1)(vi).

With pre-control PM emissions above 100 tpy and post-control PM emissions below 100 tpy, the rest of PM PSEUs at the Kiln No. 6 are not large PSEUs, and shall comply with CAM requirements established upon the Title V permit renewal, provided that the PSEUs are not subject to a post 11/15/1990 NSPS or NESHAP by that time.

6.0 AMBIENT AIR QUALITY REVIEW

An air quality analysis is required to determine the ambient impacts associated with the construction and operation of the proposed CEMEX's Kiln No. 6. The main purpose of the air quality analysis is to demonstrate that emissions emitted from the proposed cement plant, in conjunction with other applicable emissions from any existing sources (including secondary emissions from growth associated with the new project), will not cause or contribute to a violation of any applicable National Ambient Air Quality Standard (NAAQS) or PSD increment in a Class I or Class II area. NAAQS exist for NO_2, CO, $PM_{2.5}$,, PM_{10}, SO_2, Ozone (O_3), and lead. PSD increments exist for SO_2, NO_2, and PM_{10}.

PM_{10} has been used as a surrogate for $PM_{2.5}$ in air quality analysis, following the current EPA guidance until $PM_{2.5}$ NSR implementation rules are adopted and incorporated into the Georgia Rules for Air Quality Control. Therefore, in this analysis compliance with $PM_{2.5}$ has been assessed through compliance with PM_{10} standard.

The proposed source triggers PSD review for CO, PM_{10}, NO_x, VOC and SO_2. An air quality analysis was conducted to demonstrate the source's compliance with the NAAQS and PSD Increment standards for these pollutants. An additional analysis was conducted to demonstrate compliance with the Georgia's air toxics program. This section discusses the air quality analysis requirements, methodologies, and results. Supporting documentation may be found in the Dispersion Modeling Report of the application and in the additional information packages.

6.1 Modeling Requirements

The air quality modeling analysis was conducted in accordance with Appendix W of Title 40 of the Code of Federal Regulations (CFR) §51, *Guideline on Air Quality Models*, and Georgia EPD's *Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions (Revised).*

The proposed project will cause net emission increases of CO, PM_{10}, NO_x, and SO_2 that are greater than the applicable PSD Significant Emission Rates. Therefore, air dispersion modeling analyses are required to demonstrate compliance with the NAAQS and PSD Increment. VOC does not have established PSD modeling significance impact levels (SIL) (an ambient concentration expressed in either $\mu g/m^3$ or ppm). Modeling is not required for VOC emissions; however, the project will likely have no impact on ozone attainment in the area based on data from the monitored levels of ozone in City of Macon, Bibb County and the on level of emissions increases that will result from the proposed project.

The modeling input data and information were obtained as follows:

- Meteorological Data: Surface data from meteorological station 03813 in Macon, Georgia and upper air data from station 13861 in Waycross, Georgia used in all the evaluations that required the use of AERMOD model. These data correspond to the 5-year period from 1987-1991.

- Source Data: Location and emission rates of the proposed kiln stacks and other sources within the property were provided by the consultants, Koogler and Associates Inc. Emission rates are based on daily throughput rates, equipment specifications, and AP-42 emission factors.

- Terrain Elevation: Topography was found to be generally flat in the site vicinity, with no terrain elevations above the height of the main stack (106.7 meters of stack height + 85 meters of the base elevation) within 20 km of the surrounding area. Elevations of all sources and receptors were extracted from the terrain files processed by AERMAP. This information was verified by plotting such AERMAP-processed terrain files and comparing elevations with USGS 7.5 minutes topographic maps.

- Building Downwash: GEP, building downwash analysis files were provided by the consulting company and were based on scale plot plans included in the application. Results were verified using this information and the BPIPPRM program (version 04274).

- Class I Areas: One Class I area exists within a 200 km range from CEMEX. This is Okefenokee National Wildlife Refuge, located 196 km southeast from the cement plant.

Class II Significance Impact Analysis

Initially, a Significance Analysis was conducted to determine if the CO, PM_{10}, NO_x, VOC and SO_2 emissions increases at CEMEX would significantly impact the area surrounding the facility. Maximum ground-level concentrations were compared to the pollutant-specific U.S. EPA-established Significant Impact Level (SIL). The SIL for the pollutants of concern are summarized in Table 6-1.

If a significant impact (i.e., an ambient impact above the SIL) does not occur, no further modeling analyses would be conducted for that pollutant for NAAQS or PSD Increment. If a significant impact does occur, further refined modeling would be completed to demonstrate that the proposed project would not cause or contribute to a violation of the NAAQS or consume more than the available Class II Increment.

Under current U.S. EPA policies, the maximum impacts due to the emissions increases from a project are also assessed against monitoring *de minimis* levels to determine whether pre-construction monitoring should be considered. These monitoring *de minimis* levels are also listed in Table 6-1. If either the predicted modeled impact from an emission increase or the existing ambient concentration is less than the monitoring *de minimis* concentration, the permitting agency has the discretionary authority to exempt an applicant from pre-construction ambient monitoring. This evaluation is required for CO, PM_{10}, NO_x, and SO_2.

If any off-site pollutant impacts calculated in the Significance Analysis exceed the SIL, a Significant Impact Area (SIA) would be determined. The SIA encompasses a circle centered on the new cement plant with a radius extending out to (1) the farthest location where the emissions increase of a pollutant from the project causes a significant ambient impact, or (2) a distance of 50 km, whichever is less. All sources within a distance of 50 km of the edge of a SIA are assumed to potentially contribute to ground-level concentrations within the SIA and would be evaluated for possible inclusion in the NAAQS and PSD Increment analyses.

Table 6-1: Summary of Significant Impact Levels

Pollutant	Averaging Period	PSD Significant Impact Level (ug/m^3)	PSD Monitoring De Minimis Concentration (ug/m^3)
$PM_{2.5}$	Annual	Not Final	Not Final
	24-hour	Not Final	Not Final
PM_{10}	Annual	1	--
	24-Hour	5	10
SO_2	Annual	1	--
	24-Hour	5	13
	3-Hour	25	--
NO_2	Annual	1	14
CO	8-Hour	500	575
	1-Hour	2000	--

NAAQS Analysis

The primary NAAQS are the maximum concentration ceilings, measured in terms of total concentration of pollutant in the atmosphere, which define the "levels of air quality which the U.S. EPA judges are necessary, with an adequate margin of safety, to protect the public health." Secondary NAAQS define the levels that "protect the public welfare from any known or anticipated adverse effects of a pollutant." The

primary and secondary NAAQS, listed in Table 6-2 below, are equivalent for NO_2, PM_{10}, and SO_2; no secondary NAAQS have been developed for CO.

