Illinois Environmental Protection Agency
Bureau of Air, Permit Section
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Project Summary for a Construction Permit Application from Universal Cement, LLC. for a Portland Cement Manufacturing Plant in Chicago, Illinois

Site Identification No.:	031600GVX
Application No.:	08120011
Date Received:	December 10, 2008

Schedule

Public Comment Period Begins:	September 4, 2011
Public Hearing Date:	October 19, 2011
Public Comment Period Closes:	November 18, 2011

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PROJECT SUMMARY

I. INTRODUCTION

Universal Cement, LLC. has proposed to construct a Portland cement manufacturing plant east of Lake Calumet in Chicago. The plant would have the capacity to produce about a million tons of cement per year. Universal Cement proposes to construct a plant that would include an in-line raw mill; a kiln system; a finish mill; enclosed material handling and storage; enclosed fuel storage and handling; raw material and fuel receiving hoppers; roadways; and other ancillary operations.

The Illinois EPA has reviewed Universal Cement’s application and made a preliminary determination that the application for the proposed project meets applicable requirements. Universal Cement will utilize the best available control technology, as applicable, to reduce emissions from the plant. Moreover, the air quality modeling demonstrates that the projected maximum operation will not cause violations of the National Ambient Air Quality Standards (NAAQS) or applicable Prevention of Significant Deterioration (PSD) increment standards.

The Illinois EPA has prepared a draft of the construction permit that it would propose to issue for the proposed plant. The permit is intended to identify the applicable rules governing emissions from the plant and to set limitations on those emissions. The permit is also intended to establish appropriate compliance procedures for the plant, including requirements for emissions testing, continuous emissions monitoring, recordkeeping and reporting. Prior to issuing the permit, the Illinois EPA is holding a public comment period that includes a public hearing to receive comments on the terms and conditions of the draft permit.

II. PROJECT DESCRIPTION

The project includes a preheater/precalciner kiln system capable of producing about 1 million tons per year of clinker, an intermediate product used in the production of cement. The clinker production train consists of an in-line raw mill, a blending silo, kiln system (preheat tower, precalciner, rotary kiln), clinker cooler and a solid fuel mill. Other equipment in the project includes clinker storage silos, a finish mill, and the associated raw material, solid fuel and finished product handling equipment.

The kiln is the heart of the Portland cement process since the chemical reactions necessary to produce Portland cement take place there. The kiln is a slightly inclined, slowly rotating steel cylindrical tube that is lined with refractory materials. Raw materials are introduced at the high end and the rotation of the kiln causes the materials to be slowly transported down the other end. Fuel is burned at the lower or discharge end of the kiln. The hot combustion gases move counter-current to the material flow, thereby subjecting the material in the kiln to increasingly higher temperatures.

The kiln is a 5-stage preheater/precalciner design with an in-line raw mill. In the preheater, raw kiln feed is introduced into a series of cyclones. In the cyclones, the material flows counter-current with the kiln exhaust, thus recovering heat from the exhaust gases to preheat the raw feed. The kiln system will also have a vertical precalciner vessel where a portion of the fuel feed to the system is fired and the raw materials are partially calcined, converting limestone to lime prior to entering the rotary kiln. This preheater/precalciner design results in a fuel efficient process, and the preheater/precalciner design produces less emissions than any other existing cement plant design, per ton of cement clinker produced. The kiln will have a dedicated fuel mill, blending bin, and clinker cooler.

The principal fuel for the kiln will be a blend of coal and petroleum coke. Natural gas (or propane) will be used to fire the kiln during startup operations. However, the kiln will also have the capability of firing scrap whole tires[1] as fuel.

The product of the rotary kiln is commonly referred to as clinker. Heat from the hot clinker leaving the kiln is recovered in cooling devices and a portion of the heat is returned to the kiln system preheating combustion air. The cooled clinker is mixed with a form of calcium sulfate, usually gypsum, and ground in a finish mill to produce Portland cement, which is then stored, pending bulk loadout.

The kiln will utilize staged combustion technology and selective noncatalytic reduction (SNCR) system to minimize emissions of nitrogen oxides (NO_x). If whole tires are combusted in the kiln, their effect may be to further reduce NO_x emissions. In addition, a circulating fluidized bed absorber will be installed for control of sulfur dioxide (SO_2), acid gases and mercury emissions. Emissions of particulate matter will be controlled by a baghouse. Carbon monoxide (CO) emissions will be controlled by means of good combustion practices.

The clinker cooler, mills, and storage bins will all be equipped with fabric filters (baghouses) to control particulate matter emissions. Clinker and cement conveying equipment transfer points will also be equipped with baghouses.

Raw material and solid fuel handling conveyors will have weather covers, and transfer points will be enclosed to prevent wind-blown particulate matter emissions. Water sprays will be used on raw material and fuel receiving hoppers to maintain raw material and solid

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[1] A discussion regarding the beneficial use of tires as fuel can be found at the USEPA website - http://www.epa.gov/osw/conserve/materials/tires/faq-tdf.htm, and for a discussion of the role of tires in reducing emissions, see http://www.epa.gov/osw/conserve/materials/tires/pubs/tdf-report08.pdf

fuel moisture contents and to suppress fugitive dust, as needed. Sweeping and watering will be used to control fugitive dust from paved roadways.

III. PROJECT EMISSIONS

The potential emissions of the proposed plant are listed in Attachment 1. Potential emissions are calculated based on continuous operation at the maximum design throughput for the kiln. Actual emissions will be less to the extent that the plant does not operate at its maximum capacity, does not operate at all hours of the year, and operates within a reasonable margin of compliance. The air quality effects resulting from these emissions are described in Section VII below.

IV. APPLICABLE EMISSION STANDARDS

The application shows that the proposed project will comply with applicable federal and state emission standards, including applicable federal emission standards adopted by the United States EPA (40 CFR Parts 60 and 63) and the emission standards of the State of Illinois (35 Ill. Adm. Code: Subtitle B, Subchapter c.

The kiln, clinker cooler and all other associated equipment would be subject to the federal New Source Performance Standards (NSPS) for Portland Cement Plants, 40 CFR 60, Subpart F. This NSPS sets emission limits for SO_2, NO_x, particulate matter and opacity from the kiln. In addition, the NSPS for Coal Preparation Plants, 40 CFR 60, Subpart Y, will apply to those coal processing operations conducted at the source, setting particulate and opacity limits for coal processing, conveying, storage, and transfer operations. Emergency diesel-fired engines will be subject to 40 CFR 60, Subpart IIII for Stationary Compression Ignition Internal Combustion Engines, which requires engine manufacturers to meet emission limits for diesel-fired emergency generators used at the plant. The facility will be subject to Subpart IIII compliance requirements specific to owners and operators of subject equipment. The Illinois EPA administers the NSPS in Illinois on behalf of the United States EPA under a delegation agreement.

Pursuant to 35 IAC 217, Subpart H, the kiln will be subject to the NO_x emission limits for Illinois’ revised Reasonably Available Control Technology (RACT) rule for cement kilns.

V. NEW SOURCE REVIEW

a. Nonattainment New Source Review

This project is in an area classified as nonattainment for ozone such that NO_x and VOM emissions are regulated as ozone precursors.

This project is subject to rules governing Major Stationary Sources Construction and Modification (MSSCAM), i.e., 35 IAC Part 203, for NO_x, as its emissions are greater than 100 tons/year. Emissions of VOM will be less than 100 tons/year so that MSSCAM will not apply for VOM.[2]

The Greater Chicago Area is also classified as nonattainment for $PM_{2.5}$. However, emissions of $PM_{2.5}$ will not exceed the major source threshold of 100 tons per year, so that MSSCAM will not be applicable for emissions of $PM_{2.5}$. However, SO_2 emissions will exceed 100 tons per year and will be subject to MSSCAM because it is a precursor for $PM_{2.5}$.

For a major project MSSCAM requires: 1) "emission limits" for a "nonattainment area pollutant" that represents the Lowest Achievable Emission Rate (LAER), 2) compensating emission reductions from other sources, commonly called offsets, 3) an analysis of alternatives to the project, and 4) information confirming that other existing major sources owned by the applicant within Illinois are in compliance with applicable air pollution regulations or on a program to come into compliance. A discussion of these requirements for NO_x and SO_2 emissions follows.

i. Lowest Achievable Emission Rate (LAER)

Universal Cement submitted a control technology demonstration in its application reflecting its determination as to the emission control technology and associated emission limits that should be considered LAER, as required under MSSCAM, for NO_x and SO_2 emissions for all subject emission units at the proposed plant.

LAER is the more stringent rate of emissions based on either the most stringent emission standard, which is contained in the implementation plan of any state for the class of unit (unless it is demonstrated that such limitation is not achievable), or the most stringent emission limitation which is achieved in practice or is achievable for the class of unit.

The proposed determination of LAER for the plant's emissions of NO_x and SO_2 is discussed in detail in Attachment 3.

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[2] Even though the proposed plant would not be subject to MSSCAM for VOM, the plant's emissions of VOM, mainly from the kiln, will have to be carefully controlled or managed to keep VOM emissions below 100 tons/year. This will be facilitated as the proposed kiln will be subject to a NESHAP standard for Total Hydrocarbons (THC) or Organic Hazardous Air Pollutants and continuous emissions monitoring will be required for THC. These NESHAP requirements will effectively require that the VOM emissions of the kiln be controlled with Maximum Achievable Control Technology (MACT).

ii. Emission Offsets

The emissions of a major project in a nonattainment area must not interfere with the state plan to achieve attainment of the national ambient air quality standards. This plan consists of new programs and regulations designed to achieve the national standards and are based on a detailed analysis of current and projected emission and air quality levels. In order to account for the emissions increase from a major project proposed in a nonattainment area, the applicant must provide compensating emission reductions from other sources that have not been relied on in the attainment plan. These emission reductions are commonly referred to as “emission offsets”.

For SO_2, emission offsets must be obtained for the permitted SO_2 emissions of the plant, with one ton offsets must be provided from a source within the nonattainment area. Based on the plant’s permitted SO_2 emissions of 231.1 tons per year, as reflected in the draft permit, an offset of 231.1 tons of SO_2 per year would need to be secured prior to construction.

For NO_x, because the Chicago area is a moderate ozone nonattainment area, emission offsets must be provided at a ratio of 1.15:1.0. That is, for each ton of permitted NO_x emissions, 1.15 tons of offsets must be provided from a source within the nonattainment area. Based on the plant’s permitted NO_x emissions of 873 tons per year, as reflected in the draft permit, an offset of 1004 tons of NO_x per year must be secured prior to construction of the plant.

iii. Analysis of Alternatives

An applicant seeking to construct a major source subject to Major Stationary Sources Construction and Modification (MSSCAM) must analyze alternatives to the proposed source. Universal Cement has prepared the required analysis. The Illinois EPA has considered this analysis, concluding that the analysis reasonably demonstrates that potential benefits of the proposed plant should outweigh potential impacts from the proposed plant. See Attachment 4 for a further discussion of this analysis required by MSSCAM.

iv. Existing Source Compliance

Universal Cement currently does not operate any existing major source in Illinois. Thus, this requirement is met.

b. i. Prevention of Significant Deterioration (PSD)

The proposed plant is a major new source subject to the federal rules for Prevention of Significant Deterioration of Air Quality (PSD), 40 CFR 52.21. The proposed plant is major for emissions of NO_x, SO_2, CO and PM/PM_{10}, with potential annual emissions of more than 100 tons for each of the pollutants. The proposed plant is also major for emissions of greenhouse gases (GHG), with potential annual emissions of more than 100,000 tons per year, as carbon dioxide equivalents (CO_2e). Under PSD, once a proposed source is major for any PSD pollutant, all PSD pollutants whose potential emissions are above the specified significant emission rates in 40 CFR 52.21(b)(23) are also subject to PSD review. Because emissions of sulfuric acid mist, lead, and hydrogen sulfide/total reduced sulfur will be below their respective significance thresholds of 7.0, 0.6, and 10 tons per year, PSD will not apply for these pollutants.

ii. Best Available Control Technology (BACT)

Under the PSD rules, a source or project that is subject to PSD must use BACT to control emissions of pollutants subject to PSD. Universal Cement has provided a BACT demonstration in its application addressing emissions of pollutants that are subject to PSD, i.e., NO_x, SO_2, CO, PM/PM_{10} and greenhouse gases (GHG).

