Illinois Environmental Protection Agency
Bureau of Air, Permit Section
Springfield, Illinois

Supplemental Project Summary for an Application for a Construction Permit/PSD Approval from Mississippi Lime Company for a Lime Manufacturing Plant near Prairie du Rocher

Site Identification No.: 157863AAC
Application No.: 08100063

Schedule for Reopening of Public Comment Period
Additional Public Comment Period Begins: April 18, 2014
Public Hearing: June 2, 2014
Additional Public Comment Period Closes: July 2, 2014

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I. INTRODUCTION

Mississippi Lime Company (Mississippi Lime) has applied for an air pollution control construction permit for a lime manufacturing plant. The plant would be constructed adjacent to Mississippi Lime's existing limestone mine north of Prairie Du Rocher. The plant would have two kilns to convert limestone into lime.

The Illinois EPA originally issued an air pollution control permit for the proposed plant in December 2010. However, that permit never became effective. This is because it was appealed to the USEPA and remanded back to the Illinois EPA for further consideration of certain matters.

The Illinois EPA has now conducted a further review of Mississippi Lime's application considering the remand of the original permit and new standards that have become effective since December 2010. The Illinois EPA has made a preliminary determination that the application for the proposed plant would still meet applicable requirements. Accordingly, the Illinois EPA has prepared a new draft of a construction permit that it would now propose to issue for the plant. However, before issuing a new construction permit for the plant, the Illinois EPA is reopening the public comment period, including holding another public hearing.[1] This will provide the public with the opportunity to comment on the further analyses and evaluations that have been conducted for the proposed plant in response to the remand of the original permit. This will also provide the public with the opportunity to comment on the associated changes to the draft construction permit that the Illinois EPA has now prepared for the proposed plant, as well as certain other changes to this draft construction permit.

II. BACKGROUND ON PROPOSED PLANT

Lime is manufactured in kilns by high-temperature roasting or "calcination" of limestone to drive off carbon dioxide and to convert the limestone into lime. The kilns are the principal sources of emissions at a lime manufacturing facility. They emit a variety of air pollutants, including particulate matter (PM), sulfur dioxide (SO_2), nitrogen oxide (NO_x), carbon monoxide (CO), volatile organic material (VOM) and greenhouse gases (GHG).[2] The emissions of these pollutants

[1] As part of the remand of the original permit, the Illinois EPA was directed to reopen the public comment period for this project. The public comment has now been reopened, as directed, in accordance with USEPA's "Procedures for Decision making," 40 CFR Part 124. For this purpose, a new draft permit has been prepared as provided for by 40 CFR 124.6. A new public comment period is being held as provided for by 40 CFR 124.10.

[2] Lime kilns emit particulate matter (PM) or dust that is generated from the limestone as it moves through the kiln and from ash released by the fuel burned in the kiln. They also emit sulfur dioxide (SO_2) due to the combustion of sulfur contained in the fuel and in the limestone feedstock. Lime kilns also emit nitrogen oxide (NOx), which is formed in a kiln when nitrogen and oxygen in the combustion air combine during burning of fuel. Lime kilns emit carbon monoxide (CO) and volatile organic material (VOM), which are products of incomplete combustion of fuel and the organic matter present in the limestone. Lime kilns also emit greenhouse gases (GHG) from the fuel that is burned in the kiln and from the calcination process, which

are controlled and minimized by a variety of measures and control equipment, including good combustion practices and process efficiency.

Mississippi Lime applied for a construction permit for a lime manufacturing plant with two rotary kilns with preheaters. The plant would be constructed adjacent to Mississippi Lime's existing limestone mine north of Prairie Du Rocher. The plant would process limestone composed primarily of calcium carbonate ($CaCO_3$) into high-calcium lime or calcium oxide (CaO), also known to as "quick lime". Some of the quick lime would be further processed by the addition of water to convert it into hydrated lime ($Ca(OH)_2$).

The two kilns at the plant would burn solid fuel, i.e., coal and petroleum coke. In addition to having an integral lime cooler that would recover heat to dry and preheat the fuel, each kiln would have a preheater at the exhaust end to heat the stone feed to the kiln using the heat in the hot flue gas from the kiln. These features will increase the energy or fuel efficiency of the kilns, lowering the amount of fuel that is used by the kilns. This will reduce the emissions of GHG and other pollutants from the kilns as these emissions are related to the fuel burned in the kilns. The emissions of the kilns would also be controlled by a combination of design, work practices and add-on emission control equipment. Emissions of NO_x, CO and VOM would be controlled by good combustion practices. PM emissions would be controlled by add-on baghouses or fabric filters. SO_2 emissions would be controlled by the natural ability of limestone and lime dust to absorb SO_2, with SO_2 then being removed from the flue gas in the dust collected by the fabric filters.