Table 6-2: Summary of National Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS	
		Primary/Secondary (ug/m^3)	Primary/Secondary (ppm)
$PM_{2.5}$	Annual	15/15	--
	24-Hour	35/35	--
PM_{10}	Annual	50/50	--
	24-Hour	150/150	--
SO_2	Annual	80/None	0.03/None
	24-Hour	365/None	0.14/None
	3-Hour	None/1300	None/0.5
NO_2	Annual	100/100	0.053/0.053
CO	8-Hour	10,000/None	9/None
	1-Hour	40,000/None	35/None

If the maximum pollutant impact calculated in the Significance Analysis exceeds the SIL at an off-property receptor, a refined NAAQS and PSD Increment analysis is required. The NAAQS analysis would include the potential emissions from all emission units at CEMEX, except for units that are generally exempt from permitting requirements and are normally operated only in emergency situations. The emissions modeled for this analysis would reflect the results of the BACT analysis for the modified emission unit. Facility emissions would then be combined with the allowable emissions of sources included in the regional source inventory. The resulting impacts, added to appropriate background concentrations, would be assessed against the applicable NAAQS to demonstrate compliance. For an annual average NAAQS analysis of any of theses pollutants, the highest modeled concentration among five consecutive years of meteorological data would be assessed, while the highest sixth-high impact would be assessed for the 24-hour PM_{10} concentration, and the highest second-high impact for the rest of the short-term averaging periods of the rest of the pollutants.

PSD Increment Analysis

The PSD Increments were established to "prevent deterioration" of air quality in certain areas of the country where air quality was better than the NAAQS. To achieve this goal, U.S. EPA established PSD Increments for certain pollutants. The sum of the PSD Increment concentration and a baseline concentration defines a "reduced" ambient standard, either lower than or equal to the NAAQS that must be met in an attainment area. Significant deterioration is said to have occurred if the change in emissions occurring since the baseline date results in an off-property impact greater than the PSD Increment (i.e., the increased emissions "consume" more that the available PSD Increment).

U.S. EPA has established PSD Increments for NO_X, SO_2, and PM_{10}; no increments have been established for CO. The PSD Increments are further broken into Class I, II, and III Increments. CEMEX's Kiln No. 6 is located in a Class II area. The PSD Increments for Class I and II areas are listed in Table 6-3.

Table 6-3: Summary of PSD Increments

Pollutant	Averaging Period	PSD Increment	
		Class I (ug/m^3)	Class II (ug/m^3)
$PM_{2.5}$	Annual	Not Final	Not Final
	24-Hour	Not Final	Not Final
PM_{10}	Annual	4	17
	24-Hour	8	30
SO_2	Annual	2	20
	24-Hour	5	91
	3-Hour	25	512
NO_2	Annual	2.5	25

To demonstrate compliance with the Class II PSD Increments, the increment-affecting emissions (i.e., all emissions increases or decreases after the appropriate baseline date) from the cement plant and those sources in the regional inventory would be modeled to demonstrate compliance with the PSD Class II increment for any pollutant greater than the SIL in the Significance Analysis. For an annual average analysis, the highest incremental impact will be used. For a short-term average analysis, the highest second-high impact will be used.

The determination of whether an emissions change at a given source consumes or expands increment is based on the source classification (major or minor) and the time the change occurs in relation to baseline dates. The major source baseline date for NO_x is February 8, 1988, and the major source baseline for SO_2 and PM_{10} is January 5, 1976. Emission changes at major sources that occur after the major source baseline dates affect Increment. In contrast, emission changes at minor sources only affect Increment after the minor source baseline date, which is set at the time when the first PSD application is completed in a given area, usually arranged on a county-by-county basis. The minor source baseline dates in Houston County have been set for PM_{10} and SO_2 as August 21, 1985, and for NO_2 as July 13, 1993.

6.2 Modeling Methodology

Screening and refined dispersion modeling was used for this modeling analysis. Details on the dispersion model, including meteorological data, source data, and receptors can be found in *EPD's PSD Dispersion Modeling and Air Toxics Assessment Review in Appendix C of this Preliminary Determination* and/or in the permit application.

6.3 Class II Area Significant Impact Modeling Results

A Class II area significant impact analysis was conducted using AERMOD model (version 07026) for NO_x, PM_{10}, SO_2, and CO, which are the criteria pollutants emitted in significant amounts from the permitted facility. AERMOD runs were undertaken using a square receptor grid 14x14 kilometer, centered on the proposed kiln, and with spacing between receptors as follows: every hundred meters from the facility's fence line up to 5 kilometers, every five hundred meters from the end of the fine grid up to 5 kilometers, and every one kilometer from the end of the intermediate grid up to 4 kilometers.

Table 6-4 shows that the proposed project will not cause ambient impacts of CO above the appropriate SILs. Because the emissions increases from the proposed project result in ambient impacts less than the SILs, no further PSD analyses were conducted for CO.

However, ambient impacts above the SILs were predicted for NO_2, PM_{10}, and SO_2 for all the relevant averaging periods, requiring NAAQS and Increment analyses be performed for these pollutants.

Table 6-4: Class II Significance Analysis Results – Comparison to SILs

Pollutant	Averaging Period	Modeling Met Data Period (yymmddhh)	UTM East (km)	UTM North (km)	Maximum Impact* (ug/m^3)	Significant Impact Distance (km)	SIL (ug/m^3)	Significant?
NO_2	Annual	1991	252051	3589970	2.11	1.5	1	Yes
PM_{10}	24-hour	89011024	252088	3588897	18.26	5	5	Yes
	Annual	1989	252194	3588753	3.32	1.4	1	Yes
SO_2	3-hour	87022612	252051	3589056	120.73	3.5	25	Yes
	24-hour	91055524	252051	3589056	45.20	2.9	5	Yes
	Annual	1991	252051	3588970	2.89	1.4	1	Yes
CO	1-hour	89102511	252051	3589056	203.21	N/A	2000	No
	8-hour	99041806	252051	3589056	133.1	N/A	500	No

* Highest values; Data for worst year provided only.

Significant Impact Area

For any off-site pollutant impact calculated in the Significance Analysis that exceeds the SIL, a Significant Impact Area (SIA) must be determined. The SIA encompasses a circle centered on the facility being modeled with a radius extending out to the lesser of either: 1) the farthest location where the emissions increase of a pollutant from the proposed project causes a significant ambient impact, or 2) a distance of 50 kilometers. All sources of the pollutants in question within the SIA plus an additional 50 kilometers are assumed to potentially contribute to ground-level concentrations and must be evaluated for possible inclusion in the NAAQS and Increment Analysis.

Based on the results of the Significance Analysis, the distance between the Kiln No. 6 and the furthest receptor from the facility that showed modeled pollutant concentrations exceeding the corresponding SILs were determined, as shown in Table 6-4.

NAAQS and Increment Affecting Sources Regional Inventory

The next step in completing the NAAQS and Increment analyses was the development of a regional source inventory. Nearby sources that have the potential to contribute significantly within the facility's SIA are ideally included in this regional inventory. CEMEX prepared an inventory of NAAQS and PSD Increment sources as below:

Three offsite source inventories were conducted to include all sources affecting PSD increment for the following pollutants and areas:

- For PM_{10} within a range of 55 kilometers.
- For SO_2 within a range of 53.5 kilometers.
- For NO_2 within a range of 51.5 kilometers.

In all cases, the selected range (extended SIA) includes a circular area with a radius of 50 km plus of the corresponding SIA. The minor source PSD baseline date for all the counties located within the extended SIAs was taken into consideration to determine if a source had to be included in the inventory. In addition, the 20D methodology was applied to screen out those facilities that were not significant enough to be included in the modeling analysis, and as a result, only the following number of off-site sources was included per emissions inventory that was modeled:

- For PM_{10}, six sources were included.
- For SO_2, ten sources were included.
- For NO_2, eight sources were included.

In applying the 20D Rule, facilities in close proximity to each other (within approximately 2 kilometers of each other) were clustered and considered as one source. The regional source inventory used in the analysis is included in the permit application.