BACT is defined by Section 169(3) of the federal Clean Air Act as:

> An emission limitation based on the maximum degree of reduction of each pollutant subject to regulation under this Act emitted from or which results from any major emitting facility, which the permitting authority, on a case-by-case basis, taking into account energy, environmental and other costs, determines is achievable for such facility through application of production processes and available methods, systems and techniques, including fuel cleaning, clean fuels, or treatment or innovative fuel combustion techniques for control of each such pollutant.

BACT is generally set by a “Top Down Process”. In this process, the most effective control option that is available and technically feasible is assumed to constitute BACT for a particular unit, unless the energy, environmental and economic impacts associated with that control option are found to be excessive. An important resource for BACT determinations is USEPA’s RACT/BACT/LAER Clearinghouse (Clearinghouse), a national compendium of control technology determinations maintained by USEPA. Other documents that are consulted include general information in the technical literature and information on other similar or related projects that are proposed or have been recently permitted.

For the proposed project, another very important resource for the BACT determinations was USEPA recent rulemakings revising the NESHAP and NSPS regulations for Portland cement manufacturing plants. The revisions to these regulations, which address emissions of particulate matter, NO_X and SO_2, as well as certain other pollutants, were adopted by USEPA in September 2010.

A demonstration of BACT for units at the source subject to PSD was provided in the permit application and the proposed determinations of BACT by the Illinois EPA are discussed in Attachment 2. The draft permit includes proposed BACT limits for emissions of NO_x, SO_2, CO, PM/PM_{10} and greenhouse gases. These proposed limits, as well as the proposed LAER limits, have generally been determined based on the following:

- Emission data provided by the applicant;
- The demonstrated ability of similar equipment to meet the proposed emission limits or control requirements;
- Compliance periods associated with limits that are consistent with those used by USEPA in recent revisions to NSPS and NESHAP regulations for new emission units at Portland cement plants;
- Emission limits that account for normal operational variability based on the equipment and control equipment design, when properly operated and maintained;[3] and

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[3] In the terminology used by USEPA when it recently revised the NESHAP and NSPS regulations for Portland cement plants, BACT and LAER limits must be Upper Prediction Limits (UPL). Similar to standards that reflect Maximum Achievable Control Technology (MACT), as set by the USEPA in NESHAP rules, and standards that reflect that Best Demonstrated Technology (BDT), as set by USEPA in NSPS, BACT and LAER limits must be set at levels that account for the normal variation in emissions from emission units when the units and associated control measures are properly operated and maintained.

For example, as explained by USEPA when addressing kilns in its rulemaking for the revised NESHAP, “We have chosen the 99th confidence UPL as a reasonable upper limit because only one percent of future tests of the MACT pool of lowest emitting kilns will exceed the limit if they are performing as well as the emission test data indicate (i.e., these kilns will achieve the limit 99 percent of the time in the future). If we did not account for variability in this manner and set the limit based solely on the average performance, then these kilns could exceed the limit half the time or more.” USEPA, *Development of the MACT Floors for the Final NESHAP for Portland Cement*, August 6, 2010.

- Review of emission limits and control efficiencies required of other Portland cement plants as reflected in USEPA's *RACT/BACT/LAER Clearinghouse*.

VI. ADDITIONAL REGULATORY REQUIREMENTS FOR THE PLANT

a. Maximum Achievable Control Technology (MACT)

Potential annual emissions of hazardous air pollutants (HAPs) from the plant are less than 25 tons in aggregate and less than 10 tons for any single HAP. Accordingly, the plant will be an area source for purposes of the NESHAP, 40 CFR 63 Subpart LLL. Thus, a case-by-case determination of Maximum Achievable Control Technology (MACT) is not required for the proposed plant, pursuant to Section 112(g) of the Clean Air Act.

b. Emissions Reduction Market System (ERMS)

The plant's seasonal emissions of VOM are projected to be greater than 10 tons, so that it will be subject to the ERMS. As a result of seasonal emissions exceeding 10 tons, Universal Cement would be required to obtain and retire allotment trading units (ATU) in an amount equivalent to its VOM emissions each season to comply with the ERMS. Pursuant to 35 IAC 205.210, Universal Cement is required to obtain these ATUs prior to the season after its VOM emissions first exceed 10 tons in an ozone season.

c. Clean Air Act Permit Program (CAAPP)

This plant would be considered a major source under Illinois' Clean Air Act Permit Program (CAAPP) pursuant to Title V of the Clean Air Act, because it is a major source for purposes of New Source Review. Universal Cement will need to apply for a CAAPP permit within 12 months of commencing operation.

VII. AIR QUALITY IMPACT ANALYSIS

a. Introduction

The previous discussions addressed emissions and emission standards. Emissions are the quantity of pollutants emitted by a

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Accordingly, using the measured particulate matter emission from the best performing existing cement kiln, which was the basis for the revised NESHAP limit for new kilns, which averaged 0.0069 lb/ton clinker, ranging from 0.0025 to 0.1036 in individual test runs, USEPA adopted an emission standard for new kilns of 0.01 lb/ton clinker. The adopted standard is four times higher than the lowest emission rate from the kiln measured in any of the 12 test runs for the kiln. The adopted standard is 45 percent higher than the average of the results of all the test runs.

source, as they are released to the atmosphere from various emission units. Standards are set limiting the amount of these emissions as a means to address the presence of contaminants in the air. The quality of air that people breathe is known as ambient air quality. Ambient air quality considers the emissions from a particular source after they have dispersed following release from a stack or other emission point, in combination with pollutants emitted from other nearby sources and background pollutant levels. The level of pollutants in ambient air is typically expressed in terms of the concentration of the pollutant in the air. One form of this expression is parts per million. A more common scientific form is in micrograms per cubic meter, which are millionths of a gram by weight of a pollutant contained in a cubic meter of air.

The United States EPA has established standards for the level of various pollutants in the ambient air. These ambient air quality standards are based on a broad collection of scientific data to define levels of ambient air quality where adverse human health impacts and welfare impacts may occur. As part of the process of adopting air quality standards, the USEPA compiles scientific information on the potential impacts of the pollutant into a “criteria” document. Hence the pollutants for which air quality standards exist are known as criteria pollutants. Based upon the nature and effects of a pollutant, appropriate numerical standards(s) and associated averaging times are set to protect against adverse impacts. For some pollutants several standards are set, for others only a single standard has been established.

Areas can be designated as attainment or nonattainment for criteria pollutants, based on the existing air quality. In an attainment area, the goal is to generally preserve the existing clean air resource and prevent increases in emissions which would result in nonattainment. In a nonattainment area efforts must be taken to reduce emissions to come into attainment. An area can be attainment for one pollutant and nonattainment for another.

Compliance with air quality standards is determined by two techniques, monitoring and modeling. In monitoring one actually samples the levels of pollutants in the air on a routine basis. This is particularly valuable as monitoring provides data on actual air quality, considering actual weather and source operation. The Illinois EPA operates a network of ambient air monitoring stations across the state.

Monitoring is limited because one cannot operate monitors at all locations. One also cannot monitor to predict the effect of a future source, which has not yet been built, or to evaluate the effect of possible regulatory programs to reduce emissions. Modeling is used for these purposes. Modeling uses mathematical equations to predict ambient concentrations based on various factors, including the height of a stack, the velocity and temperature of exhaust gases, and weather data (speed, direction and atmospheric mixing). Modeling is performed by computer, allowing detailed estimates to be made of air quality impacts over a range of weather data. Modeling techniques are well developed for essentially stable pollutants like particulate matter, NO_x, and CO, and can readily address the impact of individual sources. Modeling techniques for reactive pollutants, e.g., ozone, are more complex and have generally been developed for analysis of entire urban areas. They are not applicable to a single source with small amounts of emissions.

Air quality analysis is the process of predicting ambient concentrations in an area as a result of a project, and comparing the concentration to the air quality standard or other reference level. Air quality analysis uses a combination of monitoring data and modeling as appropriate.

b. Air Quality Analysis for NO_2, SO_2, PM_{10} and CO

An ambient air quality analysis was conducted by the consulting firm, Trinity Consultants, on behalf of Universal Cement to assess the impact of the emissions of the proposed project. This analysis determined that the proposed project will not cause or contribute to a violation of any applicable air quality standard.

Modeling Procedure

Step 1 - Significance Analysis: The starting point for determining the extent of the modeling necessary for any proposed plant is evaluating whether the plant would have a “significant impact”. The PSD rules identify Significant Impact Levels (SIL), which represent thresholds triggering a need for more detailed modeling.[4] These thresholds are specified for all criteria pollutants, except ozone and lead.

Step 2 - Refined (Full Impact) Analysis: For pollutants for which impacts are above the SIL, more detailed modeling is performed by incorporating proposed new emissions units at the proposed plant, stationary sources in the surrounding area (from a regional inventory), and a background concentration.

Step 3 - Refined Culpability Analysis: For pollutants for which the refined (full impact) modeling continues to indicate a modeled exceedance of a NAAQS, a more refined culpability analysis is performed incorporating additional specific procedures consistent with U.S. EPA guidance.

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[4] The significant impact levels do not correlate with health or welfare thresholds for humans, nor do they correspond to a threshold for effects on flora or fauna.

Table 1 shows the results of the Step 1 significance analysis

Table 1 – Step 1 Significance Analysis Results (μg/m^3)

Pollutant	**Averaging Period**	**Maximum Predicted Impact**	**Significant Impact Level**
NO_2	1-hour	18.4	7.52*
NO_2	Annual	0.47	1
PM_{10}	24-hour	47.61	5
SO_2	1-hour	5.87	7.85*
SO_2	3-hour	4.67	25
SO_2	24-hour	1.48	5
SO_2	Annual	0.12	1
CO	1-hour	37.13	2,000
CO	8-hour	15.61	500

* interim Significant Impact Level

The significance analysis (Step 1) results demonstrate that all impacts over all averaging periods for SO_2 and CO are insignificant and no refined (full impact) analysis is required for these pollutants. As modeling results demonstrate that impacts are significant for the PM_{10} 24-hour and for the 1-hour NO_2 averaging periods, a refined (full impact) analysis (Step 2) was performed for these pollutants and averaging periods.

PM_{10} – Annual & 24-hour

The Step 2 refined (full impact) and Sep 3 refined culpability and analyses demonstrate that the project would not cause or contribute to a violation of the NAAQS or applicable PSD increment(s) for PM_{10}.

Under Step 2, for the 24-hour PM_{10} NAAQS analysis, modeled PM_{10} concentrations, considering the project emissions, emissions from regional inventory sources, and an additional background monitored concentration, showed that a modeled exceedance of the NAAQS occurred at several modeled receptor locations. Further Step 3 culpability analysis of these NAAQS exceedance receptor locations determined that at all but six of these modeled receptor locations, the proposed plant’s impact were less than significant during the time period of the modeled exceedances. At the six remaining receptors, using a direction specific background concentration, no PM_{10} 24-hour NAAQS exceedances were predicted at any receptor where the proposed plant was predicted to have a significant impact.

Under Step 2, for the annual PM_{10} PSD increment analysis, no exceedances of the annual PM_{10} PSD increment standard were predicted. Also under Step 2, for the 24-hour PM_{10} PSD increment analysis, modeled PM_{10} concentrations, project emissions, and “increment-affecting” emissions from regional inventory sources, a modeled exceedance of the 24-hour PM_{10} PSD increment standards occurred at several modeled receptor locations.

Further Step 3 culpability analysis of these 24-hour PM_{10} PSD increment exceedance receptor locations indicated that at all but one of these modeled receptor locations, the proposed plant’s impacts were less than significant during the time period of the modeled exceedance. Excluding an adjacent source’s increment affecting emissions at this lone receptor location resulted in increment consumption being less than the 24-hour PM_{10} increment. Consistent with USEPA guidance, fencing of this adjacent source’s property to prevent public access is proposed to address this remaining receptor, with such fencing being required by a condition in the permit.

NO_2 - 1-hour

Under Step 2, for the 1-hour NO_2 NAAQS analysis, considering the project emissions, emissions from regional inventory sources, and an additional background monitored concentration, a modeled exceedance of the NAAQS occurred at several modeled receptor locations. Further Step 3 culpability analysis of these NAAQS exceedance receptor locations determined that the probability of Universal Cement exceeding the 1-hour NO_2 SIL is insignificant.

c. Vegetation and Soils Analysis

Universal Cement provided an analysis of the impacts of the proposed plant on vegetation and soils. The first stage of this analysis focused on the use of modeled air concentrations and published screening values for evaluating exposure to flora from selected criteria pollutants (SO_2, NO_x, CO, and PM_{10}). These screening values or threshold ambient concentrations (which may indicate levels of potential adverse impacts) are provided for “sensitive”, “intermediate”, and “resistant” species. The applicant has conservatively compared maximum modeled concentrations against “sensitive” species threshold concentrations, and in all instances, modeled impacts are below the “sensitive” value thresholds.