For further background on the proposed plant, one may refer to the project summary prepared by the Illinois EPA for the initial public comment period.[3]

III. THE REMAND OF THE ORIGINAL PERMIT

The Illinois EPA issued a construction permit to Mississippi Lime for this proposed plant on December 30, 2010 (original permit). As that permit provided approval to construct the plant under the federal rules for Prevention of Significant Deterioration of Air Quality (PSD), 40 CFR 52.21, parties who had submitted comments during the public comment period for this action had standing to petition the Environmental Appeals Board (EAB) of the USEPA to review the permit decision.[4] The Sierra Club filed such an appeal of the original permit with the EAB challenging a number of aspects of the permit. Following consideration

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drives off carbon dioxide (CO_2) from the limestone to convert it into lime.

3 Illinois EPA, *Project Summary for an Application for Construction Permit/PSD Approval from Mississippi Lime Company for a Lime Manufacturing Plant in Prairie Du Rocher, Illinois*, October 2010.

4 Construction permits issued by the Illinois EPA that provide approval to construct under the PSD rules, like the construction permit originally issued for the proposed plant, are subject to the federal procedures for appeal of PSD permits. This is because the Illinois EPA issued these PSD approvals under the federal PSD rules pursuant to a delegation of authority from USEPA.

of that permit and the petition for appeal, the EAB issued a Remand Order[5] on August 9, 2011 sending the permit back to the Illinois EPA for further consideration of certain matters. As a consequence of this remand, the original permit issued in 2010 never became effective.

Upon review of the original permit, the EAB found the support provided by the Illinois EPA for certain determinations that were made in conjunction with that permit was deficient. These aspects of that permit were set forth in the Remand Order. The EAB's Remand Order and the work that Mississippi Lime and the Illinois EPA have conducted in response to the Remand Order are discussed in detail in Appendix A of this Supplemental Project Summary. A listing of the changes to the permit that are now proposed, as reflected in the new draft permit, is provided in Appendix B of this Supplemental Project Summary.

As a general matter, the Remand Order found that the support or justification provided by the Illinois EPA to accompany a number of aspects of the original permit, as listed below, was not sufficient:

- The determination of Best Available Control Technology (BACT) for the kilns for startup and shutdown emissions.
- The determination of BACT for the kilns for emissions of SO_2.
- The BACT limits selected for the kilns for emissions of NO_x and filterable PM and PM_{10}.
- The determination that the SO_2 emissions of the proposed plant would not cause or contribute to a violation of the National Ambient Air Quality Standard (NAAQS) for SO_2 on a one-hour average.
- The decision to not establish SO_2 and NO_x emissions limits for the kilns based on one-hour averages to protect the one-hour SO_2 and NO_2 NAAQS.

Further evaluations have now been conducted in response to the Remand Order, as discussed in this Supplemental Project Summary. The further evaluations of BACT that have been conducted in response to the Remand Order are discussed in Attachments 1 through 4 of this Supplemental Project Summary. These evaluations have resulted in certain changes to the BACT limits for the proposed plant, as reflected in the new draft of a construction permit for the plant. The impact of the proposed plant on hourly air quality for SO_2 and NO_2 has also been further considered. The new draft of the construction permit would set limits for the SO_2 and NO_x emissions of the kilns that apply on a one-hour average to protect the one-hour SO_2 and NO_2 NAAQS.

IV. NEW REQUIREMENTS

[5] USEPA, Environmental Appeals Board, *Remand Order, In re: Mississippi Lime Company, Permit No. 157863AAC*, PSD Appeal No. 11-01, August 9, 2011 (Remand Order).

With the passage of time, there are a number of new "standards" or requirements that now apply to the proposed plant that did not exist or apply on December 30, 2010, when the original permit was issued in 2010.[6] These new requirements must also now be addressed by Mississippi Lime and the Illinois EPA as part of the permitting of the proposed plant. These new requirements that are now being addressed for the plant include the following:

1. Best Available Control Technology (BACT) for emissions of greenhouse gases (GHG). BACT is now required for GHG emissions because it became a regulated pollutant under the federal PSD rules on January 1, 2011. (See Attachment 5 of this Supplemental Project Summary for a discussion of the proposed BACT determination for the plant for GHG emissions.)

2. The revised National Ambient Air Quality Standard (NAAQS) for $PM_{2.5}$ on an annual basis. This revised NAAQS adopted by USEPA became effective on March 18, 2013.[7] (See Section VIII(B) of this Supplemental Project Summary for a discussion of the new analyses that were conducted to address the $PM_{2.5}$ NAAQS.)

3. The PSD increments for $PM_{2.5}$, which took effect on October 20, 2011. (See Section VIII(C) of this Supplemental Project Summary for a discussion of the new analyses that were conducted to address the PSD Increments for $PM_{2.5}$.)

V. OTHER REVISIONS

Changes are also proposed to certain aspects of the construction permit for the plant due to further consideration of the original permit by Mississippi Lime and the Illinois EPA.