Similar to the PSD increment analysis, NAAQS modeling was conducted for all sources located within the range of the extended SIA for each pollutant. Small sources were excluded using the 20-D rule and as a result, the following number of offsite sources was included per emissions inventory that was modeled:
-

- For PM_{10}, six sources were included.
- For SO_2, ten sources were included.
- For NO_2, eight sources were included.

Increment Analysis

In the PSD increment analysis, impacts within the facility's SIA due to the potential NO_2, PM_{10}, and SO_2 emissions from all sources at the facility and those PSD increment consuming sources included in the regional inventory were calculated.

Modeling was conducted using AERMOD (version 07026) with a Cartesian circle-shaped grid of receptors spaced 100 meters from each other, and with a radius equal to the corresponding Significant Impact Area for each pollutant. Receptors were placed all along the area, including the adjacent Houston American Cement Cement's (HAC) site.

Results of the modeling exercise showed that for SO_2 and NO_2, predicted concentrations are below the allowable increment and therefore in compliance. However, for PM_{10} modeling results yielded exceeding values for both annual and 24 hour averaging periods. A summary is shown in Table 6-5.

Table 6-5: Class II Area PSD Increment Assessment. First Set of AERMOD Runs

Pollutant	Averaging Period	Allowable Increment ($\mu g/m^3$)	Maximum Increment Consumed* ($\mu g/m^3$)	Receptor UTM Zone 17		Model Met Data Period
				X(m)	Y(m)	(yymmddhh)
PM_{10}	Annual	17	110.58	253751	3589770	1987
	24-Hour	30	567.4	253751	3589770	89020224
SO_2	Annual	20	3.54	252051	3588970	1991
	24-hour	91	41.37	252051	3589056	91123124
	3-hour	512	114.28	252051	3589056	91123124
NO_2	Annual	25	2.79	252.51	3588970	1991

* Highest concentration for annual averaging periods, and highest second high concentration for 24-hour and 3-hour averaging periods.

Nevertheless, these exceeding events for PM_{10} occurred in receptors located only inside HAC's property, which leads to a reasonable doubt of those high values being caused by HAC's emissions inside its own property (not ambient air from HAC's point of view), and not by the contribution of CEMEX.

To determine if those exceedances occurred because of HAC's or because of CEMEX's proposed operations, a second set of AERMOD runs was undertaken by turning off HAC's sources and modeling only the receptors of concern with the full meteorological data record. The results of this second set of model runs are shown in Table 6-6.

Table 6-6: Class II Area PSD Increment Assessment - Second Set of AERMOD Runs

Pollutant	Averaging Period	Allowable Increment ($\mu g/m^3$)	Maximum Increments Consumed* ($\mu g/m^3$)	Receptor UTM Zone 17		Model Met Data Period
				X(m)	Y(m)	(yymmddhh)
PM10	Annual	17	3.74	253751	3589770	1991
	24-Hour	30	20.82	253751	3589770	89121124

* Highest concentration for annual averaging period, and highest second high for the 24-hour period.

Since these values are below the allowable increments, it can be concluded that CEMEX does not contribute to PSD increment violation events, and that they are caused by the emissions of HAC inside its own property.

<u>Class II NAAQS Analysis</u>

Modeling was conducted using the AERMOD model (version 07026) with the same receptor grids used for each pollutant in the PSD Increment analysis. Results showed that for SO_2 and NO_2 predicted concentrations are below the corresponding NAAQS and therefore in compliance, but for PM_{10}, modeling yielded exceeding values for both annual and 24 hour averaging periods. A summary is shown in Table 6-7.

Table 6-7: Class II Area NAAQS Assessment - First Set Of AERMOD Runs

Pollutant	Averaging Period	Predicted Concentration* ($\mu g/m^3$)	Total Impact** ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)	Receptor Location UTM Zone 17		Model Met Data Period (yymmddhh)
					X (m)	Y (m)	
PM_{10}	Annual	110.58	130.58	50	253751	3589770	1987
	24-Hour	514.24	552.24	150	253751	3589770	87090824
SO_2	Annual	3.57	10.67	80	252051	3588970	1991
	24 Hour	41.68	73.08	365	252051	3589056	91123124
	3 Hour	114.28	200.68	1300	252051	3589056	91123124
NO_2	Annual	2.8	16.8	100	252051	3588970	1991

* Highest concentration for annual averaging periods of all pollutants. Highest second high concentration for 24-hour and 3-hour averaging periods for SO_2. Highest sixth high concentration for 24 hour averaging period for PM_{10}.

** Total impact is the sum of the predicted concentration plus the background concentration.

As in the PSD Increment analysis, exceeding values in NAAQS analysis occurred only in receptors located inside HAC's property. Therefore, the same procedure previously described was used to determine to which extent CEMEX contributes to such high values. Thus, the modeling was redone for PM_{10} with HAC's sources turned off, and results are summarized in Table 6-8 showing that predicted concentrations are all below the corresponding NAAQS. For the short-term averaging periods, the impacts are the highest sixth-high impacts. For the annual averaging period, the impacts are the highest impact. When the total impact at all significant receptors within the SIA are below the corresponding NAAQS, compliance is demonstrated.

Table 6-8: Class II NAAQS Analysis Results

Pollutant	Averaging Period	Year	UTM East (km)	UTM North (km)	Maximum Impact (ug/m^3)	Background (ug/m^3)	Total Impact (ug/m^3)	NAAQS (ug/m^3)	Exceed NAAQS?
PM_{10}	24-hour	01/2/1990	252500	3589700	38.12	38	76.12	150	No
	Annual	1989	252500	3589700	15.91	20	35.91	50	No

Data for worst year provided only.

As indicated in Table 6-8 above, total modeled PM_{10} impacts at all significant receptors within the SIA are below the corresponding NAAQS.

6.4 Class I Area Impact Analysis

Federal Class I areas are regions of special national or regional value from a natural, scenic, recreational, or historic perspective. Class I areas are afforded the highest degree of protection among the types of areas classified under the PSD regulations. U.S. EPA has established policies and procedures that generally restrict consideration of impacts of a PSD source on Class I Increments to facilities that are located near a federal Class I area. Historically, a distance of 100 km has been used to define "near", but more recently, a distance of 200 kilometers has been used for all facilities that do not combust coal.

One Class I area is located within approximately 200 kilometers of the proposed cement plant, i.e., Okefenokee National Wildlife Refuge located approximately 196 kilometers southeast of the facility. The U.S. Fish and Wildlife Service (FWS) is the designated Federal Land Manager (FLM) responsible for oversight of this Class I area.

FLM requested CEMEX to assess impacts on Class I areas using the CALPUFF modeling system. This assessment, as presented by the consulting company, is formed by three components: Class I significance analysis, visibility analysis, and deposition analysis.

CALPUFF version 5.8 was used, with five years of meteorological data: SAMSOM surface data from 5 stations (Macon, Atlanta, Savannah, Tallahassee, and Jacksonville), and SCRAM upper air data from two

stations (Waycross and Athens). These data was used instead of the CALMET three-year data set created by VISTAS, arguing that the latter files were not yet available at the time that the modeling exercise was undertaken.

The FLMs involved are the Fish and Wildlife Service (FWS), and the Forrest Service (FS). They are the primary reviewing agencies in Class I matters and were therefore contacted to request their opinion on whether this type of meteorological data, not deemed appropriate by GA EPD, could be accepted in this particular case. As response, FS deferred the review of this project to the FWS, and the latter provided no comments or guidance on how they wished to proceed.