Potential adverse impacts to soil and vegetation from deposition of hazardous air pollutants (trace elements including hazardous metals) are the focus of the methodology. In this stepwise process, soil (depositional) loadings calculated from annual average air concentrations (modeling results) are combined with published endogenous soil concentration data and compared against threshold impact information. Dispersion modeling results were obtained for short- and long-term averaging periods for lead, mercury, and other metals, acid gases, organics, and dioxins/furans. Annual average concentrations were converted to deposited soil concentrations and plant tissue concentrations and compared against guideline benchmark levels for soil and plants. In all cases, the pollutant levels were less than the benchmark levels.

The proposed plant’s emissions are not expected to result in harmful effects to the soils and vegetation in the area. Maximum modeled impacts for SO_2, NO_x, CO, PM_{10}, sulfuric acid mist, ammonia, hydrogen chloride and hydrogen fluoride do not exceed the guideline benchmark concentrations. Maximum soil impacts due to HAP emissions from the proposed Universal Cement facility are predicted to be well below measured background levels and ecological screening levels. Likewise, the modeled maximum water and sediment impacts in Lake Calumet due to HAP emissions from the proposed facility are all below ecological benchmark levels.

Consultation between the Illinois EPA and the Illinois Department of Natural Resources, as required under Illinois’ Endangered Species Act, have been conducted with regard to a review of the above conclusions with respect to species of vegetation and animals that are endangered within the vicinity of the plant. The Department has concluded that adverse effects are unlikely.

The United States Fish and Wildlife Service, as required under the United States Endangered Species Act, reviewed the above conclusions with respect to species of vegetation and animals that are present in the area and indicated that there will be no adverse effects.

d. Construction and Growth Analysis

Universal Cement provided a discussion of the emissions impacts resulting from residential and commercial growth associated with construction of the proposed plant. Anticipated emissions resulting from residential, commercial, and industrial growth associated with construction and operation of the proposed plant are expected to be low. Despite the large number of workers required during the construction phase and a significant number of permanent employees for operation of the plant, emissions associated with new residential construction, commercial services, and supporting secondary industrial services are not expected to be significant as the plant will draw from the existing work force and will be supported by the existing infrastructure. Thus, impacts would be minimal and distributed throughout the region.

VIII. DRAFT PERMIT AND CONDITIONS

The Illinois EPA has prepared a draft of the construction permit that it would propose to issue for this plant. The conditions of the permit set forth the emission limitations of the plant and the air pollution control requirements that the plant must meet. These requirements include the applicable emission standards that apply to the various units at the plant. They also include the measures that must be used and the emission limits that must be met for emissions of different regulated pollutants from the plant.

Limits are set for the emissions of various pollutants from the plant. In addition to annual limits on emissions, the permit includes short-term emission limits and operational limits, as needed to provide practical enforceability of the annual emission limits. As previously noted, actual emissions associated with the plant would be less than the permitted emissions to the extent that the plant operates at less than capacity and control equipment normally operates to achieve emission rates that are lower than the applicable standards and limits.

The permit would also establishes appropriate compliance procedures for the project, including requirements for emission testing, required work practices, operational monitoring (e.g., continuous emissions monitoring on the kiln for NO_x, $SO_{2,}$ filterable PM, CO, total hydrocarbons (THC), CO_2, and mercury), recordkeeping, and reporting. These measures are imposed to assure that the operation and emissions of the plant are appropriately tracked to confirm compliance with the various limitations and requirements established for individual units.

IX. REQUEST FOR COMMENTS

It is the Illinois EPA's preliminary determination that the draft permit for the proposed project meets applicable state and federal air pollution control requirements, subject to the conditions in the draft permit. The Illinois EPA is therefore proposing to issue a construction permit for the project. Comments are requested on this proposed action by the Illinois EPA and the conditions of the draft permit.

ATTACHMENT 1

Potential Emissions From the Plant

Pollutant	Potential Emissions (Tons Per Year)
Particulate Matter (PM)	142.3
Particulate Matter (PM_{10})	134.8
Particulate Matter ($PM_{2.5}$)	99.6
Sulfur Dioxide (SO_2)	231.1
Nitrogen Oxides (NO_x)	872.3
Carbon Monoxide (CO)	613.1
Greenhouse Gases (GHG)	1,100,000
Volatile Organic Material (VOM)	97.1
Lead	0.41
Sulfuric Acid Mist	6.9
Hydrogen Chloride	9.5
Total HAP	24.3

ATTACHMENT 2

BACT Discussion

This attachment provides a discussion of the proposed determination the BACT for the emission units at the plant would that emit pollutants subject to PSD (i.e., NO_x, SO_2, PM, CO and GHG).

Section A.1 - Clean Fuels (Alternative Fuels)

The determination of BACT requires consideration of use of “clean fuels” as a technique to control emissions from a proposed emission unit.[5] The clean fuels that Universal Cement examined were: (1) biomass, (2) natural gas, and (3) low sulfur fuels.

Biomass fuels, as the primary fuels for the kiln, are not currently consistent with the nature of the plant, which would produce cement, a physical product, for sale. To effectively convert limestone and other materials into cement, the kiln needs fuels with consistent heat content and other physical properties. This objective is inconsistent with use of currently available biomass fuel. As a general matter, the composition and properties of biomass fuels are significantly different than those of coal and petroleum coke. For example, biomass is not a friable material and cannot be pulverized like coal or petroleum coke and, as such, biomass would burn at a different rate in the kiln. The lower heat content of biomass also results in it not being a suitable primary fuel for a process designed for high-heat content fuels.

In addition, as the objective for the plant is to reliably and consistently manufacture Portland cement, this necessitates the use of commercial fuels for which a reliable supply will be available during the life of the plant. Even if biomass fuels could be used exclusively in the kiln, biomass fuels cannot yet generally be considered a commercial fuel. Farming to produce low quality biomass fuels, of the type that would potentially be available for use at the proposed plant, is in its infancy. The future availability of such fuel and its cost cannot be determined or predicted in a way that would allow it to be considered an available fuel. In this regard, key factors are the nature of government programs that accelerate the development of commercial biomass fuels and the extent to which rules are adopted and programs implemented that increase competition for this fuel, such as federal rules supporting use of renewable fuels. The situation with the proposed plant is different from projects in which a source proposes to utilize or develop certain biomass resources. In those cases, the sources are voluntarily accepting the uncertainty in the future availability and cost of

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[5] Within the context of analyzing alternative fuels and production processes in cement manufacturing, it is important to distinguish between the use of clean fuels from the use of cleaner raw materials (which falls under the examination of alternative production processes, which are addressed in Attachment 4).

material from the selected resource.[6] While biomass is contemplated as a desired fuel for use in the cement industry in the future, it is not considered a dependable fuel at this time. Thus, biomass derived fuels are readily rejected for purposes of BACT.

These considerations, which preclude use of biomass as the required fuel for the proposed plant, also preclude the use of a blend of biomass with coal and petroleum coke as the fuel for the plant.

It is also noteworthy that combustion of biomass in the kiln would have other undesirable operational consequences for the plant. More air would generally need to be pulled through the kiln, which would be accompanied by an increase in electricity usage. The capacity of the kiln would also be lowered. Alternatively, the kiln would need to be larger to maintain the design production capacity of the plant. In either case, the overall energy efficiency of the kiln and the plant would be lowered. More physical space would be needed to store biomass fuel. A separate fuel handling system would be needed for biomass fuel.

Another clean fuel for consideration is natural gas.[7] While use of natural gas would decrease emissions of greenhouse gas, it would significantly increase NO_x emissions. Given the role of emissions of NO_x in air quality for ozone and fine particulate matter and in acid rain, this increase in NO_x emissions would have significant adverse environmental impacts, as relevant to determining whether it is appropriate to require use natural gas as BACT.

A cement kiln fired only with natural gas would also not be viable economically. With natural gas costing about three times more than coal and petroleum coke, the cement produced by the plant would cost approximately $16 per ton more solely due to the additional cost of natural gas.[8] Under these economic conditions, the plant would not be built and Portland cement would instead be imported.

An additional clean fuel considered was low sulfur coal, such as the Powder River Basin coals. Considering the cost impacts of using low sulfur coals and natural gas, an average cost chart was developed by the applicant to

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[6] As applied to the proposed plant, biomass fuel is appropriately approached as an opportunity fuel when available, while coal and petroleum coke are commercial fuels.

[7] When considering the reduction in emissions of GHG with natural gas, a technical consideration is that for the same quantity of heat content in the fuel, natural gas would necessitate greater volumes relative to the solid fuels, coal and petroleum coke. As a consequence, for a given amount of clinker production, the natural-gas fired kiln would have to be sized larger. A larger sized kiln reduces energy efficiency, and increases electrical consumption.

A larger size kiln, needed to burn natural gas, results in a larger surface area for radiative losses, and also requires increased fan size for kiln draft. Additionally, larger drive motors are required for a larger kiln, further increasing electrical consumption.

[8] This increase in the cost per ton of cement would be approximately 20 percent higher, firing natural gas exclusively, than a comparable solid-fuel fired plant, based on an approximate cement cost of $80 per ton.

compare the average cost of utilizing these two fuels, relative to the use of coal and petroleum coke as the baseline fuel. An incremental cost analysis was, also provided by the applicant.

With regard to fuel-based sulfur, it is also relevant that the lower sulfur content in low sulfur coal would have at most a minor effect on the SO_2 emissions of the kiln. This is because fuel sulfur carries over into the clinker and the Portland cement produced by the plant. Sulfur is introduced into the kiln from three points: fuel sulfur enters at the kiln “bottom” and the precalciner section near the top of the kiln, whereas the sulfur in the feed (primarily limestone) enters at the top of the preheater. This affects what happens to the sulfur in the kiln system and whether it is emitted as SO_2. Sulfur in raw material is emitted up the stack whereas fuel-bound sulfur becomes part of the clinker. In short, SO_2 emissions from the kiln are due to sulfur in the limestone, rather than sulfur in the fuel. Thus, reduction of sulfur in the fuel with low sulfur coals or natural gas would do little, if anything, to reduce the SO_2 emissions from the kiln.

Unlike the examination of an add-on control devices, which commonly is focused on control of a specific pollutant or combined control for multiple pollutants, the “clean fuels” analysis is more complex. The use of clean fuels by the proposed plant would act to increase emissions or some pollutants at the expense of increases in emissions of other pollutants.[9] Drawing together the pollutant-by-pollutant conclusions from this and other sections elsewhere in this document, the following conclusions are made.

- The NO_x emissions of the proposed kiln would increase with use of natural gas. Accordingly, use of natural gas is not an emission control technology for NO_x. (See Section A.2)

- SO_2 emissions of the kiln would not noticeably decrease with use low sulfur fuels (e.g., natural gas or low-sulfur coals) relative to the proposed fuel and otherwise required control technology. This is because fuel-bound sulfur is assimilated into the clinker rather than released into the flue gas from the kiln. Since natural gas was determined to be equivalent for SO_2 emissions (albeit more costly), no further analysis was necessary. (See Section A.2)

- Particulate matter and CO emissions of the kiln would also not decrease noticeably as a consequence of use of low sulfur fuels relative to the proposed fuels firing of the proposed fuel and otherwise required control technology. Indeed, the ash from high ash fuels becomes part of the makeup of the clinker itself, an operational benefit not inherent with the use natural gas. (See Section A.2)

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[9] This concern for contradictory effects is further amplified as pollutants for which the area is nonattainment or air quality is “at risk” are addressed in the BACT analysis for clean fuels. In particular, as related to GHG use of natural gas in the kiln does not pose direct concerns for local air quality whereas use of natural gas in the kiln would pose such concerns due to increased NO_x emissions.

- Emissions of GHG, as CO_2, would decrease with use of natural gas, compared to the proposed fuels, since natural gas would contains less carbon and more hydrogen than the proposed fuels. This decrease in GHG emissions would be accompanied by an increased cost of fuel and a cost analysis was performed to determine the cost-effectiveness of fuel-switching. This analysis showed that the use of natural gas would not be cost-effective. The added cost would also make the plant and its cement non-competitive and lead to use of importation of cement instead of cement from the proposed plant.[10] From a global perspective, this would actually result in CO_2 emissions increases compared to building the plant in this location using the proposed fuels. (See Section A.3)

Therefore, performing a comprehensive analysis of the per-pollutant conclusions above, it is clear that it is not cost-effective to require the use of natural gas as a clean (alternative) fuel in the kiln.