A. Handling and Loadout of Lime

Mississippi Lime has identified several requirements in the original permit related to the emissions of particulate matter from the handling and loadout of the lime that need to be corrected. The original permit would not have allowed any visible emissions from the operations at which quick lime would be loaded out from the plant by truck, rail and barge, effectively requiring complete capture of particulate emissions from these operations. Upon further consideration, Mississippi Lime has realized that this is not possible. Because quick lime is a nodular or granular material[8] and is not transported or

[6] The emission standards that will apply to the emission units at the proposed plant, pursuant to the federal New Source Performance Standards (NSPS) and National Emission Standards for Hazardous Air Pollutants (NESHAP) and pursuant to state rules, have not changed since December 30, 2010.

[7] The USEPA revised 40 CFR 50.18, effective March 18, 2013, establishing a more stringent NAAQS for $PM_{2.5}$ on an annual basis, i.e., 12.0 $\mu g/m^3$, annual arithmetic mean, averaged over three years. (78 FR 3086, 3277, January 15, 2013)

[8] The physical forms of quick lime and hydrated lime, which this plant would also make by further processing quick lime, are significantly different. The hydrated lime would

shipped in tanks, it is not feasible for loadout of quick lime to be conducted in a way that eliminates the potential for uncaptured emissions. For the filter air pollution control devices used to control emissions from the transfer and storage of lime at the plant, the original permit also would have set an erroneous value for the control of emissions or the level of performance that these devices would be required to achieve, expressed as the mass of particulate in grains per standard cubic foot of exhaust (gr/scf). Finally, the limits set in the original permit for the emissions of some of these operations reflected certain mistakes in the emission data was originally provided for these operations by Mississippi Lime.[9]

Mississippi Lime has submitted additional material to support appropriate revisions to the provisions of the original permit for handling and loadout of lime, including a supplemental BACT demonstration for these operations.[10] To address uncaptured emissions from loadout of lime by barge, Mississippi Lime has proposed a limit for the opacity of emissions, i.e., 20 percent opacity, six-minute average. To address uncaptured emissions from loadout of quick lime into trucks and rail cars, Mississippi Lime has now proposed a limit on the presence of visible emissions from these loadout operations, i.e., total duration of visible emissions no more than 2.5 minutes in each hour. The limits proposed by Mississippi Lime would appropriately address operation of the devices that would capture emissions from these loadout operations, requiring effective operation of these devices as well as use of work practices that would reduce the generation of emissions. For the filter devices associated with handling and loadout of lime, Mississippi Lime has proposed a corrected value for the required performance of these devices, 0.005 grains per standard cubic foot of exhaust (gr/scf), rather than 0.0002 gr/scf. The corrected value would be identical to the performance requirement that has been set for the filter devices that would be used to control emissions from the material handling operations for limestone and solid fuel.

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be a free-flowing powder, which would be able to be transferred pneumatically in a stream of air. Given its physical form, hydrated lime would be transported in closed tanker trucks and hopper rail cars. All air displaced during loadout of hydrated lime would be captured and ducted to control equipment so that there will only be stack emissions.

[9] The original emission data provided by Mississippi Lime for loadout operations only addressed "controlled emissions," which would occur from the vents or stacks from the filter devices for these operations. The data did not account for any uncaptured emissions. For loadout of quick lime, for which not all emissions can be captured, Mississippi Lime has now provided data for uncaptured emissions.

The original emission data also contained mistakes for certain operations that would share a control device, with data provided for both operations. For certain other operations, control efficiency was applied a second time when $PM_{2.5}$ emissions were being determined. However, mistakes were not present in the original emission data due to the level of performance, in gr/scf, that was used for filter devices. In particular, the original emission data was not based on the erroneous rate of 0.0002 gr/scf, as would have been required by the original permit.

[10] Mississippi Lime Company, *Lime Processing And Handling Addendum to Supplemental Remand Analysis*, December 4, 2013.

Mississippi Lime has also made corrections to the emission data it provided for these operations.

The revisions to the provisions of the permit for handling and loadout of lime that Mississippi Lime has proposed are appropriate. The revised provisions would more accurately and properly address the emissions of these operations while still requiring use of BACT. The revised air quality air analyses for $PM_{2.5}$ that Mississippi Lime has now submitted use the corrected emissions data for these operations, which includes data for the uncaptured emissions from the loadout of quick lime. Mississippi Lime has also submitted revised analyses for PM_{10} air quality based on corrected emission data for PM_{10}. Accordingly, the revised draft of the construction permit for the plant that the Illinois EPA has prepared would include the revisions that Mississippi Lime proposed for these operations. The further evaluations of BACT that have been conducted for these operations are discussed in attachments to this Supplemental Project Summary. (Attachment 6 addresses the requirements for uncaptured emissions from loadout of quick lime and Attachment 7 addresses the performance requirement for filter devices.)