In light of this situation, it was decided to conduct only a significant impact analysis to determine if potential emissions from CEMEX would cause an impact that exceeds EPA's Significant Impact Levels (SIL) on the aforementioned Class I area. GA EPD did not assess AQRV's given that such responsibility corresponds to the FLM.

The significance analysis was undertaken using AERMOD model (version 07026) as a screening tool, modeling emissions of PM_{10}, NO_x, and SO_2 from the proposed plant with receptors located at 50 km downwind in direction to Okefenokee, forming an arch of approximately 46 km, which is the width of the extension of Okefenokee at this distance with respect to its azimuth with CEMEX. Such receptor grid was 1 km - spaced between adjacent points, and results with maximum predicted concentrations are shown in Table 6-9. As indicated in table, the significance levels are not exceeded for any of the pollutants.

Table 6-9: Class I Significance Analysis Results – Comparison to SILs

Pollutant	Averaging Period	Model Met Data Period (yymmddhh)	UTM East (km)	UTM North (km)	Maximum Projected Impact (ug/m^3)	SIL (ug/m^3)	Significant?
NO_2	Annual	1987	290307.69	3555649.00	0.01862	0.1	No
PM_{10}	24-hour	89041024	247646.53	3540121.75	0.04129	0.3	No
	Annual	1987	290307.69	3555649.00	0.0035	0.2	No
SO_2	3-hour	89031903	280678.53	3547625.50	0.4110	1.0	No
	24-hour	89041024	247646.53	3540121.75	0.01489	0.2	No
	Annual	1987	290307.69	3555649.00	0.0127	0.1	No

Results show that all maximum predicted concentrations are below the corresponding SIL, requiring no further analysis. It should be noted that the new kiln is proposing to operate with maximum emission rates of 2.0 lb/ton clinker, 1.95 lb/ton clinker, and 0.153 lb/ton clinker for SO_2, NO_x and PM_{10} respectively. However, EPD has established for this new kiln a BACT SO_2 emission limit of 1.0 lb/ton clinker, which is the emission rate that was used in the Class I analysis. If the 2.0 lb/ton clinker were to be used, then the predicted concentrations would exceed the SILs and a refined analysis using CALPUFF would be required.

Another important remark is that for the Class II analyses, the SO_2 emission rate of 2.0 lb/ton clinker was used. Compliance with NAAQS and Class II increment standards using this emission rates would assure compliance with the more stringent limits that were set afterwards.

Preconstruction Monitoring Evaluation

All pollutants in Table 6-10 were evaluated to determine if the facility should be required to conduct preconstruction monitoring. As shown in the table, concentrations of CO and NO_2 are below their respective de minimis level, which exempts those contaminants from preconstruction monitoring requirements.

Table 6-10: Modeled Maximum Pollutant Impacts/Concentration vs. Monitoring De Minims Levels

Pollutant	Averaging Period	Model Met Data Period (yymmddhh)	UTM East (km)	UTM North (km)	Monitoring De Minims Level (ug/m^3)	Modeled Maximum Impact (ug/m^3)	Significant?
NO_2	Annual	1991	252051	3589056	14	2.11	No
PM_{10}	24-hour	89011024	252088	3588897	10	18.26	Yes
SO_2	24-hour	91052224	252051	3589056	13	45.21	Yes
CO	8-hour	99041806	252051	3589056	575	133.1	No

* Data for worst year provided only

For PM_{10} and SO_2, modeled concentrations are greater than the de minimis levels and therefore preconstruction monitoring was required. In lieu of such monitoring effort, existing ambient air data from representative regional monitoring stations have been provided as part of the application.

In the case of ozone, since no significant air quality concentration has been established, PSD permit applicants with net emissions increase of 100 tons per year or more of VOC are required to perform an ambient impact analysis that includes pre-application monitoring data to determine the current state of the ambient air conditions for this pollutant. CEMEX's Kiln No. 6's VOC emissions are 350 tons per year and therefore it falls under this category of applicants.

For all these three pollutants, ambient air monitoring data were obtained from the following stations:

- Station 130210012 located in Macon, Bibb Co., GA, approximately 27 miles northeast of CEMEX.

- Station 130210007 located in Macon, Bibb Co., GA, approximately 25 miles northeast of CEMEX.

GA DNR-EPD operates both stations and therefore they comply with EPA's requirements of quality assurance and data relevance.

Reviews of the monitored data in the above-mentioned stations show average values of 76 μg/m^3 for 24 hour PM_{10}, and 26.8 μg/m3 for annual PM_{10}, both over the 2002-2005 period. For SO_2 the monitored second high concentrations are 0.022 ppm for the 3-hour period, and 0.009 ppm for the 24 hour period. The annual average was 0.00195 ppm, all values over the 2006-2007 period. Finally, for ozone, the monitored data over the last three-year period (2005 – 2007) show a design value (3-year average of fourth high annual values) of 79 ppb. All these results leave a significant margin from their corresponding standard (NAAQS).

Concerning the site being representative of the area, although the distance of the monitoring station from the proposed facility is 30 miles, it should be considered that ozone is a secondary pollutant, thus not emitted from the facility's stacks, but formed in the atmosphere by chemical reactions during transport of emissions of NO_x and VOC at some distance from the source. Therefore, CEMEX's contribution to Ozone concentrations would have to be estimated from measurements not in the surrounding area of the facility, but at some distance from there.

On the other hand, CMAQ modeling conducted by GA EPD showed that sensitivity for ozone at this monitor (Bibb County) was of 0.4 ppt/TPD of VOC. Considering that CEMEX is located in the adjacent Houston County, the impact of its VOC emissions on the ozone concentration in the surrounding areas can be considered negligible and not likely to cause and excess in the 8 hour standard.

7.0 ADDITIONAL IMPACT ANALYSES

PSD requires an analysis of impairment to visibility, soils, and vegetation that will occur as a result of a modification to the facility and an analysis of the air quality impact projected for the area as a result of the general commercial, residential, and other growth associated with the proposed project.

Soils and Vegetation

The effect of a proposed project's emissions on local soils and vegetation is often addressed through comparison of modeled impacts to the secondary NAAQS. The secondary NAAQS were established to protect general public welfare and the environment. Impacts below the secondary NAAQS are assumed to indicate a lack of adverse impacts on soils and vegetation. As discussed in Part 6.0 of this determination, the modeled ambient impacts associated with the proposed project are below the NAAQS. Therefore, no negative impacts on soils and vegetation are anticipated to result from the implementation of the proposed project.

Growth

The purpose of a growth analysis is to predict how much new growth is likely to occur as a result of the project and the resulting air quality impacts from this growth. No adverse impacts on growth are anticipated from the project since any workforce growth and residential and commercial growth that would be associated with the proposed project (expected to be minimal) would not cause a quantifiable impact on the air quality of the area surrounding the facility.

Visibility

Regarding the Class II visibility analysis, no sensitive receptors were found within the SIA of any of the pollutants under evaluation, therefore no further analysis was required.