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[10] In addition, use of natural gas would entail fundamental design changes that would lower the overall kiln system efficiency (e.g., a larger sized kiln) result in an increase in the usage of electricity at the plant, and require the transport of additional raw materials to the site.

Section A.2 - Kiln – Pollutants other than Greenhouse Gases

1. Nitrogen Oxides (NO_x)

To control NO_x emissions from the kiln, many techniques and technologies were evaluated. The following technologies are available: staged combustion, Low-NO_x burners, fuel substitution, use of tires as a supplemental fuel, selective catalytic reduction (SCR), and selective non-catalytic reduction (SNCR).

Potentially Available Technologies

Staged Combustion

In staged combustion, fuel is combusted at multiple locations to minimize the formation of NO_x. In the proposed kiln system, fuel is introduced both at the rotary kiln and to the precalciner vessel. The gases from the kiln arrive in the precalciner with some excess oxygen, as the process requires oxidizing conditions at the outlet of the kiln to produce acceptable clinker. The initial combustion in the precalciner occurs in a fuel rich and oxygen poor zone. This results in reducing conditions in the primary burn zone of the precalciner that causes existing NO_x to be converted to nitrogen. Combustion is completed in the calciner vessel in a secondary burning zone where hot air from the clinker cooler is introduced, which completes the combustion. This combustion occurs in an oxygen-rich fuel lean zone. Since the temperatures in this second zone are considerably less than the first zone, overall formation of NO_x is minimized. NO_x reductions of up to 45 percent have been noted with this design. Clearly this control technique is feasible and the design of the plant will incorporate this technique.

Low-NO_x burners

Low-NO_x burner technology stages combustion in the high temperature zone of the flame. Although low-NO_x burners have been extensively used in the industrial furnace industry, application of this technology to cement kilns has encountered many obstacles. First, when used in trials, little or no NO_x reductions have been found to occur. Second, there has been one documented case of refractory damage due to the use of low-NO_x burner technology (Note: refractory is the heat insulation protecting the kiln shell from the high temperatures generated in the kiln). In effect, while low-NO_x burner technology is not feasible, the purported benefits of it are already achieved through the use of staged combustion.

Fuel substitution

Coal as a fuel in the kiln combusts at a lower flame temperature than if natural gas was combusted in the kiln. Thus, coal combustion will emit lower amounts of thermal NO_x than would natural gas (and fuel oil). So, while coal contains more fuel nitrogen, the use of coal results in lower overall NO_x generation.

If used, tires may reduce emissions of NO_x because tires help to create secondary combustion zones, thereby effectively further facilitating staged combustion within the kiln. Tires, while useful in controlling NO_x in older cement kiln design, have not been demonstrated as a NO_x control technology with the latest staged combustion preheater/precalciner kiln design.

SCR

In general, SCR is a very effective add-on control technology to reduce NO_x emissions from coal-fired boilers. However, it has not yet been successfully implemented on a cement kiln. SCR involves the injection of ammonia or urea into the flue gases at an appropriate location downstream of the combustion zone within the appropriate temperature profile, whereby the ammonia reacts with NO_x in the presence of a catalyst, to produce nitrogen and water. SCR could be fitted on Universal Cement’s kiln after the insertion of flue gas reheating and associated equipment after the baghouse. Applying an SCR to these types of dust-laden (post PM control) flue gases leads to the catalyst being fouled, preventing the effective use of the catalyst.

SNCR

Selective Non Catalytic Reduction (SNCR) is a method to reduce nitrogen oxide emissions that involves injecting either ammonia or urea into the post-combustion gases at a location where the flue gas is between 760 and 1,093 degrees Celsius (1,400 and 2,000°F) to react with the nitrogen oxides formed in the combustion process. The resulting product of the chemical reaction is elemental nitrogen (N_2), carbon dioxide (CO_2), and water (H_2O). SNCR is a proven and reliable technology already used within the cement industry that has been shown to reduce NO_x emissions to as high as 65 to 70 percent. The implementation of SNCR has the added benefit of reducing ammonia slip. This will help in limiting formation of sulfates (particulate matter) on downstream equipment and lowering the potential for added condensable particulate.

Ranking of technologies

After ranking of the technologies, SNCR control technology and staged combustion design were selected as the feasible technology providing the best reduction of NO_x.

The resulting BACT level of control for NO_x, considering the use of SNCR technology and the staged combustion design, source variability, and supported by the permit application, is proposed to be set at 1.5 lbs/ton clinker (30-day rolling average).[11]

The RACT/BACT/LAER Clearinghouse was also consulted for similar operations to review required control technologies across the United States. The Clearinghouse indicated that the proposed NO_x BACT limit for the kiln would be the lowest rate in comparison to all other similar cement kilns addressed in the Clearinghouse.[12]

2. Sulfur Dioxide (SO_2)

Various SO_2 control techniques and technologies were evaluated. The following technologies are available: circulating fluidized bed absorber, wet scrubber, lime spray-drying, inherent absorption, D-SO_x cyclone system, fuel substitution, use of low sulfur limestone and in-line raw mill preheater/precalciner kiln. The general means to control SO_2 is to use some form of lime to be sprayed or otherwise injected into the process at some point. Thus, the control of SO_2 is focused on the form in which lime can efficiently react with the sulfur compounds in the cement kiln and flue gases.

Potentially Available Technologies

Circulating Fluidized Bed Absorber

A circulating fluidized bed absorber (CFBA) is a reactor, typically a vertical cylinder, in which flue gases are brought into contact with lime slurry. While flue gases enter the reactor at the bottom and flow upward, lime is sprayed into the reactor and reacts with the SO_2, mercury, hydrogen chloride (HCl) and other acid gases in the flue gas and neutralizes the acid gases. The reactor portion of the CFBA includes a cyclone to collect solid particles (e.g., lime and reaction products, such as cement kiln dust) from the flue gas for re-circulation back to the reactor. The solid particles that do not get recirculated from the integral cyclone are controlled by the downstream baghouse. The CFBA is a cutting-edge technology, proven in other industries, that has shown great promise as an innovative means to control SO_2 in the cement industry.

Wet Scrubbing

In wet scrubbing, the contaminants in the flue gas stream are scrubbed out by a liquid to produce exhaust with a lower concentration of those

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[11] See 75 FR 54970, 54994 (September 9, 2010) National Emissions Standards for Hazardous Air Pollutants for the Portland Cement Manufacturing Industry and Standards of Performance for Portland Cement Plants for a recent discussion by USEPA of source variability and best demonstrated technology for cement kilns.

[12] Most notably, Universal Cement identified the permit for a kiln at Cemex Cement’s plant in Brooksville, Florida. The NO_x emission limit established in that recent permit helped serve as one of the bases to set BACT for the proposed kiln, and is numerically the same.

contaminants. Lime-based scrubbant is commonly used to reduce SO_2, but can have a negative impact on control of condensable acid gases, such as sulfuric acid mist. Wet scrubbing has had an effective track record as an SO_2 control device on cement kilns in the US. To their detriment, wet scrubbing requires increased consumption of water, the addition of a waste water treatment plant, discharge of waste water, and a significant increase in plant electrical consumption.

Lime Spray Drying

Lime spray drying would also occur upstream of the kiln baghouse. Due to its alkaline nature, lime spraying causes corrosion and abrasion problems for equipment used in ongoing operation at cement plants, such as conveying equipment. As a result, the inability of these control devices to continuously operate has rendered them infeasible.

Inherent Absorption

By the very nature of cement production, the materials used in cement production tend to inherently provide SO_2 control. Fuel-bound sulfur combines with oxygen to form SO_2 upon combustion, but due to the raw materials processed in a cement kiln being alkaline in nature, most of the SO_2 is absorbed to form sulfate salts before reaching the exhaust stack. In turn, these sulfate salts will end up in the final clinker product. Clearly, proper combustion practices will inherently and efficiently lock in the sulfur to these sulfates.

D-SO_x

In a D-SO_x cyclone system, a portion of the calciner exit gas is stripped from the calciner exit duct and ducted to a collection cyclone to separate the entrained dust from the exit gas. The captured dust is fed to the first or second preheater tower cyclone exit duct, where conversion of pyritic sulfur to SO_2 begins. While such a system is available, it will not meet the NESHAP standard for new cement kilns.

Fuel Substitution

The use of low-sulfur fuels has already been addressed in the discussions of “Alternative Fuels” in Attachment 2, Section A.1. As explained, the use of low sulfur fuels will not significantly reduce emissions of SO_2 compared to use of high sulfur coal and petroleum coke. This is because SO_2 emissions from the kiln are primarily due to sulfur contained in the limestone feed and not sulfur in the fuel.

Low-Sulfur Raw Materials

Use of low-sulfur raw materials (limestone) was evaluated. These materials are not found in the Midwest. The environmental impacts (particularly the increases in emissions of CO_2 and NO_x) from transporting low-sulfur limestone from the regions where it is present to the plant outweigh any benefit for reduced in SO_2 emissions. There would also be significant cost impacts associated with the transportation of these materials to the plant.

Plant Design

A cement plant utilizing an in-line raw mill preheater/precalciner design will provide the lowest SO_2 emissions of all other kiln technologies. In this design, exhaust gases from the kiln are brought into close contact with the alkaline raw materials, in an ideal temperature and moisture range for optimal scrubbing efficiency. In addition, inherent adsorption of sulfur compounds within this kiln system in conjunction with the use of the highest ranking (i.e., optimal) lime injection system, namely a circulating fluidized bed absorber, constitute BACT for the control of SO_2 from the kiln.

Ranking of Technologies

After ranking of the technologies, CFBA was selected as the feasible technology providing the best reduction of SO_2.

The resulting BACT level of control for SO_2, considering the use of CFBA technology and inherent absorption, source variability, and supported by the permit application, is proposed to be set at 0.40 lb/ton of clinker (30-day rolling average).[13]

The RACT/BACT/LAER Clearinghouse was also consulted for similar operations to review required control technologies across the United States. The Clearinghouse shows that there are lower SO_2 emission limits. However, they have been set for certain kilns in Florida and the southwestern U.S., where there are marl or similar deposits of carbonate raw material with a very low sulfur content. In addition, as noted above, transportation and use of low-sulfur raw materials from Florida and other parts of the southwestern U.S. where they are present would present environmental and cost impacts. As a consequence, the SO_2 BACT determination for the proposed kiln would be the lowest rate relative to all types of similar cement kilns addressed by the Clearinghouse.

3. Carbon Monoxide (CO)

The following CO control technologies are analyzed for possible applicability to the proposed cement plant: good combustion practices, thermal/catalytic oxidation and maintaining excess air.

Potentially Available Technologies

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[13] See 75 FR 54970, 54995 (September 9, 2010) National Emissions Standards for Hazardous Air Pollutants for the Portland Cement Manufacturing Industry and Standards of Performance for Portland Cement Plants for a recent discussion by USEPA of source variability and best demonstrated technology for cement kilns.

Good Combustion Practice

Regarding good combustion practices, a properly designed and operated kiln system effectively functions as a thermal oxidizer. CO formation is minimized when the kiln temperature and oxygen levels in the combustion zones of the kiln are adequate for complete combustion.

Oxidation

Thermal oxidation reduces CO emissions by supplying adequate heat and sufficient oxygen to ensure that the CO is converted to CO_2. Temperatures of 1450 – 1600 °F must be achieved to reach a rate of CO reduction of 95 percent. In catalytic oxidation, the combustion gases pass over a catalyst where the CO is converted to CO_2. One key difference between catalytic oxidation and thermal oxidation is that catalytic oxidation can operate at a much lower temperature than thermal oxidation. While thermal/catalytic oxidation has been applied to coating lines and other organic material emitting processes, it has not been widely used on cement kilns. In the two cases in which it has been used, it followed wet scrubbing in the control train. In those cases, the thermal/catalytic oxidizers were utilized to avoid PSD review or to comply with a consent order. The use of these thermal/catalytic oxidizers has met with significantly operational problems such that they were not continuously operated. Neither unit employed thermal/catalytic oxidation to reduce emissions of CO. One of the facilities has since ceased production, the other operates at reduced capacity. For these reasons, thermal/catalytic oxidation is not a feasible control technique to control CO from cement kilns. In addition, use of a thermal/catalytic oxidizer is ineffective where CO concentrations are already low.