B. Very Low-Load Operation of the Kilns

In the revised draft of the construction permit, the criterion for very low-load, “non-productive” operation of the kilns would be revised. This criterion is important for the primary BACT limits for pollutants other than GHG from the kilns. These limits are expressed in terms of the allowable emissions per ton of lime produced. Because these limits are expressed in terms of production, they cannot be directly applied during periods when lime is not being produced by a kiln, i.e., during the initial part of startup and the last part of shutdown. Because these limits are based upon emission data that reflect normal operation of lime kilns, with normal process and thermal efficiency, the original permit generally provided that the primary BACT limits would not apply during very low-load operation of the kilns. This served to appropriately address the entirety of startups and shutdowns of the kilns. It also served to address periods when a kiln would be temporarily placed on hot-standby because of breakdowns of the associated equipment handling the flow of limestone, fuel or lime to or from a kiln. During such periods, instead of being subject to the primary BACT limits for pollutants other than GHG, in pounds per ton of lime, the emissions of the kilns would be subject to secondary BACT limits expressed in pounds of emissions per hour. Upon further review of the operation of rotary lime kilns, Mississippi Lime has concluded that very-low load operation of a kiln is better defined as operation at less than 30 percent of the capacity of the kilns, rather than as less than 20 percent of capacity. The new draft of the permit reflects this revised criterion for very low-load operation of a kiln, while otherwise maintaining consistency with the approach to very-low load operation taken in the original permit.

C. Emergency Engine Generators

The emergency engines at the proposed plant would now be explicitly addressed in the draft construction permit for the proposed plant. Each of the proposed kilns will have a small diesel oil-fired engine generator, with a capacity of less than 500 horsepower, to supply emergency power. The purpose of these units will be to prevent damage to the kilns by maintaining rotation of the kilns when the plant loses electric power from the grid. These units will not be large enough to maintain the actual operation of the kilns during power outages. While these engines were addressed by Mississippi Lime in its original application, they were not addressed in the original construction permit. They are now addressed in the revised draft of the construction permit. The relevant provisions of the permit would restrict the operation of these engines to the role described by Mississippi Lime in its application.

VI. EMISSIONS OF THE PROPOSED PLANT AND APPLICABILITY OF PSD

A summary of the permitted or potential emissions of PSD pollutants from the proposed plant as would be allowed by the new draft permit is provided below. In practice, the actual emissions from the plant should be less than the permitted emissions as units operate at less than their maximum capacity and emission rates are normally lower than the applicable standards and limits.

Summary of the Permitted Annual Emissions of the Proposed Plant (Tons/Year)

Pollutant	Permitted Emissions
NO_x	1,533
CO	1,095
SO_2	219
$PM/PM_{10}/PM_{2.5}$	107/106/53.7
VOM	22
GHG, as CO_2e	1,201,878

The proposed plant is subject to the substantive requirements of the federal PSD rules for certain pollutants.[11] For these pollutants, the PSD rules require: 1) “emission limits” on the emission units at the plant that represents Best Available Control Technology (BACT), 2) an assessment of the impact of the plant’s emissions on air quality, and 3) an analysis of impacts of the plant’s emissions on soils, vegetation, and visibility. The Illinois EPA administers the federal PSD permit program in Illinois pursuant to a delegation of authority from USEPA.

[11] The proposed plant would be located in an area that is classified as attainment or unclassified for all criteria air pollutants. Accordingly, the plant is not subject to Illinois’ rules for Nonattainment New Source Review (Major Stationary Sources Construction and Modification, 35 IAC Part 203) for any pollutants.

The proposed plant is subject to PSD for emissions of SO_2, NO_x, CO, PM and PM_{10} because the plant's permitted emissions of these pollutants would each be more than 100 tons/year. The plant is also subject to PSD for emissions of particulate $matter_{2.5}$ ($PM_{2.5}$) because its permitted emissions of $PM_{2.5}$ would be more than the significant emission rate for $PM_{2.5}$ set by the PSD rules.[12] Finally, the proposed plant is now subject to PSD for GHG because its GHG emissions would be more than 100,000 tons/year.[13]

As a general matter, the relevant requirements of the PSD rules as of December 31, 2012 were addressed with the issuance of the original permit in 2010. Due to the remand of that permit, the Illinois EPA has now further evaluated and reconsidered certain aspects of those requirements of the PSD rules as directed by the Remand Order. The Illinois EPA has also addressed certain new requirements under the PSD rules that are now applicable for the plant.

VII. BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

The federal Clean Air Act defines BACT as "... an emission limitation based on the maximum degree of reduction ... which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable ....".

Mississippi Lime submitted a BACT demonstration in its application reflecting its judgment as to the emission control technology and associated emission limits that should be considered BACT under the PSD rules for various units at the plant. The BACT demonstration evaluates various technologies that could be used to control emissions of different pollutants. It also includes a review of the emission limits set as BACT for other lime plant projects in the country that were subject to PSD permitting.