Georgia Toxic Air Pollutant Modeling Analysis

Georgia EPD regulates the emissions of toxic air pollutant (TAP) through a program covered by the provisions of *Georgia Rules for Air Quality Control*, 391-3-1-.02(2)(a)3.(ii). A TAP is defined as any substance that may have an adverse effect on public health, excluding any specific substance that is covered by a State or Federal ambient air quality standard. Procedures governing the Georgia EPD's review of TAP emissions as part of air permit reviews are contained in the agency's "*Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions (Revised)*."

Selection of Toxic Air Pollutants for Modeling

For projects with quantifiable increases in TAP emissions, an air dispersion modeling analysis is generally performed to demonstrate that off-property impacts are less than the established Acceptable Ambient Concentration (AAC) values. The TAP evaluated is restricted to those that may increase due to the proposed project. Thus, the TAP analysis would generally be an assessment of off-property impacts due to facility-wide emissions of any TAP emitted by a facility. To conduct a facility-wide TAP impact evaluation for any pollutant that could conceivably be emitted by the facility is impractical. A literature review would suggest that at least one molecule of hundreds of organic and inorganic chemical compounds could be emitted from the various combustion units. This is understandable given the nature of the fuels (natural gas, coal, oils, wood wastes, spent tires, pet cokes, etc.) fed to the combustion sources, and the fact that there are complex chemical reactions and combustion of fuel taking place in the kiln. The vast majority of compounds potentially emitted however are emitted in only trace amounts that are not reasonably quantifiable.

A cement kiln using a fabric filter control system was the only emission source considered for the following toxics air pollutants: Ag, As, Ba, Be, Cd, Cr, HCl, Cu, Hg, Ammonia, Pb, Se, Tl, Benzene,

Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Formaldehyde, Phenanthrene, Pyrene, and Naphthalene.

The kiln is assumed to operate 24 hour per day at an hourly production rate of 160 tons per hour of clinker. Emissions were calculated for each pollutant using AP-42 emission factors with the exception of Hg and HCl, for which different emission factors were used, based on plant design and source testing.

Determination of Toxic Air Pollutant Impact

The Georgia EPD *Guideline* recommends a tiered approach to model TAP impacts, beginning with screening analyses using SCREEN3, followed by refined modeling, if necessary, with ISCST3 or ISCLT3. For the refined modeling completed, the infrastructure setup for the SIA analyses was relied upon with appropriate sources added for the TAP modeling. Note that per the Georgia EPD's *Guideline*, downwash was not considered in the TAP assessment.

Initial Screening Analysis Technique

Generally, an initial screening analysis is performed in which the total TAP emission rate is modeled from the stack with the lowest effective release height to obtain the maximum ground level concentration (MGLC). Note the MGLC could occur within the facility boundary for this evaluation method. The individual MGLC is obtained and compared to the smallest AAC. Due to the likelihood that this screening would result in the need for further analysis for most TAP, the analyses were initiated with the secondary screening technique.

Modeling was conducted using a generic emission rate of 1 g/sec for which a hypothetical predicted concentration was found. The Modeled Ground Level Concentration (MGLC) for each pollutant was then calculated multiplying the hypothetical predicted concentration by the ratio of the emission rates. SCREEN3 V96043 dispersion model was used for such analysis.

MGLCs calculated by SCREEN3 are 1-hour concentrations and therefore results were converted to annual, 24 hour, and 15 minutes averages in order to compare them to the corresponding acceptable ambient concentration (AAC) which were obtained from the following sources:

- EPA's Integrated Risk Information System (IRIS) as an inhalation reference concentration (RfC) or calculated as a risk based ambient concentration (RBAC).
- OSHA's Permissible Exposure Limits as timed weighted averages (TWA) or Ceiling limit.
- American Conference of Governmental and Industrial Hygienists (ACGIH) as short-term exposure limits (STEL).
- National Institute for Occupational Safety and Health (NIOSH) as STEL values.

Comparison of MGLCs with their respective AACs show that the former are always below the latter and therefore in compliance with EPD's Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions. Table 7-1 summarizes the results.

Table 7-1: Projected Impacts – Air Toxics

POLLUTANT	CHRONIC (LONG TERM)			ACUTE (SHORT TERM) Averaging period of 15 minutes	
	Averaging Period	MGLC ($\mu g/m^3$)	AAC ($\mu g/m^3$)	MGLC ($\mu g/m^3$)	AAC ($\mu g/m^3$)
Ag	24 hour	5.70E-06	2.37E-2	NA	NA
As	Annual	2.24E-05	2.4E-4	3.70E-04	2.0E-1
Ba	24 hour	4.30E-03	1.19	NA	NA
Be	Annual	1.23E-06	4.0E-4	2.03E-05	5.0E-2

POLLUTANT	CHRONIC (LONG TERM)			ACUTE (SHORT TERM) Averaging period of 15 minutes	
	Averaging Period	**MGLC ($\mu g/m^3$)**	**AAC ($\mu g/m^3$)**	**MGLC ($\mu g/m^3$)**	**AAC ($\mu g/m^3$)**
Cd	Annual	4.11E-06	6.0E-4	6.78E-05	30
Cr	24 hour	1.31E-03	2.37	NA	NA
HCl	Annual	2.61E-01	20	4.31E+00	298
Cu	24 hour	4.95E-02	2.37	NA	NA
Hg	Annual	4.48E-05	3.0E-1	7.40E-04	10
Ammonia	Annual	1.87E-02	100	3.08E-01	2400
Pb	24 hour	7.00E-04	0.04	NA	NA
Se	24 hour	1.87E-03	4.75E-1	NA	NA
Tl	24 hour	5.04E-05	2.37E-1	NA	NA
Benzene	Annual	2.99E-02	1.3E-1	4.93E-01	320
Benzo(a)pyrene	24 hour	1.21E-06	4.75E-1	NA	NA
Benzo(b)fluoranthene	24 hour	5.23E-06	4.75E-1	NA	NA
Benzo(g,h,i)perylene	24 hour	7.28E-07	4.75E-1	NA	NA
Benzo(k)fluoranthene	24 hour	1.40E-06	4.75E-1	NA	NA
Chrysene	24 hour	1.49E-06	4.75E-1	NA	NA
Formaldehyde	Annual	4.30E-03	8.0E-2	1.42E-02	37
Phenanthrene	24 hour	3.64E-03	4.75E-1	NA	NA
Pyrene	24 hour	4.11E-05	4.75E-1	NA	NA
Naphthalene	Annual	3.17E-03	3.0	5.24E-02	7500

8.0 EXPLANATION OF DRAFT PERMIT CONDITIONS

The permit requirements for this proposed modification/source are included in draft Georgia Air Quality Permit Amendment No. 3241-153-0003-V-04-2.

Section 1.0: Facility Description

This new source is a dry process Portland cement manufacturing line (Kiln No. 6) capable of producing 1,405,104 short tons of clinker and 1,927,200 short tons of cement per year. The Kiln No. 6 consists mainly of raw materials handling and storage, kiln feed preparation with a raw mill, a dry process rotary kiln coupled with a preheater/precalciner and a calciner, a clinker cooler, a coal/coke mill, a finish mill, and cement storage, packaging and shipping operations. The raw materials such as limestone, clay, fly ash and other additives are mixed according to specification, grinded and dried in the raw mill. The powdery material produced by the raw mill, referred to as dry/kiln feed, is then conveyed into the preheater/precalciner, calciner, and kiln in turn for pyroprocessing into cement clinker nodules. The clinker nodules are cooled in the clinker cooler and then mixed and grinded with limestone, gypsum and/or other additives as necessary in the finish mill to formulate Portland cement. The kiln system has a capacity of 270 short tons per hour of dry feed input to the preheater/precalciner, and 160 short tons per hour of clinker output from the kiln. The finish mill can produce 220 short tons per hour of Portland cement. Cement produced is stored or packaged as necessary, and distributed by both truck and rail.