Excess Air

Providing the proper oxygen to fuel ratio reduces CO emissions by oxidizing the CO to CO_2. Cement kilns require excess air for proper oxidation. However, adding excess air above the amount necessary for proper operation to either the kiln or the precalciner would cause a large increase in NO_x emissions from the kiln. Thus, particularly in plants with preheater/precalciner design employing staged combustion, careful control of the kiln is required to find the lowest amount of CO while not increasing NO_x emissions that at the same time can produce high quality clinker.

Ranking of Technologies

No ranking of technologies was necessary, since the only feasible technology was the use of good combustion practices to reduce CO emissions. The resulting BACT level of control for CO, considering the use of good combustion practices, source variability and supported by the permit application, is proposed to be set at 1.05 lbs/ton clinker (30-day rolling average).

The RACT/BACT/LAER Clearinghouse was also consulted for similar operations to review required control technologies across the United States. The Clearinghouse indicated that the CO BACT determination for Universal Cement would be the lowest for any existing cement kilns found on the RACT/BACT/LAER Clearinghouse.

4. Particulate Matter (PM)

Emissions occur as a result of carryover of dust in the flue gas. Options for control of filterable particulate include filtration (i.e., baghouses), electrostatic precipitation and scrubbing.

Potentially Available Technologies

Fabric filters

Fabric filters, or baghouses, use filtration to separate dust particles from dusty gases. They are one of the most efficient types of dust collection available, and the most effective collectors can achieve a nominal collection efficiency of more than 99 per cent for fine particulate matter ($PM_{2.5}$).

ESP

Electrostatic precipitators (ESP) control particulate emissions through electrical forces. ESPs can achieve high control efficiencies of 99 per cent or more. The most important aspect for control efficiency for an ESP is its size, which allows for higher residence time, which increases the likelihood that each particle will be collected.

Scrubbers

Scrubbers control particulate emissions through the capture of particles within droplets of water, which is sprayed into the exhaust stream as a mist, but agglomerates into larger and larger droplets. Removal of the droplets and particulates from the gas stream typically requires a mechanically aided separator and/or a mist eliminator, achieving a control efficiency from 80 per cent up to 99 percent. Where applicable, baghouses can achieve better control of filterable particulate than scrubbers.

Ranking of Technologies

The BACT limit for filterable PM, considering the use of fabric filter, source variability, and supported by the permit application, is proposed to be set at 0.010 lb/ton clinker, 30-day average.[14]

Particulate emissions also occur as condensable particulates. The combination of the CFBA (determined to be BACT for SO_2) and baghouse, will provide very effective control of total PM_{10}, including both filterable and condensable particulate, from the kiln. This is because the CFBA is very effective in controlling SO_2, which is one of the principal contributors to condensable particulate. The BACT level of control for total PM, considering the use of fabric filter and the CFBA, and supported by the permit application, is proposed to be set at 0.140 lb/ton clinker, 3-hour average.[15]

The RACT/BACT/LAER Clearinghouse was also consulted for similar operations to review required control technologies at other kilns across the United States. The information in the Clearinghouse indicates that the proposed BACT determinations for PM/PM_{10} (total) and PM (filterable) for the proposed kiln would be the lowest rates relative to all types of similar cement kilns addressed by the Clearinghouse.

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[14] See 74 FR 21136, 21154-21156 (May 6, 2009) National Emissions Standards for Hazardous Air Pollutants for the Portland Cement Manufacturing Industry; Proposed Rule. Also, “Development of the MACT Floors for the Final NESHAP for Portland Cement,” Office of Air Quality Planning and Standards, U.S. EPA (August 6, 2010), see especially pages 16-17.

[15] This proposed BACT limit also serves to control particulate matter as $PM_{2.5}$ (i.e., fine particulate matter with an aerodynamic diameter of 2.5 microns or less). The low proposed BACT determination effectively requires the filter bags in the baghouse to use a fabric material that has enhanced control of fine particulate matter, as compared to a conventional woven or felt filter material.

Section A.3 - Kiln - Greenhouse Gases

Over 99 percent of the emissions of greenhouse gases (GHG) from the proposed plant will come from the kiln, with most of the GHG being carbon dioxide (CO_2). Emissions of GHG are produced by the kiln by two routes: calcination of the limestone to lime and combustion of fuel. The BACT determination for the kiln system and the plant examined which control measures and work practices minimize the generation of CO_2 per ton of product.[16]

There will also be some nitrous oxide (N_2O) emitted from the kiln. These emissions will be controlled as they are associated with combustion of fuel, so that lowering CO_2 emissions should reduce emissions of N_2O. Emissions of N_2O should also be controlled by measures that reduce the formation of NO_x.

Potentially Available Technologies

Universal Cement examined five categories of control measures and work practices as a means to minimize CO_2. These were:

a. Measures to improve Energy Efficiency of the Clinker Production Process, including: i. Preheater/Precalciner Kiln Process, ii. Kiln Seal Management Program, iii. Refractory Selection (Kiln Insulation), iv. Energy Recovery from the Clinker Cooler, and v. Use of Fluxes and Mineralizers.

b. Heat Recovery for Power, i.e., cogeneration.

c. Fuel Substitution, i.e., use of natural gas and/or biomass fuels.

d. Product Composition, i.e., use of supplemental raw materials and cement additives.

e. Carbon Capture/Removal and Storage, including: i. Carbon Sequestration, ii. The Calera Process, iii. Oxy-Combustion, iv. Post-Combustion Solvent Capture and Stripping, v. Post-Combustion Membranes, and vi. Superheated Lime.

Infeasible Technologies/Measures

Some of these measures, as listed below, were deemed infeasible. The rationale for deeming these measures infeasible is summarized below.

i. Use of fluxes and Mineralizers

ii. Use of Supplemental Raw Materials and Cement Additives

iii. Carbon Sequestration

iv. The Calera Process

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[16] Emissions of GHG are addressed in terms of carbon dioxide equivalents (CO_2e).

v. Oxy-Combustion

vi. Post-Combustion Solvent Capture and Stripping

vii. Post-Combustion Membranes

viii. Superheated lime

ix. Cogeneration

1. Use of Fluxes and Mineralizers

Fluxes and mineralizers can be used in cement kiln raw feed to reduce the required peak temperature to produce acceptable clinker. This, in turn, helps to reduce the generation of GHG (principally CO_2). Fluoride has been shown to be a good fluxing agent since it reduces the peak temperature but the only practical source of this agent can be found in materials deemed to be a hazardous waste. The use of such wastes in the proposed kiln has not been permitted. In addition, fluoride presents problems with the loss of strength of the cement, as well as corrosion of the kiln’s refractory.

Other possible mineralizer candidates have been shown to damage the clinker cooler, so that the number of such candidates is extremely limited. The applicant has demonstrated that it is not possible to predict the impact of fluxes and mineralizers.[17] Therefore, the use of fluxes and mineralizers has not been relied upon for CO_2e reduction.

2. Product Composition - Use of Supplemental Raw Materials and Cement Additives

Two means of reducing greenhouse gases using supplemental raw materials and cement additives are to: (1) substitute a portion of the limestone that participates in the calcination process with materials that do not participate and/or (2) add material in the finish mill to replace the equivalent amount of clinker produced (thus reducing the amount of fuel to produce the same amount of total clinker).

While the addition of supplemental materials to the raw feed and finish mill may reduce GHG emissions, from a practical standpoint, guaranteeing specific product quality ultimately defines to what degree material substitution can be implemented. The BACT analysis for GHG in the application materials has an extensive discussion of these issues. The Illinois EPA concurs with Universal Cement that further use of supplemental raw materials and cement additives is an infeasible control technique (i.e., for BACT level of control), at this time, due to the detrimental effect on product quality.

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[17] See Section 3.1.2.1.5 of the application supplement submittal, February, 2011.

3. Carbon Capture and Storage/Sequestration (CCS)

The technology for purifying and capturing the greenhouse gas/carbon dioxide emissions, compressing, transporting and injecting them in geologic formations is in its developmental infancy at this time. In addition, Chicago is far from any location where pipelines could transport the CO_2 to viable storage locations. Given these critical deficiencies, the Illinois EPA deems CCS to be infeasible at this time.

4. The Calera Process

The Calera Process “captures” CO_2 by converting it first to carbonic acid, by passing the exhaust gases through a wet alkaline scrubber system containing calcium, magnesium or sodium. The water in the scrubbant reacts with the carbonic acid so that carbonates, such as calcium carbonate, magnesium carbonate or sodium carbonate are formed. These precipitated carbonate minerals can either be ‘sequestered’ into the cement or removed offsite, and the salts produced in the scrubber water can be removed or sold. The Calera Process is still in its pilot stage of research, and the Illinois EPA concurs with Universal Cement that it is an infeasible technology at this time.

5. Oxy-Combustion

Oxy-combustion occurs when fuel is combusted in an atmosphere of almost pure oxygen while nitrogen is first removed from air by means of an air separation unit. The combustion gases are comprised mainly of CO_2, which theoretically can be further purified, compressed, captured and stored. This technology is still in the development stages for full-scale applications.[18] The Illinois EPA concurs with Universal Cement that Oxy-Combustion is an infeasible technology at this time.

6. Post-Combustion Solvent Capture and Stripping

Post-combustion solvent capture and stripping is a process used at gas-fired power plants and gasification facilities that uses an amine-based chemical solvent to strip out and purify CO_2 from flue gases, while routing other contaminants for further processing and control. The almost pure CO_2 can be further purified, compressed, captured and stored. The USEPA’s guidance document that addresses GHG emissions from cement manufacturing plants highlights the deficiencies of this technology, some of which are: (1) the effect of SO_2 in the exhaust gases on the formation of amine salts; (2) solvent degradation due to NO_x in the exhaust; (3) reduction in scrubber efficiency due to particulate matter in the exhaust gas; (4) the large amounts of steam necessary to strip out the CO_2; (5) the presence of other acidic compounds in the exhaust gas that lowers efficiency; and (6) the large amounts of wastewater that must be managed from the scrubber. The

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[18] FutureGen 2.0 is a proposed full-scale demonstration for this technology and will presumably be applied to a nominal 200 MW coal-fired utility boiler.

Illinois EPA also concurs with Universal Cement that Post-Combustion Solvent Capture and Stripping is an infeasible technology at this time.

7. Post-Combustion Membranes

Post-Combustion Membranes technology uses permeable or semi-permeable membranes to separate CO_2 from flue gas. This CO_2 would be purified, compressed, captured and stored. This technology is in its pilot study research stage, so is not available for use on cement kilns. Thus, the Illinois EPA also concurs with Universal Cement that Post-Combustion Membranes is an infeasible technology at this time.

8. Superheated Lime

With superheated lime (CaO), the calcination and combustion reactions are performed separately so that the largely concentrated CO_2 generated from the calcination process can be separated, purified, compressed, captured and stored. Like many CO_2 concentration and capture technologies, this technology is in its infancy also, and the Illinois EPA concurs with Universal Cement that superheated lime is an infeasible technology at this time.

9. Cogeneration

Cogeneration is the production of electricity and useful thermal energy simultaneously from a common fuel source, in this case, the kiln system. The rejected heat from the kiln system can be used to power an electric generator. Surplus heat from the electric generator can be used for on-site processes, or for heating purposes.

A cogeneration system using waste heat from the kiln system would be technically possible at the proposed plant. However, it would actually increase rather than decrease the plant's GHG emissions. Therefore, cogeneration cannot be considered a feasible emissions control technology for GHG in this particular case. This is because there would actually be a loss of efficiency due to the accompanying changes in the temperature profiles in preheater/precalciner. For example, the raw mill temperature, which would operate at 250°F using a 5-stage preheater/pre-calciner design, would rise to 400°F or higher, changing the design in the preheater/pre-calciner to a 3-stage design. The fuel consumption of the proposed plant would increase, from its estimated value of 3.18 mmBtu/ton of clinker produced to 3.53 mmBtu/ton.[19]

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[19] In the application for the recently issued permit in New York (Lafarge Modernization Project), the heat rate per ton of product is 2.73 mmBtu/ton, which is lower than that the design rate for the proposed plant. While Lafarge plans to have a small cogeneration system (providing approximately 17 percent of its plant's electrical needs), the lower heat rate appear largely due to the fact that the Lafarge kiln system and clinker production will be much larger. Thus, the Lafarge may be more efficient than that of the proposed plant due to economies that result from the relative size of the two kilns. It is also noteworthy, that the GHG emission rate for the proposed plant is lower.