The Illinois EPA has reviewed the material submitted by Mississippi Lime and made its independent determination of BACT. In addition to the material submitted by Mississippi Lime, the Illinois EPA's determination of BACT relies upon its general knowledge of the types of operations at the plant. As a general matter explained below, the Illinois EPA concurred with Mississippi Lime's selection of control technologies as it reflected technologies that are commonly used at lime manufacturing plants and effectively control emissions. The Illinois EPA's determination of BACT for the proposed plant, as now set forth in the new draft permit, would establish stringent performance requirements for the use of this control technology at the proposed plant.

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[12] Under the PSD rules, 40 CFR 52.21(b)(23), the $PM_{2.5}$ emissions of a proposed construction project are considered significant if the increase or net increase in annual emissions is equal to or greater than 10 tons per year.

[13] The permitted emissions of the proposed plant for other PSD pollutants would not be significant. For example, the permitted VOM emissions of the plant would be less than 40 tons/year and permitted emissions of sulfuric acid mist would be less than 7 tons/year.

The BACT requirement of the PSD rules was generally addressed for the proposed plant with the issuance of the original permit. As already discussed, in response to the remand of the original permit, the Illinois EPA has now further evaluated and reconsidered certain aspects of the original BACT determination for the proposed plant as directed by the Remand Order (see Attachments 1 through 4.) The Illinois EPA has also addressed BACT for emissions of GHG, as now required for the proposed plant by the PSD rules. (see Attachment 5). Finally, the Illinois EPA has reevaluated BACT for handling and loadout of lime, for which Mississippi Lime has requested revisions to the original determination of BACT and the provisions of the original permit (see Attachments 6 and 7). As is appropriate, the various further evaluations of BACT were conducted in accordance with the Top-Down Process that USEPA broadly endorses for BACT determinations.[14]

VIII. AIR QUALITY ANALYSIS

As required by the PSD rules, Mississippi Lime has submitted air quality analyses that assess the potential effect of the proposed plant on ambient air quality. The analyses were conducted by Shell Engineering & Associates, Inc. The analyses addressed the impacts of emissions of particulate, NO_x, CO, and SO_2, i.e., the PSD pollutants that would be emitted in significant amounts by the proposed plant and for which NAAQS have been established. The analyses used reference dispersion models and other approved methodology. The results of these analyses follow.

The air quality analysis requirement of the PSD rules was addressed with the issuance of the original permit in 2010.[15] As a consequence of the remand of the 2010 Permit, the Illinois EPA has now further evaluated and reconsidered certain aspects of the air quality for the proposed plant as directed by the Remand Order. The Illinois EPA has also addressed the new requirements of the PSD program related to air quality that are now applicable relative to the plant's impacts on air quality for $PM_{2.5}$.

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[14] As a general matter, the "Top-Down" BACT process consists of the following five steps for each determination of BACT that is required for the emissions of a pollutant from new or modified emission units:
  Step 1 - Identify all available control technologies
  Step 2 - Eliminate technically infeasible control technology options
  Step 3 - Rank remaining control technologies by control effectiveness
  Step 4 - Evaluate most effective control technologies and document results
  Step 5 - Select BACT limit.

[15] As part of its original application, Mississippi Lime conducted an analysis of the impact of the proposed project on visibility in the wilderness area at the National Mingo Wildlife Refuge in southeastern Missouri. This area is a Class I Area under PSD rules. This analysis was not sent to the federal land manager for this area for review before the original draft permit was made available. This oversight was identified in March 2014 and has been rectified. This analysis was sent to the responsible federal land manager before the public comment was initiated on this new draft permit. The federal land manager reviewed the analysis and concluded that the proposed project would not pose concerns for impacts on visibility.

A. Additional Analysis for the Hourly SO_2 NAAQS

In response to the remand of the 2010 Permit, a new analysis of the hourly SO_2 air quality impacts of the proposed lime kilns was conducted to address the one-hour SO_2 NAAQS. The modeling was based on the maximum hourly SO_2 emission rates from the kilns, 40 lbs/hr per kiln.[16] The hourly significant impact level (SIL) for SO_2 adopted by USEPA, 7.85 µg/m^3, was used for this new analysis.[17, 18]

This new analysis was conducted using the updated modeling tools that are now contained in the model.[19] The new analysis included monitored background concentrations[20] and modeled impacts from existing sources in Illinois and Missouri. The preliminary modeling analysis indicated the proposed plant would have significant air quality impacts for SO_2 on an hourly basis, i.e., the maximum modeled impacts of the plant were above 7.85 µg/m^3. Accordingly, full impact modeling was conducted to address compliance with the one-hour SO_2 NAAQS. The full impact analysis showed exceedances of the one hour SO_2 NAAQS on certain days at certain receptors. However, the proposed plant would not contribute significantly to these modeled exceedances using the applicable SIL of 7.85 µg/m^3.