Raw materials for the kiln system include limestone, clay, iron ore/mill scale (or other iron sources) and bauxite/fly ash (or other alumina sources), gypsum, either quarried on-site (limestone and clay) or brought in by both truck and freight train.

Fuel authorized for the kiln include natural gas, coal, petroleum coke, fuel oils, landfill gas, and other non-hazardous liquid and solid fuels such as "on-specification" used oil fuels, waste tires, plastic, filter fluff and wood wastes. A coal mill grinds up to 185,310 short tons of coal/petroleum coke annually for firing the kiln. Emissions of regulated air pollutants from combustion of each fuel are evaluated via performance tests before the fuel authorization.

The Kiln No. 6 uses NH_3 solution-injection based SNCR in combination with SCC and low NO_x burners to minimize NO_x emissions from the in-line kiln/raw mill. Fabric filters/baghouses are employed to capture PM emitted from exhaust stacks serving various process units in the Kiln No. 6. Wet suppression/water spray and other precautions are utilized as necessary to reduce fugitive emissions from the new belt conveyors, added roads, and other materials handling equipment installed in the existing on-site quarry as part of the Kiln No. 6 project. A hydrated lime injection system is used as necessary to comply with SO_2 emission limits. The in-line kiln/raw mill system is also designed and operated to minimize emissions of CO and VOC via controlled combustion, and SO_2 via raw material management and hydrated lime injection.

Section 3.0: Requirements for Emission Units

The ambient impacts of the criteria pollutants emitted from the Kiln No. 6 were assessed using atmospheric dispersion models and determined to be acceptable under pertinent NSR/PSD rules. Condition 3.2.8 ensures these impacts remain acceptable to the EPD. In addition, this condition also ensures the impacts of the gaseous toxic air pollutants to be acceptable under pertinent SIP rules by establishing the stack exit conditions used during the impact assessment.

To establish the emission levels upon which ambient impact of the source is modeled, Condition 3.2.9 contains annual/rolling 12-month CO, PM/PM_{10}, NO_x, SO_2, and VOC emission limits/caps for all the affected emission units constructed and modified as part of the Kiln No. 6 project, as identified also by the condition. All the emission limits are PSD/BACT limits and have acceptable ambient impacts. Each of the limits is the product of the relevant BACT limit (lb. of pollutant/ton of clinker) in Condition 3.3.6

and the annual production limit for clinker (tpy) in Condition 3.2.10. In addition, these limits allow the establishment of pertinent record keeping requirements for proper emission tracking, compliance demonstration, and fee calculation.

Because most of the PSD/BACT emission standards in this permit are based on the quantity of clinker produced, Condition 3.2.10 limits the hourly and annul clinker production rates to establish the potential capacity of the cement plant during this initial PSD permitting. Any production rate increases above these limits will be subject to an EPD review.

The ambient impacts of the criteria and toxic gaseous air pollutants emitted from this cement plant have been assessed using atmospheric dispersion models and determined to be acceptable under pertinent NSR/PSD and SIP rules. Condition 3.2.11 ensures these impacts to remain acceptable to the Division by fixing the stack exiting conditions because this stack accounts for all the emissions of the criteria and toxic gaseous air pollutants and approximately half of the PM/PM_{10} emissions from the Kiln No. 6.

Emissions from the kiln system are affected by the various fuel combustion processes occurring at different locations of the kiln system. Condition 3.2.12 contains detailed firing requirements that are designed to minimize emissions from the kiln. These requirements intend to maintain the kiln combustion conditions the same as those utilized during the performance testing and thus the levels and/or characteristics of the emissions. The condition limits the use of used oil as fuel to "on-specification" used oil fuel that is not regulated as hazardous waste and shall meet the content limits as specified. The annual usage limit for the "on-specification" used oil fuels ensures the emissions of heavy metals and toxic compounds involved to stay below the applicable significant levels under pertinent NSR and/or NESHAP rules. CEMEX shall conduct performance testing on any new fuels whose impacts on air pollutant emissions have not been determined as acceptable.

Condition 3.2.13 incorporates operating and process and control equipment requirements for compliance with the BACT emission limits in this permit amendment. These requirements are considered as part of the BACT for the emission control devices involved. The requirements also include O&M and work practice plans to ensure proper function of the process and control equipment involved and the normal operation.

Condition 3.2.14 requires the continuous monitoring of the pressure drops across the large baghouses with air flow rate greater than 10,000 acfm. This requirement ensures the pressure drops to be maintained at the levels or inside the ranges established during the most recent Division-approved performance testing, or CEMEX shall report any deviation as an excursion. This requirement ensure the maintenance of the capture efficiencies of the baghouses at or greater than the testing levels.

Condition 3.2.15 ensures the proper function and quick repair of the pollution systems. To reduce emissions and thus to comply with pertinent emission limits, Conditions 3.2.16 through 3.2.21 establish the pollution control and prevention requirements for the on-site quarry and associated activities. Recent permits issued by the EPD to similar sources contain same requirements.

To establish plant-wide PM_{10} emission levels for PSD ambient impact modeling, Condition 3.2.22 limits PM_{10} emission limits for the existing PM emission units currently having no written PM_{10} emission limits. The Permittee is required to demonstrate compliance with certain limits via performance testing.

The annual/rolling 12-month Hg emission limit in Condition 3.2.23 allows the track/record keeping of mercury emissions and mercury contents in the raw materials, and keeps the mercury emissions in check. Consequently, it provides additional assurance for the Kiln No. 6 to comply with the MACT mercury emission limit specified in 40 CFR Part 63, Subpart LLL.

Conditions 3.2.25 through 3.2.33 incorporate mainly the applicable operating requirements and limitations under 40 CFR Part 63, Subpart LLL, i.e., the NESHAP MACT standard for Portland cement

industry. As a new affected facility/source, the Kiln No. 6 shall comply with all the applicable emission standards and other requirements under Subpart LLL on and after initial startup, as specified in Condition 3.2.26. Condition 3.2.27 identifies affected operations/process units subject to Subpart LLL. Condition 3.2.28 prohibits the use of hazardous wastes as kiln fuels and thus allows the kiln to avoid being subject to 40 CFR Part 63, Subpart EEE, i.e., the NESHAP MACT standards for hazardous waste combustors. Because high temperature would increase D/F emissions, Condition 3.2.29 limits the temperature at the main kiln stack to ensure compliance with the D/F emission limit. Condition 3.2.30 ensures the compliance with the Hg emission limits by prohibiting the use as a raw material or fuel of Hg-rich fly ash generated by activated carbon Hg control systems employed by boilers.

Without an alkali bypass, the Kiln No. 6 kiln will not be subject to certain NSR/PSD and NESHAP requirements and/or standards. Condition 3.2.34 requires permit amendment to add conditions containing the applicable requirements and/or standards when CEMEX decides to add the alkali bypass to the kiln.

Conditions 3.2.35, 3.2.36 and 3.2.37 incorporate applicable operating requirements and limitations for the new emergency stationary diesel engine/generator serving the Kiln No. 6 under 40 CFR Part 60, Subpart IIII, i.e., the NSPS standard for stationary compression ignition internal combustion engines. Required by the rule, CEMEX shall purchase the engine certified for compliance with all the applicable emission standards.