Further calculations provided by Universal Cement also demonstrate use of a 5-stage preheater/precalciner system is more efficient than use of a 3-stage preheater/precalciner system with cogeneration. A state-of-the-art cement plant that utilizes waste heat for cogeneration (3-stage) will emit 0.97 tons of CO_2e per ton of clinker whereas a state-of-the-art cement plant like that to be employed at Universal Cement (that uses that same waste heat most efficiently in the 5-stage process) emits 0.93 tons of CO_2e per ton of clinker. Therefore, applying cogeneration to an already efficient 5-stage process worsens its efficiency (i.e., increases the CO_2e rate over 0.93 tons per ton), rather than improves it. Thus, with Universal Cement’s planned 5-stage preheater/precalciner design, cogeneration is not a feasible control technology for GHG.

Feasible Technologies

The remaining technologies, which have been deemed to be feasible, are as follows and are further discussed below:

i. Preheater/Precalciner Kiln Process

ii. Kiln Seal Management Program

iii. Refractory Selection (Kiln Insulation)

iv. Energy Recovery from the Clinker Cooler

v. Use of Fuel Alternatives

1. Preheater/Precalciner Kiln Process

Among the various types of kiln system process types, namely, wet, long dry, semi-dry, dry with preheater and dry with preheater/precalciner, the preheater/precalciner kiln has been shown to be the most energy efficient because it utilizes the heat from the kiln exhaust most optimally, relative to the other technologies. For instance, the preheater/precalciner kiln can typically achieve a nominal efficiency of 3.6 mmBtu/ton of clinker produced while long dry kilns can typically achieve a nominal efficiency of 4.0 mmBtu/ton and older wet kiln technology achieves a nominal efficiency of 5.0 mmBtu/ton. It does so by routing the hot kiln exhaust gases counter-current to the direction of gravity-fed raw materials prior to entering the kiln. Furthermore, preheater exhaust gases are hot enough to be useful in drying materials entering the raw mill. The use of staged pre-heating is complicated by the fact that using exhaust heat in multiple cyclones to sufficiently reduce moisture levels results in less heat in each additional cyclone. Universal Cement has demonstrated that it will obtain optimal extraction of beneficial heat by using a 5-stage cyclone preheater. Additional preheater stages, beyond the five planned by Universal

Cement, could require additional fuel firing, and thus reduce energy efficiency.

The pre-calciner enables a portion of the calcination process to be separated from the kiln drum. Fuel used in each of these ‘sub-processes’ (kiln and pre-calciner) can be managed separately. As a consequence of kiln system refinements over the years, kiln length has been reduced, providing for greater overall efficiency. Thus, the use of preheater/precalciner technology is the standard at new cement kilns, so is certainly a feasible technology that can be utilized at the proposed plant. The Illinois EPA concurs with this determination.

2. Kiln Seal Management Program

Reducing heat losses by minimizing leakage from kiln inlet and outlet seals can provide a modest savings with regard to maintaining the efficiency of the kiln. Thus, the establishment of a kiln seal management program is certainly a feasible work practice that can be utilized at Universal Cement. The Illinois EPA concurs with this determination.

3. Refractory Selection (Kiln Insulation)

Designing the kiln’s refractory to insulate is based on the nature of the fuels and raw materials so as to optimally minimize heat losses and protect the outer shell of the kiln against corrosion in the kiln. It is clearly a feasible means of keeping the kiln system as efficient as possible. The Illinois EPA concurs with this determination.

4. Energy Recovery from the Clinker Cooler

After the hot clinker exits the kiln, but before it can be ground into final product in the finish mill, it contains a great deal of heat (at approx. 2000°F) and must be cooled (to approx. 200°F). That amount of heat can be of extreme benefit in the early stages of the manufacturing process, such as heating the pre-combustion air and fuel to the kiln system, thereby reducing the energy input to the process (from fuel). Optimizing the amount of waste heat that can be re-circulated has been an ongoing effort in the cement industry. The current generation of clinker cooler heat recovery technologies achieves substantial recovery of waste heat.

In the clinker cooler, air will be used to cool the clinker as it moves along a series of reciprocating cross-bars and grates. The hot air from the first stages of the clinker cooler is then used as combustion air in the kiln system. While the use of standard reciprocating grates increases electricity usage by about 2.5 kW-hour/ton cement (the energy recovery (in the form of heat from the clinker cooler) provides an additional 8 percent boost to efficiency. The third generation grate cooler technology is the most optimal, because it is the most efficient in conveying the clinker and distributing the outside air to cool the clinker. Reciprocating cross-bars have been determined to be the most efficient, even if worn components decrease transport efficiency (which is a problem with standard reciprocating grates). These third generation coolers have already been employed at other cement manufacturing plants (including Europe), so are feasible and available. The Illinois EPA concurs with this determination.

5. Use of Fuel Alternatives

Use of alternate fuels, such as biomass, and natural gas may be means to reduce greenhouse gas emissions in some situations, however, their limitations in this case were discussed previously in Section A.1, the BACT discussion for the use of clean (alternative) fuels, and Section A.2 for SO_2 reduction.

Ranking of Technologies

Step 3 of the Top-Down BACT Process requires a ranking of the feasible technologies in order of their ability to reduce GHG emissions:

Potential Cement Kiln Control Technologies	**Potential GHG Control**	
	Fuel Usage or CO_2 Reduction	**Annual CO_2 Emission Reduction (ton/year)**
Fuel Substitution (coal to natural gas)	40% less CO_2 from fuel	187,000
Preheater/Precalciner Kiln Process	3.34 mmBtu/ton Clinker	36,500
Energy Recovery from 3rd Generation Rotary Clinker Cooler	3.46 mmBtu/ton Clinker	18,000
Refractory Selection (Insulation)	3.47 mmBtu/ton Clinker	20,000
Kiln Seal Management	3.59 mmBtu/ton Clinker	4,600
Base Case Kiln (precalciner, 3 stage preheater, uses coal)	3.6 mmBtu/ton Clinker	0

Evaluation of Most Effective Controls

Other than fuel substitution, all of the potential control technologies and techniques above will be utilized. Substituting alternative fuels for coal and petroleum coke, while lowering the rate of greenhouse gas emissions, results in costs that are prohibitive. Considering only the fuel cost and the GHG emissions from the combustion of fuel, a kiln firing coal has an average cost effectiveness of $18.73 per ton of CO_2 produced; a kiln firing natural gas has an average cost effectiveness $121.72 per ton of CO_2 produced. With the design fuel, Illinois bituminous coal, as the baseline case, the use of natural gas relative to this design fuel, gives an average incremental cost of $96.60/ton of CO_2 removed. Thus using natural gas as the primary fuel decreases the CO_2 emissions less than 20 percent, at an estimated cost of $16,000,000 per year. This cost indicates that using natural gas as a cleaner fuel would render the plant cost-prohibitive, as the proposed plant would not be cost competitive, and would likely not be built.[20]

Selection of BACT

Among the above feasible measures, the following have been determined to be BACT: (1) use of a preheater/precalciner kiln utilizing a five-stage preheater [Note: this was already determined as a BACT technology for criteria pollutants]; (2) Kiln seal management program; (3) refractory selection; and (4) energy recovery from the use of a third generation (i.e., state-of-the-art) clinker cooler. The resulting BACT level of control for GHG, utilizing these measures, and supported by the permit application, is proposed to be set at 1860 pounds of GHG per ton of clinker produced, annual average basis. This metric reflects one of the highest rates of efficiency from modern cement kiln technologies. [21]

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[20] In addition, cement would be imported and the net result would be increased CO_2e emissions due to the additional transportation of imported cement.

[21] Incidentally, although not part of the formal BACT determination process, because no pollutants subject to regulation would be emitted from these units, the proposed plant would be expected to utilize modern measures that will act to make the plant operate more efficiently and thus act to reduce its GHG emissions. These measures include: a computerized process control and management system; use of belt conveyors and bucket elevators (rather than pneumatic transport); use of a vertical roller mill system with a high efficiency air separator and cyclone system; use of vertical roller mills in the coal mill and finish mills; use of an adjustable speed drive for the kiln fan (which is the most energy efficient means to reduce energy consumption); and use of high efficiency motors, variable speed drives and high efficiency fans on all other miscellaneous handling and control devices.

Section A.4 - Clinker Cooler

Particulate Matter (PM)

Emissions occur as a result of carryover of dust in the flue gas. Options for control of this filterable particulate include filter technology (i.e., baghouses), electrostatic precipitators and a scrubber.

Refer to the BACT discussion for the kiln for a description of the various means of particulate emission control that could be employed on the clinker cooler.

The proposed baghouse represents the top control technology for the clinker cooler. Given that the baghouse represents the top control technology for particulate matter emissions from the clinker cooler, no further analysis of electrostatic precipitators or scrubbers is required. The resulting BACT level of control for PM, utilizing a baghouse, source variability and supported by the permit application, is proposed to be set at 0.010 lb/ton clinker, 30-day rolling average.

The RACT/BACT/LAER Clearinghouse was also reviewed for similar operations to determine required control technologies across the United States. The Clearinghouse indicated that the PM_{10} BACT determination for Universal Cement is the best rate relative to all types of clinker coolers found on the clearinghouse database.

Section A.5 - Finish Mill

Finish Mill (when not firing fuel)

Particulate Matter (PM)

Options for control of filterable particulate from the finish mill include filter technology (i.e., baghouses). For a discussion of this available technology, refer to the earlier discussions for the kiln and clinker cooler.

The resulting BACT level of control for PM, utilizing a baghouse, and supported by the permit application, is proposed to be set at 0.60 lb/hour (derived from a 0.0008 gr/dscf outlet grain loading at the exhaust stack), for both PM/PM_{10} (filterable) and PM_{10} (total) for the mill when fuel is not fired. This is the same emissions concentration limit as is proposed for the kiln and clinker cooler exhaust stacks.

The RACT/BACT/LAER Clearinghouse was also reviewed for similar operations to determine required control technologies across the United States. The Clearinghouse indicated that this BACT determination for Universal Cement would be the lowest rate relative to all types of finish mills found on the RACT/BACT/LAER Clearinghouse.

Finish Mill (combustion of fuel)

1. Nitrogen Oxides (NO_x)

The combustion of fuel by the burners in the finish mill would emit NO_x, which is formed thermally from nitrogen contained in the ambient air that is introduced into the units as combustion air. The following emission control technologies were generally reviewed as possible control options for NO_x: 1) Ultra Low-NO_x burners; 2) Low-NO_x burners with Flue Gas Recirculation; 3) Selective Catalytic Reduction (SCR); 4) Selective Non-Catalytic Reduction (SNCR); 5) SCONOX; 6) water/steam injection; and 7) use of gaseous fuel.

Potentially Available Technologies

Ultra Low-NO_x Burners

Ultra low-NO_x burner technology is one means to control NO_x emissions. To obtain an optimal flame, large amounts of excess air must be combined with the fuel, but this creates high flame temperatures. To control the generation of thermal NO_x, ultra low-NO_x technology stages combustion in the high temperature zone of the flame. The first stage is a fuel-rich, oxygen-lean atmosphere where little oxygen is available for NO_x formation and which reduces peak flame temperatures by delaying the completion of the combustion process. Combustion is then completed downstream in the second stage where excess air is available but temperatures are lower than the hottest portion of the flame core.

Ultra-low NO_x burners are considered technically feasible to control NO_x emissions from the finish mill burner.

Ultra Low-NO_x Burners with Flue Gas Recirculation

Although Low-NO_x burners can be paired with flue gas recirculation in some instances to increase control efficiency, in this instance, flue gas recirculation with ultra low-NO_x burners is not a technically feasible control technology for the finish mill. The reason is that PM from the finish mill exhaust would foul the burner components, which would have a detrimental effect on combustion efficiency. In addition, the flue gas would have a lower O_2 concentration, resulting in an increase in emissions of CO and VOM.

SCR

Selective catalytic reduction (SCR) uses a chemical reaction to remove NO_x from the exhaust gas. The reaction between gaseous NO_x and a reagent, i.e., ammonia (NH_3), as it passes through a porous ceramic bed or screen impregnated with catalyst, reduces NO_x back to N_2. This reaction, which takes place in a temperature range of 575°F to 750°F, is considered very effective in controlling NO_x. As the exhaust temperature of the finish mill will be much lower than that for which the SCR would be effective, a re-heating unit would have to be employed for the SCR to be useful, as well as to avoid the incidence of ammonia slip. If the SCR were to be employed, the PM from the finish mill itself (which is combined with the emissions from the burner), would foul the catalyst of the SCR. Thus, SCR is considered an infeasible control technology in this case. Also, relative to the base case of no control, the cost per ton of NO_x removed (approx. $85,000/ton) was too large to warrant its use.