B. Additional Analyses for the $PM_{2.5}$ and PM_{10} NAAQS

USEPA revised the NAAQS for annual $PM_{2.5}$, lowering it to 12 µg/m^3 from 15 µg/m^3.[21, 22] A full air quality impact assessment was previously completed to address the direct emissions of $PM_{2.5}$ from the proposed plant. That assessment has been updated to address the revised NAAQS for annual $PM_{2.5}$. This revised assessment for $PM_{2.5}$ also addresses uncaptured emissions from loadout of lime,

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[16] The original modeling to address the 1-hour SO_2 NAAQS used an SO_2 emission rate of 32.3 lb/hr per kiln, averaged over a three hour period. This limit, as present in the original permit, would also be retained by the new draft permit. This is because this SO_2 emission rate was used in the air quality analysis that was conducted and was relied upon to show that the proposed plant would not threaten compliance with the 3-hour SO_2 NAAQS.

The additional limit that would be set for the hourly SO_2 emissions of each kiln, 40 lb/hr, is higher than this rate. It addresses the maximum emission rates of the kilns when considered on an hourly basis, rather than on a longer, three-hour average.

[17] The original modeling, in the absence of any formal guidance from USEPA for a SIL, utilized a SIL of 10.0 µg/m^3, as recommended by Illinois EPA staff based on informal discussions with USEPA staff.

[18] USEPA has now issued definitive guidance and updated modeling tools to address the 1-hour NAAQS for SO_2. At the time of the previous analysis, no SIL had been recommended by USEPA, and no detailed guidance or regulatory modeling tools were available from USEPA for culpability analyses for the 1-hour SO_2 NAAQS. These were necessary because of the complex form of the one-hour SO_2 NAAQS, which applies as a 99th percentile one-hour daily maximum concentration, averaged over a period of three years. The guidance and modeling tools that are now available from USEPA enable straight-forward air quality analyses to address the 1-hour SO_2 NAAQS.

[19] AERMET (11059) and AERMOD (12060)

[20] Ambient hourly and seasonal data obtained from the monitor in Nilwood, Illinois.

[21] USEPA, NAAQS Particulate Matter Final Rule, 78 FR 3086 (Jan. 2013)

[22] In this rulemaking, the 24-hour NAAQS for $PM_{2.5}$, 35 µg/m^3, was not revised by USEPA.

considers new background monitoring data for $PM_{2.5}$ and also considers the secondary $PM_{2.5}$ impacts from the SO_2 and NO_x emissions of the plant as these pollutants are precursors to formation of $PM_{2.5}$ in the atmosphere.

The direct $PM_{2.5}$ impacts for the plant and from existing sources in the background inventory for the area, as well as secondary $PM_{2.5}$ impacts for the plant and existing sources, were considered in the full impact assessment for comparison to the $PM_{2.5}$ NAAQS. A modeled design value for the direct impacts from the plant and nearby sources was determined using dispersion modeling with the AERMOD regulatory model. The secondary impacts of the proposed plant were estimated using ratios calculated from existing regional photochemical CAMx modeling analyses. Secondary impacts from existing sources are accounted for as they contribute to background concentrations of $PM_{2.5}$, as measured at the ambient monitoring station in Baldwin.

The modeled direct impact design values for the plant and nearby sources were developed as described in USEPA's March 2010 guidance.[23] The cumulative design values are 1.73 $\mu g/m^3$, annual, and 5.01 $\mu g/m^3$, 24-hour. The predicted secondary impacts account for the formation of $PM_{2.5}$ from NO_x and SO_2 emitted by the plant. A peer-reviewed, regulatory model is not currently available to examine the secondary $PM_{2.5}$ impacts from individual sources of NO_x and SO_2, so a ratio was developed based on previous regional modeling for the region conducted by USEPA in developing its Cross State Air Pollution Rule (CSAPR).[24] During its extensive cross-state analysis,[25] USEPA conducted two modeling runs using the regional models CAMx that predicted secondary $PM_{2.5}$ impacts at various ambient monitoring stations based on two different inventories for NO_x and SO_2 emissions, one without CSAPR and one with CSAPR. Using the two scenarios, differences in state emissions input to the modeling runs were correlated with changes in predicted $PM_{2.5}$ impacts at the nearby ambient monitoring station in Baldwin, Illinois. A ratio of the potential NO_x and SO_2 emissions of the proposed plant compared to Illinois' overall NO_x and SO_2 emissions as used by USEPA in its modeling was then used to predict secondary $PM_{2.5}$ impacts due to the precursor emission from the proposed plant. The estimated secondary $PM_{2.5}$ impacts are 0.18 $\mu g/m^3$, annual average, and 0.23 $\mu g/m^3$, 24-hour average

The secondary impacts from NO_x and SO_2 emissions of the nearby sources were accounted for as these impacts are included in the background concentration determined from a representative ambient

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[23] USEPA, *Modeling Procedures for Demonstrating Compliance with $PM_{2.5}$ NAAQS*, March 2010.
The relevant provisions of this guidance are confirmed by USEPA's March 14, 2013 public draft of new guidance.