Conditions 3.2.38 and 3.2.39 contain applicable operating and notification requirements for the new emergency stationary diesel engine/generator under 40 CFR Part 63, Subpart ZZZZ, i.e., the NESHAP MACT standard for stationary reciprocating internal combustion engines.

Condition 3.3.6 establishes the equipment/source and/or emission-specific BACT emission standards, and corresponding compliance methods and data average time if applicable. Please note that the main kiln stack (stack ID No. K218) accounts for all the CO, NO_x, SO_2, and VOC and approximately half of the PM/PM_{10} emissions from the entire Kiln No. 6 project, and consequently is required to be equipped with CEMS for CO, NO_x, SO_2, and VOC (as THC) emissions and COMS for visible emissions. The CEMS and COMS greatly enhance the emission monitoring and compliance by continuously providing relatively accurate real time emission data. The constant emission data feedback also allows timely optimization or adjustment of the operation of the kiln system to minimize the emissions involved.

Because it takes time to shakedown and optimize the complicated operation of the kiln system and the SNCR, Condition 3.3.6 allows a relative high NO_x emission limit during the initial startup period as defined in the condition, a provision contained in the PSD permits issued recently to similar cement plants by the State of Florida. All the limits for criteria pollutants emitted from the main kiln stack are based on pounds of the pollutant per ton of clinker, the most common unit for the standards involved among permits issued to cement plants. PM/PM_{10} emission from other point sources/stacks have identical emission limits in the unit of grain loading/concentration, which is also the most common among permits issued to cement plants or similar sources. Other applicable SIP emission standards for PM, SO_2, visible and fugitive emissions are subsumed by more stringent BACT limits in the condition.

Conditions 3.3.7 and 3.3.8 specify respectively the affected sources at the Kiln No. 6 and the applicable emission limit under 40 CFR Part 60, Subpart Y, i.e., the NSPS standard for coal preparation plants. Except the 20% opacity visible limit, the coal mill stack is also subject to the more stringent PM/PM_{10} and visible emissions limits under BACT. Because a small portion of exhaust gas stream from the clinker cooler is routed the coal mill for drying the coal or petrol coke, this unit is also subject to the NESHAP MACT standard for Portland cement plants, i.e., 40 CFR Part 63, Subpart LLL.

Conditions 3.3.9 through 3.3.11 incorporate applicable emission limits under 40 CFR Part 63, Subpart LLL, i.e., the NESHAP MACT standards for Portland cement plants. Because the kiln and the clinker share a single stack, i.e., the main kiln stack, this stack assumes the more stringent PM and visible emissions for the clinker cooler. The coal mill's stack No. K241 is subject to the same PM and visible emission limits as applicable to the main kiln stack because a portion of exhaust gas stream from the clinker cooler is routed to the coal mill to dry coal and pet coke. The coal mill stack only has PM/PM_{10} and no D/F, Hg or VOC emissions and thus is not subject to the emissions limits for D/F, Hg or VOC emissions under Subpart LLL.

Condition 3.3.12 establishes the applicable emission limits for Kiln No. 6's process units/operations that are subject to the 40 CFR Part 60, Subpart OOO, i.e., the NSPS standard for nonmetallic mineral processing plants. This is one of the standard conditions in the EPD's condition vault.

Conditions 3.3.13 and 3.3.14 incorporate the applicable emission and fuel standards for the new emergency stationary diesel engine/generator under 40 CFR Part 60, Subpart IIII, the NSPS standard for stationary compression ignition internal engines. The manufacturer of the engine is required to certify with EPA that the engine is in compliance with applicable emission limits before selling the engine. Please note that the diesel to be used by the engine is subject to sulfur and cetane index or aromatic content standards that become more and more stringent with later compliance date.

Section 4.0: Requirements for Testing

Condition 4.1.3 in the current Title V operating permit No. 3241-153-0003-V-04-0 has been updated to list all the applicable methods for performance testing and monitoring of the emissions from the Kiln No. 6 and the existing cement plant.

Conditions 4.2.7 through 4.2.19 incorporate the applicable testing requirements and/or procedures under 40 CFR Part 63, Subpart LLL. The initial performance tests for PM, D/F and VOC/THC and visible emissions shall be conducted separately while the raw mill is in normal operation and shutdown because the operating status of the raw mill may affect such emissions. Certified and calibrated CEMS and COMS shall be used in the testing wherever equipped with. Method 5 testing and visible emission testing with COMS shall be conducted simultaneously on the main kiln stack and the finish mill stack, as required in Condition 4.2.3. Method 9 shall be used for other affected sources. Conditions 4.2.11, 4.2.12 and 4.2.13 require separate performance testing for the D/F, VOC/THC and Hg emissions on the main kiln stack, the only source for such emissions. Conditions 4.2.14 and 4.2.15 require for follow up testing on the PM and visible emission (every 5 years) and Hg emission (every 30 months) respectively. Conditions 4.2.16 through 4.2.18 establishes the retesting requirements for the similar emission from similar source whenever a source modification may adversely affect compliance with the applicable emission limit(s). CEMEX shall notify the Division of the retesting of the D/F emissions 60 days in advance and complete the retesting within 360 hours after the planned modification period begins. Condition 4.2.19 exempts CEMEX from the applicable PM and visible emission standards or operating requirements when conducting PM CEMS correlation tests to prepare for the use of the PM CEMS.

Condition 4.2.20 requires CEMEX to use Method 9 to conduct initial performance testing on the visible emissions from the sources subject to 40 CFR Part 60, Subpart Y.

Conditions 4.2.21 through 4.2.24 incorporate applicable testing requirements for the visible and fugitive emissions from the sources subject to 40 CFR Part 60, Subpart OOO. Condition 4.2.22 allows shortened testing when the emissions meet certain conditions. Condition 4.2.23 allows an alternative testing procedure when the fugitive emissions from two or more sources continuously interfere with each other.

Conditions 4.2.25 through 4.2.28 establish the initial performance testing requirements for sources and/or emissions subject to PSD/BACT or SIP emission standards. No such testing is required when a testing pursuant to Subpart LLL has already been conducted for the same emissions from the same source under

the same operating conditions. Testing using Method 201 or 201A in conjunction with Method 202 may be required when the PM emission rate(s) from Method 5 exceed the PM_{10} emission limit from the same source(s). Condition 4.2.26 requires initial performance testing on CO, NO_x and SO_2 emissions from the main kiln stack K218, the only stack discharging such emission. Affected by the operating status of the raw mill, the SO_2 emissions shall be tested when the raw mill is in normal operation and when it is shutdown respectively. CEMEX shall record all operating parameters and other production information and/or data affecting the emissions and/or required in the determination of emissions involved in the same units as the relevant PSD/BACT emission limits.

Firing of new fuels may have adverse effects on the emissions from the kiln system. Condition 4.2.27 requires performance testing for firing any new fuel before the fuel use authorization. A permit amendment may be required to establish new or revised operating and, if necessary, emission requirements for the use of the new fuel(s). A Part 70 permit amendment issued recently to a similar cement plant by the Division contains similar testing requirements for the use of new fuels.

Condition 4.2.28 requires the Permittee to conduct performance tests on certain existing sources obtaining written PM_{10} emission limits via this permit amendment to facilitate ambient impact analysis. The condition contains an option to simplify the testing.