SNCR

SNCR is a flue gas treatment system that reduces post-combustion NO_x emissions using ammonia or urea injection, similar to SCR but without a catalyst. However, in the absence of a catalyst, higher temperatures in the range of 1600 to 2000°F are required for ammonia to selectively react with nitric oxide to form molecular nitrogen and water. Maintaining the desired temperature window is, therefore, one of the most important operating and design considerations. This desired temperature window will not be found in the finish mill system. Since SNCR does not use a catalyst, additional heating would have to be employed to significantly raise the temperature of the finish mill exhaust to the temperature at which the SNCR would function, as well as to avoid ammonia slip. Thus, the operation of an SNCR is considered infeasible.

SCONOx

SCONOx™ uses a potassium carbonate coated catalyst to reduce emissions of oxides of nitrogen, typically from natural gas-fired, water injected turbines. The catalyst oxidizes carbon monoxide to carbon dioxide, and nitric oxide (NO) to nitrogen dioxide. The carbon dioxide is exhausted while the nitrogen dioxide adsorbs onto the catalyst to form potassium nitrites and potassium nitrates. Dilute hydrogen gas is passed periodically across the surface of the catalyst to regenerate the coating. The regeneration cycle converts the potassium compounds back to potassium carbonate, water, and elemental nitrogen. The potassium carbonate is thereby made available for further adsorption and the water and nitrogen are exhausted. As with SCR, the SCONOx™ technology would suffer from PM fouling the catalyst since the finish mill exhaust would include process PM in the gas. Therefore, the use of SCONOx™ is considered technically infeasible. Additionally, Universal Cement found SCONOx™ to be cost-prohibitive because, relative to the base case of no control, the cost per ton of NO_x removed (over $100,000/ton) was too large to warrant its use.

Water/Steam Injection

The injection of steam or water into the combustion zone can decrease peak flame temperature, thus reducing thermal NO_x formation. Steam is injected either into the fuel, the combustion air, or directly into the combustion chamber. Water injection may be preferred over steam due to its availability, lower cost, and greater thermal effect. Water/steam injection is deemed infeasible because its use would defeat the purpose of the finish mill itself, namely, by adding rather than removing moisture from the material.

Use of Natural Gas

Natural gas is the design fuel for the burners in the finish mill. Accordingly, for the purpose of BACT, the use of natural gas is clearly a technically feasible control option for combustion emissions. In addition, natural gas has a very low fuel nitrogen content, resulting in very low fuel-bound NO_x emissions.

Ranking of Technologies

Of the feasible control options, the use of natural gas and ultra-low NO_x burners are available. The proposed BACT limit for NO_x, utilizing exclusively natural gas as a fuel and employing ultra-low-NO_x burner technology, as supported by the permit application, is 0.01 lb/mmBtu. The format of these limits (lb million Btu of heat input to the unit) is selected to be consistent with the format used by USEPA.

The RACT/BACT/LAER Clearinghouse was also consulted for similar units due to combustion to review required control technologies across the United States. The Clearinghouse indicated that the proposed NO_x BACT limit would be the lowest rate relative to all types of similar units found in the Clearinghouse.

2. Sulfur Dioxide (SO_2)

In the finish mill burners, the sulfur content of natural gas is low, so that the burners which utilize clean natural gas as fuel will be firing very low sulfur fuel. While wet scrubbing was also evaluated, the sulfur concentration is so low in the gaseous fuel for the burners that post-combustion SO_2 control ("flue gas desulfurization") would not be effective. Therefore, use of natural gas constitutes BACT for the finish mill burner.

3. Carbon Monoxide (CO)

To control CO emissions, the following technologies are available: good combustion practices, thermal oxidation, catalytic oxidation and excess air. For a discussion of these available technologies, refer to the earlier discussion for the kiln.

Upon review of the available technologies, the only feasible technology was the use of good combustion practices to reduce CO emissions.

The proposed BACT limit for CO for the finish mill utilizing good combustion practice, as supported by the permit application, is 0.080 lbs/mmBtu in any hour when fuel is fired.

The RACT/BACT/LAER Clearinghouse was also consulted for similar material dryers to review required control technologies across the United States. The Clearinghouse indicated that the CO BACT determination for the mill would be the lowest rate relative to all similar material dryers found in the Clearinghouse.

4. Particulate Matter (PM)

As already discussed, natural gas will be the design fuel for the finish mill. Particulate matter controls (like a baghouse), as discussed above for the process emissions of the finish mill when not firing fuel, will also be in place when fuel is combusted but it is not appropriate to rely upon them for control of emissions of combustion of natural gas, given the low concentrations of particulate.

The proposed BACT limit for PM for the finish mill when firing natural gas, as supported by the permit application, is 1.05 lbs/hour. This is derived from the limit for process emissions for the mill, 0.0008 gr/dscf, as discussed above for process emissions, and the USEPA's emission factor for natural gas for the mill's combustion emissions.

The RACT/BACT/LAER Clearinghouse was also reviewed for similar natural gas burner operations to determine required control technologies across the United States. The Clearinghouse indicated that this BACT determination for this mill would be the lowest rate relative to all types of similar mills found in the Clearinghouse.

Section A.6 - Milling and Material Handling

Particulate Matter (PM)

Universal Cement has proposed a variety of measures, including use of baghouses and implementation of work practices to control both so-called "stack" and "fugitive" emissions, from milling (of coal and raw material) and the handling of material with the potential to generate dust. The proposed BACT determination for PM emissions from coal and material handling is intended to require that PM emissions be effectively controlled while still providing appropriate operational flexibility in the manner with which this is accomplished in practice by the plant. This general approach has been taken because of the Illinois EPA's experience with material handling operations and associated control measures at coal-fired power plants, which is that these operations change over time as equipment ages and new systems, devices, and techniques become available. These types of changes can also occur during the detailed design and construction of a project, as new approaches to material handling operations are identified and impediments to the initial plans are identified. Accordingly, material handling operations at the proposed plant are most efficiently and consistently addressed from an administrative perspective through establishment of generic BACT control requirements, rather than with separate requirements for each individual operation.

For this purpose, the draft permit delineates two categories of material handling operations: 1) enclosed material handling and storage, and 2) handling of fuels. BACT is proposed as enclosure to prevent visible emissions. In addition, if PM emissions are aspirated to a control device, a filter or baghouse device must be used unless consideration of operational safety dictates another type of control device. This approach has been taken as filtration is generally considered the most effective active control technology for control of dust from material handling operations if it does not present safety concerns from the accumulation of combustible dust. Filters control PM emissions by passing dust-laden air through a bank of filter tubes suspended in the gas flow stream. A filter "cake", composed of captured particulate, builds up on the "dirty" side of the filter. Periodically, the dust cake is removed through a physical mechanism (e.g., a blast of compressed air from the "clean" side of the filter), which causes the dust to fall into a hopper or back into the process. The proposed approach for this category of operations requires very effective control of PM emissions, as control of fugitive emissions is addressed by the prohibition against visible emissions and control of stack emissions is addressed by the requirements and minimum performance specifications for control devices.

The resulting BACT level of control for PM for the milling and material handling, utilizing baghouses for control, and supported by the permit application, is proposed to be set at 0.004 grains per dry standard cubic foot.

The RACT/BACT/LAER Clearinghouse was also reviewed for similar operations to determine required control technologies across the United States. The Clearinghouse indicated that this BACT determination for Universal Cement would be the lowest rate relative to all types of milling and material handling found on the RACT/BACT/LAER Clearinghouse.

For raw material and fuel receiving hoppers, the performance standard proposed as BACT is opacity from affected units not to exceed 5 percent, accompanied by the timely collection of any spilled material that could become airborne after it dried. Aspiration of dust to control devices is not addressed as the moisture in the material must be sufficient to prevent direct emissions. This approach allows suppression or elimination techniques to be used along with the moisture present in a material and/or chemical or wet suppression, as appropriate, to address the handling of particular materials. This approach requires very effective control of PM emissions from material and fuel handling operations, as control of fugitive emissions is addressed by the prohibition against visible emissions and the further requirement to take actions to prevent secondary emissions from spilled material.

Section A.7 - Roadways and Open Areas

Particulate Matter (PM)

Universal Cement has proposed a variety of measures, including paving (roadways), sweepers and vacuum trucks to control emissions of fugitive dust from truck traffic on plant roads. The proposed BACT determination for roadways is intended to require that these emissions be effectively controlled while still providing appropriate operational flexibility in the manner with which this is accomplished in practice by the plant. This general approach has been taken because of the Illinois EPA’s experience with fugitive dust control programs. This experience indicates that dust control programs must be flexible to appropriately respond to changing operation and the weather (rain, hot, dry weather in the summer, and snow and ice in the winter). In addition, dust control programs change and evolve over time as new control techniques and service providers become available to control emissions. Accordingly, like material handling operations, roadways at the proposed plant are most appropriately addressed through establishment of broad BACT control requirements, rather than with detailed, prescriptive requirements for control of emissions.

For this purpose, the draft permit proposes two types of BACT requirements for roadways, an opacity requirement and a number of work practice requirements. First, control measures must be used such that opacity of emissions from truck traffic on roadways and windblown dust does not exceed 5 percent. Second, the required work practices for control of fugitive dust must include paving of regularly traveled roads and handling of collected dust in a manner that prevents it from being released back into the environment. This approach requires very effective control of PM emissions from roadways, as control of emissions is addressed both by a numerical opacity standard, which may readily be enforced by any qualified opacity observer and by specific requirements and performance standards for the fugitive dust control program.

Section A.8 - Emergency Engines

Emergency engines must be installed at the plant to provide reserve power for essential services during interruptions in the electrical supply system and in the event of a fire or other emergency. These engines will have to meet the 40 CFR 60, Subpart IIII New Source Performance Standards for stationary compression ignition internal combustion engines. For emergency engines that must have a dedicated reserve supply of fuel, BACT will be provided since, aside from meeting the recently promulgated New Source Performance Standards, ultra low-sulfur fuel must be used and operation is limited to 500 hours per year, unless specifically authorized by the Illinois EPA. Due to the use of ultra low-sulfur fuel, there will be both minimal annual emissions and lbs/mmBtu emission rates for SO2 from the engines.

Section A.9 - Startup, Shutdown and Malfunction (SSM)

During startup, shutdown and malfunction, the plant will be subject to the BACT limits for normal operation of the kiln and the other emission units at the plant. The required work practices for startup, shutdown and malfunction are intended to assure that appropriate measures are taken to minimize emissions from startup, shutdown and malfunction. For this purpose, the draft permit establishes certain basic measures that must be used to minimize emissions. It also establishes a general approach to minimize emissions through formal operating and maintenance procedures, which may be refined based on actual operating experience at the plant.

ATTACHMENT 3

Discussion of Lowest Achievable Emission Rate (LAER)

Pursuant to 35 IAC 203.301, an applicant seeking to construct a major source subject to Major Stationary Source Construction and Modification (MSSCAM) for a pollutant must demonstrate that the Lowest Achievable Emission Rate (LAER) will be applied for that pollutant. Similar to BACT, LAER is a requirement that addresses the lowest rate of emissions of the subject pollutant for a given class or category of emission unit. Since LAER must be determined for the proposed project for pollutants that are also subject to BACT, the determination of LAER must consider whether more stringent limits should be set for the pollutants as LAER is required. This would be possible as the determination of BACT reflect considerations or factors that are not relevant to the determination of LAER. It would also be possible as the determination of LAER may be directly dictated by relevant emission standards in State Implementation Plans. However, as a general matter, where best performing control technologies were selected as BACT for the proposed project and technologies were not rejected based on cost, environmental and energy impacts, it should be expected that LAER will be identical to BACT.

This attachment provides a discussion of the proposed determination of LAER for the plant for NO_x and SO_2, the pollutants emitted by the plant that would be subject to MSSCAM.

Kiln

NO_x

For the discussion of the proposed BACT technology for NO_x from the kiln, refer to Attachment 2, Section A.2. Staged combustion and use of SNCR as an add-on control technology will also serve to provide LAER for the kiln for NO_x. In the BACT determination for NO_x, no control technologies were rejected based upon consideration of cost, environmental and energy impacts.[22] The BACT limit for NO_x, considering the use of SNCR technology and the staged combustion design, source variability, and support from the permit application, is proposed to be set at 1.5 lbs/ton clinker (30-day rolling average).[23] The same limit is proposed as LAER.