[24] USEPA, Final Rule, *Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals*, 40 CFR Parts 51, 52, 72, 78 and 97, 76 FR 48208 (Aug. 8, 2011).

[25] USEPA, *Air Quality Modeling Final Rule Technical Support Document* (associated with Cross-State Air Pollution Rule), June 2011.

monitor. The ambient monitor is located in Baldwin, Illinois, approximately 30 km east northeast of the proposed plant. Data from the monitor for the years 2010, 2011, and 2012 provided design values of 9.3 μg/m^3, annual, and 17.8 μg/m^3, 24-hour. Since ambient monitors measure all $PM_{2.5}$, both primary and secondary, the primary $PM_{2.5}$ impacts from sources near the monitor that were modeled were double-counted using this approach to the contribution of existing sources.

When the modeled primary contribution from the plant and existing sources in the background inventory, the monitored background and the projected secondary impact from the plant are added together, the maximum predicted concentrations overall are 11.21 and 23.04 μg/m^3 on an annual and 24-hour basis, respectively, as shown in the table below. These concentrations comply with the $PM_{2.5}$ NAAQS. Since the emission rates used for the proposed plant in the model are the same as the emission limits in the new draft permit, the full impact assessment demonstrates that the emission limits are protective of the $PM_{2.5}$ NAAQS.

The table below also includes the results of the additional analysis for the PM_{10} NAAQS that were conducted to address changes in the permitted PM_{10} emissions from processing and handling of lime at the plant. This analysis continues to show that the emissions of the plant would not threaten the PM_{10} NAAQS.

<u>Full Impact Assessment for the $PM_{2.5}$ and PM_{10} NAAQS (μg/m³)</u>

	Averaging Period	Modeled Impacts	Monitored Background	Projected Secondary Impact	Cumulative Design Value	NAAQS
$PM_{2.5}$	Annual	1.73	9.30	0.18	11.21	12
	24-hour	5.01	17.80	0.23	23.04	35
PM_{10}	24-hour	29.23	50.00	-	79.23	150

C. Additional Analyses for the PSD Increments for $PM_{2.5}$ and PM_{10}

The PSD Increments for $PM_{2.5}$ are a new requirement that must be addressed for the proposed plant. An air quality analysis has now been conducted to address the PSD increments for $PM_{2.5}$[26] The PSD increments for $PM_{2.5}$ for Class II Areas, like the area in which the proposed plant would be located, are 4 μg/m^3, annual average, and 9 μg/m^3, 24-hour average, with a minor source baseline date of October 20, 2011.[27]

There are no other new or modified facilities in the baseline area for the proposed plant, which would consume increment if present. Accordingly, this analysis only needed to consider the impacts of the proposed plant. This analysis considered impacts from the plant due to both primary and secondary $PM_{2.5}$. Primary

[26] Even though the USEPA adopted Class II PSD increments for $PM_{2.5}$ on October 20, 2010, the "trigger date" for these new increments was October 20, 2011.
[27] USEPA, $PM_{2.5}$ PSD Increment, SILs, SMC Final Rule, 75 FR 64864 (October 20, 2010).

impacts were projected using dispersion modeling with the AERMOD regulatory modeling system. Secondary impacts were estimated using ratios calculated from existing regional photochemical CAMx modeling analyses.[28]

Consistent with USEPA's guidance for evaluating increments for $PM_{2.5}$, the annual increment design value was calculated as the highest annual average for each modeled year. The 24-hour increment design value was calculated as the highest of the 2nd highest modeled impacts for each year.

As already discussed for the analysis for the $PM_{2.5}$ NAAQS, the predicted secondary impacts account for the formation of $PM_{2.5}$ from NO_x and SO_2 emitted by the plant as they are precursors to formation of $PM_{2.5}$ in the atmosphere was developed based on previous regional modeling for the region conducted by USEPA in developing CSAPR.[29] During its extensive cross-state analysis,[30] USEPA completed two regional CAMx modeling runs that predicted secondary $PM_{2.5}$ impacts at various ambient monitoring stations based on two emissions inventories, one without CSAPR and one with CSAPR. Using the two scenarios, differences in state emissions input to the models were correlated with changes in predicted impacts at the nearby ambient monitoring station in Baldwin, Illinois. A ratio of the potential NO_x and SO_2 emissions of the proposed plant compared to Illinois' overall emissions was then used to predict secondary $PM_{2.5}$ impacts in the area.