Section 5.0: Requirements for Monitoring

Conditions 5.2.14 through 5.2.22 incorporate applicable monitoring requirements under NESHAP MACT Standard 40 CFR Part 63, Subpart LLL. The monthly and daily visible emission tests/observations required by Condition 5.2.14d.i and Condition 5.2.16 may substitute the daily VE check in Condition 5.2.25 for that day. Condition 5.2.17 requires continuous monitoring of the exhaust gas temperature at the main kiln stack as the surrogate of the D/F emissions. The hourly average THC emission date generated by the THC CEMS will be used to demonstrate compliance with the THC/VOC limit in Condition 3.3.9, and as basis to calculate the THC/VOC emissions to demonstrate compliance with other BACT THC/VOC emission limits in this permit amandment.

Condition 5.2.23 incorporates the applicable monitoring requirement under NSPS 40 CFR Part 60, Subpart IIII for the use of a non-resettable hour meter installed on the new emergency stationary diesel generator/engine to track the operating time of the generator. CEMEX shall record the time of operation of the generator/engine and the nature of the operation during that time.

As a recently promulgated NESHAP MACT standard, 40 CFR Part 63, Subpart LLL contains proper monitoring requirements. Therefore, Condition 5.2.24 assumes some appropriate monitoring requirements for PM, THC, and visible emissions under the Subpart LLL as PSD/BACT monitoring requirements for the same emissions to reduce redundant monitoring work.

Conditions 5.2.25 and 5.2.26 establish daily visible emission (VE) check requirements for point/stack sources with visible emissions and for sources with fugitive emissions. Representing a BACT requirement, Condition 5.2.25 is more stringent that the similar VE daily check condition in SIP standard condition vault.

Condition 5.2.27 establishes PSD/BACT monitoring requirements for CO, NO_x, SO_2 and THC/VOC emissions from the main kiln stack, the only source for these emissions at the Kin No. 6. The operating, instrumental and data processing requirements are extracted from pertinent SIP and/or Federal rules or procedures, and by no means to substitute the original rules or procedures. Please refer to the original documents for details.

Condition 5.2.28 establishes monitoring requirements for a number of operating parameters and mass inputs for certain process and pollution control systems that are either needed in the emission calculations

for demonstration of compliance with applicable emission limits, or necessary to maintain compliance with the emission limits.

Condition 5.2.29 incorporates the applicable maintenance requirements for the CEMS used. These requirement are extracted from pertinent SIP and Federal rules or procedures, and by no means substitute the original rules or procedures. Please refer to the original documents for details.

Condition 5.2.30 establishes the monitoring requirements for the dust/fugitive emission wet suppression systems, as contained in permits issued to similar sources.

Condition 5.2.31 establishes the monitoring and route inspection and maintenance requirements for baghouses not required to have continuous monitoring system for pressure drop across the baghouse. These are relatively small baghouses with air flow rates less than 10,000 acfm.

Section 6.0: Other Recordkeeping and Reporting Requirements

Condition 6.1.8 incorporates the applicable reporting requirements for excess emissions, exceedances, excursions or additional information to be included in the PSD/BACT quarterly reports required by Condition 6.1.4 in the current Tile V operating permit No. 3241-153-0003-V-04-0. The reporting levels of the emissions specified in Condition 6.1.8d serve as an "early warning" system to facilitate emission compliance.

Conditions 6.2.10 through 6.2.16 incorporate the applicable record keeping, notification, compliance demonstration and reporting requirements for affected cement manufacturing processes/units under 40 CFR Part 63, Subpart LLL. If necessary and/or appropriate, these requirements could be considered also as PSD/BACT requirements for the same sources and/or emissions, unless there is specific PSD/BACT requirement(s).

Conditions 6.2.17 and 6.2.18 incorporate respectively the record keeping, compliance demonstration, reporting and notification requirements under 40 CFR Part 60, Subpart OOO for the affected units at the existing on-site quarry. The source startup notification establishes the time frames for requirements such as compliance, testing, record keeping, and/or reporting.

Conditions 6.2.19 and 6.2.24 incorporate respectively the record keeping, compliance demonstration, reporting and notification requirements for the new emergency stationary diesel generator/engine under 40 CFR Part 60, Subpart IIII. The source startup notification establishes the time frames for requirements such as compliance, testing, record keeping, and/or reporting.

Conditions 6.2.25 through 6.2.28 establish respectively the record keeping, emission calculation/ compliance demonstration, reporting and notification requirements for the cement manufacturing processes/units subject to the PSD/BACT emission limits under pertinent NSR/PSD or SIP rules. The reporting levels of the emissions specified in Condition 6.2.26 serve as an "early warning" system to facilitate emission compliance.

Please note that the control efficiency of a well designed, maintained and operated baghouse is largely insensitive to the physical characteristics of the gas and dust and to the inlet dust loading. Therefore, the actual PM/PM_{10} emissions obtained by multiplying the emission factors (lbs./ton of clinker) from performance testing with the actual tonnage of clinker produced during averaging period may be less or more conservative when the clinker production rate is below or above that used during the performance testing, assuming a steady exhaust flow rate. Nevertheless, this is the most common approach for emission estimation, as seen in many chapters of EPA AP-42, including that for cement manufacturing industry. Another approach is to assume that during normal operation of the process units and control systems involved, the PM/PM_{10} emission concentrations (gr/dscf) in the exhaust gas stream are relatively constant and equal to that during the performance testing under the similar operating conditions.

Therefore, the actual PM and PM_{10} emission rates in lbs/ton of clinker could be estimated by dividing respectively the total emissions of PM and PM_{10} with the total clinker produced during the same averaging period. This approach is more in line with the characteristic of the baghouses. For the purpose of compliance demonstration, the more conservative between the two approaches should be considered first. Once deployed, the PM CEMS should generate the most accurate PM emission data among all via continuous real time analysis of the PM emissions.

For emissions of CO, NO_x, SO_2, and VOC/THC as monitored continuously by the respective CEMS, the actual emission rates for these pollutants shall be calculated respectively by using the actual concentration of each pollutant in the exhaust gas, the corresponding exhaust gas flow rate and the clinker production rate during the averaging period interested.

Condition 6.2.29 requires CEMEX to keep records of water truck usage for any of the fugitive emission sources constructed as part of the Kiln No. 6 project. Similar conditions are contained in permits issued to similar sources by EPD.

The fuel records required by Condition 6.2.30 ensure the compliance with the fuel use limit for the air heater specified in Condition 3.2.12.

The emission and fuel usage data and combustion system inspection information required by Condition 6.2.31 facilitate the Division to examine mainly the emissions periodically or track the emissions on a route basis. Similar requirements are included in the permit issued to an existing similar cement plant by the Division.

The facility startup notification requirement in Condition 6.2.32 establishes the time frames for PSD/BACT requirements such as compliance, testing, record keeping, and/or reporting.

APPENDIX A

Draft Construction Permit
CEMEX Southeast, LLC
Clinchfield (Houston County), Georgia

APPENDIX B

CEMEX Southeast, LLC PSD Permit Application and Supporting Data

Contents Include:

PSD Permit Application No. 17550, dated July 16, 2007 and revised on June 19, 2008

APPENDIX C

EPD'S PSD Dispersion Modeling and Air Toxics Assessment Review