As with the BACT determination, the RACT/BACT/LAER Clearinghouse was consulted to review required control technologies and emission limits for new and modified cement kilns across the United States. The information in the Clearinghouse indicates that the proposed NO_x LAER limit for the

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[22] Use of SCR was rejected based on consideration of feasibility, as may appropriately be considered when determining LAER.

[23] See 75 FR 54970, 54994 (September 9, 2010) National Emissions Standards for Hazardous Air Pollutants for the Portland Cement Manufacturing Industry and Standards of Performance for Portland Cement Plants for a recent discussion by USEPA of source variability and best demonstrated technology as related to cement kilns.

kiln at the proposed plant would be the best rate relative to all cement kilns addressed in the RACT/BACT/LAER Clearinghouse.

Emission standards for NO_x for cement kilns in the State Implementation Plans of various states were also reviewed. This review confirmed that the proposed NO_x LAER limit for the proposed plant is more stringent than these standards.

Universal Cement's LAER demonstration referred to information from different sources, including emission data for cement kilns compiled by USEPA during its recent rulemaking updating the NSPS for Portland cement plants. The LAER demonstration also cited other recently issued permits for new cement kilns, most notably, the permit for a kiln at Cemex Cement's plant in Brooksville, Florida. The emission rates for NO_x established in that permit served as one of the bases for the proposed BACT limit for the proposed kiln. The determination also demonstrated that low-NO_x combustion technology (staged combustion) and an SNCR system will constitute LAER for the proposed kiln.[24]

SO_2

For the discussion of the proposed BACT technology for SO_2 from the kiln, refer to Attachment 2, Section A.2. An in-line raw mill, preheater/precalciner kiln, and an add-on control system will also serve to provide LAER for the kiln for SO_2. In the proposed BACT determination, no control technologies were rejected based upon consideration of cost, environmental and energy impacts.[25] The BACT limit for SO_2, considering the required control technologies, source variability, and support from the permit application, is proposed to be set at 0.4 lb/ton clinker (30-day rolling average).[26] The same limit is proposed as LAER.

Emission standards for SO_2 for cement kilns in the State Implementation Plans of various states were also reviewed. This review confirmed that the

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[24] As with BACT, while use of whole scrap tires as a component in the fuel supply to the kiln system may reduce NO_x emissions, this practice cannot be considered available. It would necessitate use of a fuel whose continued commercial availability cannot be assured. In addition, the appropriate regulatory classification of scrap tires under federal regulation, i.e., whether they should be considered fuel or waste, is a matter that is currently being reviewed by USEPA. Classification of scrap tires as waste or additional restriction on the origin and handling of tires that could be used without being classification as waste, would have implications for the use of scrap tires by the plant, both as it affects the availability of such material and as it would threaten applicability of emission standards and requirements that the kiln would not be designed to comply with. Accordingly, use of whole scrap tires cannot be mandated as or relied upon as LAER for NO_x emissions from the kiln.

[25] Use of low-sulfur limestone was rejected based on availability, as may appropriately be considered when determining LAER.

[26] See 75 FR 54970, 54994 (September 9, 2010) National Emissions Standards for Hazardous Air Pollutants for the Portland Cement Manufacturing Industry and Standards of Performance for Portland Cement Plants for a recent discussion by USEPA of source variability and best demonstrated technology as related to cement kilns.

proposed SO_2 LAER limit for the proposed plant is more stringent than these standards.

As with the BACT determinations, the RACT/BACT/LAER Clearinghouse was consulted to review required control technologies for new and modified cement kilns across the United States. In this regard, the Clearinghouse identifies certain cement kilns in Florida and southwestern US with lower emission limits for SO_2. Upon examination, these kilns use (or propose to use) carbonate raw materials, commonly known as marl, with a sulfur content that is much lower than in the limestone that is available to the proposed plant. According to USEPA guidance,[27] the availability of a fuel or raw material in a given geographical area is a factor that may be considered when determining LAER ["A LAER requirement for low sulfur coal would depend, at least in part, on whether such fuel was available and in use in the nonattainment area in question."]. The lower sulfur-containing marl used in Florida cement kilns as a raw material, and similar materials in southwestern US kilns, are not available in the Midwest, so that the lower SO_2 emission limits for these cement kilns do not constitute LAER for the proposed kiln given the region in which it would be located.[28] Accordingly, the proposed SO_2 LAER limit for the proposed kiln is the best rate relative to similar cement kilns.

Finish Mill with burner

NO_x and SO_2

For the discussion of the proposed BACT technology for NO_x from the burner in the finish mill, refer to Attachment 2, Section A.5. The use of natural gas and an ultra low-NO_x burner will also serve to provide LAER for control of NO_x and SO_2. No control technologies were rejected for these pollutants based upon consideration of cost, environmental and energy impacts. The BACT limit for NO_x, based on use of natural gas with an ultra low-NO_x burner, supported by the permit application, is proposed to be set at 0.01 lb/million Btu. BACT for SO_2 is proposed as the exclusive use of natural gas. Identical requirements are proposed as LAER.

The RACT/BACT/LAER Clearinghouse was also consulted for similar operations to determine required control technologies for similar operations across the United States. The information in the Clearinghouse indicates that the proposed NO_x and SO_2 LAER determination for fuel combustion in the finish mill is the best rate relative to all finish mills addressed in the RACT/BACT/LAER Clearinghouse.

Engines

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[27] John Calcagni, USEPA, Memorandum, February 28, 1989, Guidance on Determining Lowest Achievable Emission Rate (LAER).

[28] In addition, transport of marl from limestone is would be uneconomical to allow for the use of these lower sulfur raw materials by the proposed plant.

The proposed determinations of LAER for the engines are identical to the determinations of BACT for the engines. The LAER determinations for the engines do not pose considerations that are not present with the BACT determinations for the engines.

Startup, Shutdown and Malfunction

During any SSM event, as described in Section A.9 of the BACT discussion, Universal Cement will continue to comply with LAER. Thus, LAER will be equivalent to BACT for any SSM event.

ATTACHMENT 4

Discussion of Alternatives to the Proposed Project

An applicant seeking to construct a major source subject to Major Stationary Source Construction and Modification (MSSCAM) must analyze alternatives to the project. Specifically, 35 IAC 203.306 provides that “[T]he owner or operator shall demonstrate that benefits of the new major source or major modification significantly outweigh the environmental and social costs imposed as a result of its location, construction, or modification, based upon an analysis of alternative sites, sizes, production processes, and environmental control techniques for such proposed source.”

The objective of Universal Cement for this proposed plant is to produce Portland cement for local markets. Its selection of Chicago for the location of the plant reflects a balancing of the monetary costs of necessary raw materials and fuel and the revenue from sale of product, with consideration of associated transportation costs. The location of the proposed plant on the Calumet River, a deep water port serving Lake Michigan, at a site with rail service and highway access, provides a favorable economic balance for the plant. Limestone may be readily delivered by lake barge. Other raw materials may be delivered by barge, rail or truck as most appropriate. This will serve to lower costs for limestone and other raw materials for the plant. The selected location for the plant also serves to increase revenues as the output from the plant would be able to be readily distributed to the established ready mix concrete market in the Chicago area.

An important issue for the location of any new cement plant is the implications for feasibility of complying with all applicable federal and state environmental regulations. The recent adoption of revised NESHAP regulations for the Portland Cement Manufacturing Industry highlights is a critical development in this regard. In order to comply with the revised NESHAP regulations, the developer of a new Portland cement plant must select a location where the plant can reasonably be assured of an adequate supply of suitable raw materials that will enable both reliable production of quality cement and compliance with all applicable requirements of the NESHAP regulations.

As explained by Universal Cement in its application, historically, a significant portion of the cement used within the Greater Chicago Area has been manufactured from limestone from quarries in northern Illinois (e.g., LaSalle County) and northern Indiana. However, with the adoption of the revised Portland Cement NESHAP, it is questionable whether this limestone can be utilized in the new cement kilns given the newly adopted NESHAP standards (e.g., the limit for THC emissions) and the performance of currently available emission control technologies. Thus, the typically abundant, readily extracted, high quality, high calcium limestone commonly found in northern Illinois and Indiana is not suitable for manufacturing Portland cement at a new plant in a manner that complies with the applicable NESHAP standards. Therefore, this proposed new plant must be developed to use limestone reserves located elsewhere in the Midwest.

One alternative that must be addressed in the analysis of alternatives for the proposed plant is location in areas where suitable limestone is present, considering other factors (e.g., transport of fuels and other raw materials), rather than in the area where the cement from the plant would be sold and used, as proposed by Universal Cement, with limestone shipped to the plant. Two alternative areas for the location of the proposed plant were generally considered, upstate Michigan, i.e., the area from which limestone for the plant is expected to come, and the area in which Portland cement plants serving Chicago and Illinois have historically been located, including northern Illinois outside the Chicago area.

The high quality and high calcium limestone in the Midwest can be found in southern Illinois/Missouri and upstate Michigan. Considering the logistics of the movement of these raw materials from southern Illinois/Missouri to a northern Illinois or Chicago location, transportation-related emissions would exceed that from sourcing the raw material from upstate Michigan. Considering the emissions generated, the costs of shipping fuels (e.g., petroleum coke) and supplemental raw materials (e.g., slag from steel furnaces), there is a significant emission and cost factor to ship these materials to either northern Illinois (outside of Chicago) or upstate Michigan and to then ship the manufactured cement back to Chicago to be distributed. One limitation with respect to a northern Illinois location is the required use of smaller, hence less efficient barges, relative to the more efficient lake freighters used on the Great Lakes.

Thus, to minimize emissions and the costs of raw material and fuel shipping across Lake Michigan, the Illinois River and land transport, Universal Cement has determined that locating the plant in Chicago minimizes both the economic and environmental costs of transporting fuels, raw materials and product i.e., the emissions generated and material shipment costs to Chicago produce lower emissions and is more cost-effective.

The plant is properly sized to address the current and projected needs of a significant portion of the ready mix concrete market within the Chicago, northern Indiana and southwest Michigan regions. Thus, based on proposed demand, the plant has not been oversized.

The following discussion for alternate production processes focuses mainly on use of other equipment that can be used for production of Portland Cement. The use of alternate raw materials was addressed in Attachment 2, Section A.2, regarding the BACT discussion for SO_2. Other technologies used to produce cement are wet process kilns and dry process kilns. However, these types of kilns represent older technologies that have been displaced by more efficient kiln technology such as multi-stage preheater/precalciner kilns. To quantify just this efficiency, measured in mmBtu per ton of clinker, the proposed 5-stage preheater/precalciner kiln will have a nominal rate of below 3.2 mmBtu/ton of clinker whereas wet and dry process kilns generally have nominal rates over 4.0 mmBtu/ton of clinker.

Related discussion of alternative production processes (each rejected due to lowering of energy efficiency) can be found in Section A.3 in the discussion regarding BACT for greenhouse gases.

Alternative control techniques are discussed in more detail throughout Attachments 2 and 3.

The location of the plant is consistent with the existing industrial nature of the immediate vicinity of the Lower Calumet River basin and the 2001 Calumet Area Land Use Plan produced by the Chicago Department of Planning and Development. Additional truck traffic will be generated, though the location will afford the plant the ability to maximize delivery of raw materials and fuels, and shipment of product by the efficient Chicago River system and Lake Michigan, and the extensive rail system and two major interstate highways in close proximity.

In addition to examining the environmental and social costs, the benefits of locating the plant at this location are (1) the creation of an estimated 400 temporary and 90 permanent jobs, (2) the subsequent economic vitality generated in the area (e.g., increased taxes will raise local property values), (3) revitalization of the industrial activity and (4) the utilization of existing railway, highway, and barge infrastructure to distribute the finished cement in the local area.

It has been shown that the air quality modeling impacts will not cause or contribute to exceedances of the NAAQS or PSD Increments. Further, emission will be offset (100 percent for SO_2 and 115 percent for NO_x). Finally, the vegetation and soils analysis for the proposed plant showed that ambient concentrations well below benchmark levels.

Universal Cement’s submittal of the analysis demonstrated that the benefits of this new plant significantly outweigh the environmental and social costs imposed as a result of its location and construction, based upon an analysis of alternative sites, sizes, production processes, and environmental control techniques for the proposed plant.

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