When the modeled primary design value and projected secondary impacts are added together, the total $PM_{2.5}$ impacts are 1.50 $\mu g/m^3$ annual and 7.03 $\mu g/m^3$ 24-hour. As shown in the table below, these impacts are well within the $PM_{2.5}$ increments.[31]

The table below also includes the results of the additional analyses for consumption of PSD increments for PM_{10} that were conducted to address changes in the permitted PM_{10} emissions from processing and handling of lime at the plant. These analyses continue to show that the impacts would be within the PM_{10} increments.

<u>Analyses for Consumption of the PSD Increments for $PM_{2.5}$ and PM_{10} ($\mu g/m^3$)</u>

	Averaging Period	Modeled Primary Impacts	Predicted Secondary Impact	Total Increment Consumption	Applicable Increment

[28] Comprehensive Air Quality Model with Extensions (CAMx).
[29] USEPA, Final Rule, *Federal Implementation Plans: Interstate Transport of Fine Particulate Matter and Ozone and Correction of SIP Approvals*, 40 CFR Parts 51, 52, 72, 78 and 97, 76 FR 48208 (Aug. 8, 2011)
[30] USEPA, *Air Quality Modeling Final Rule Technical Support Document* (associated with Cross-State Air Pollution Rule), June 2011.
[31] The maximum values for primary $PM_{2.5}$ impacts occur at locations very near the plant. The secondary $PM_{2.5}$ impacts would occur many miles away and later in time. Therefore, adding the two impacts together provides a conservative assessment.

	Averaging Period	Modeled Primary Impacts	Predicted Secondary Impact	Total Increment Consumption	Applicable Increment
$PM_{2.5}$	Annual	1.32	0.18	1.50	4
	24-hour	6.80	0.23	7.03	9
PM_{10}	Annual	4.90	---	4.90	17
	24-hour	28.88	--	28.88	30

IX. CONDITIONS OF THE NEW DRAFT PERMIT

Most of the terms and conditions of the new draft permit are identical to those of the 2010 Permit. In this regard, the new draft permit would set forth the air pollution control requirements that the plant must meet. These requirements include the applicable emission standards that apply to the plant. They also include the control measures that must be used and the emission limits that must be met as BACT for emissions of different pollutants from various emission units at the plant. The permit would also establish enforceable limits on the amounts of emissions for which the plant is permitted. In addition to annual limits on emissions, the permit includes short-term and operational limitations as needed to provide practical enforceability of the annual emission limit and to protect air quality. The permit would also establish appropriate compliance procedures for the ongoing operation of the plant, including requirements for emissions testing, required work practices, operational monitoring, 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 emission units.

The new draft of the construction permit for the proposed plant also includes certain additional conditions and certain revisions to conditions compared to the original construction permit. These additions and changes have been made as a consequence of the further evaluations conducted in response to the remand and to address new requirements that have arisen since the remand. The new draft of the permit also includes changes that are a result of further consideration of the original permit by Mississippi Lime and the Illinois EPA. These differences between the new draft and the original construction permit are summarized in Appendix B of this Supplemental Project Summary.

X. REQUEST FOR COMMENT

Based on the further evaluations that have been conducted, it is the Illinois EPA's preliminary determination that the proposed plant meets applicable state and federal air pollution control requirements. The Illinois EPA is therefore proposing to issue a construction permit for the project.

Comments are requested on the additional evaluations and the new determinations that the Illinois EPA is proposing to make and the related conditions of the new draft permit.

ATTACHMENT 1:

Supplemental BACT Analysis for Startup of the Kilns

INTRODUCTION

The startup of the proposed lime kilns will require gradual heating of the kilns using a startup fuel before coal and coke begin to be fired. The gradual heating of the kilns during startup prevents damage to the refractory lining and steel shell of the kilns. The fuel used for the initial heating of the kilns during startup must be able to be readily combusted in a cold kiln and contain sufficient heat so the initial heating of the kiln can be readily managed and occur efficiently. The fuels that are typically used for the initial heating of lime kilns during startup are natural gas and distillate fuel oil.[32] The fuel that would be used for regular operation of the kilns, i.e., a blend of coal and coke, cannot be used for this purpose. These fuels can only be fired after a kiln has been heated to a temperature at which combustion of these fuels will be sustained.[33]

Emissions of various pollutants from startup of lime kilns may be lowered by the use of a "clean fuel" for the initial heating of the kiln. Mississippi Lime has proposed to use ultra-low sulfur distillate fuel for the initial heating of the kilns during startup. Distillate oil is commonly used as a startup fuel in lime kilns. Distillate oil would be delivered to the proposed plant by truck and kept in storage tanks for use as needed for startup. While natural gas is also commonly used for startup of lime kilns, the site of the proposed plant does not have natural gas service and a pipeline would have to be built to bring natural gas to the plant.

Mississippi Lime has provided additional information to further support a determination that use of low-sulfur distillate oil for startup of the kilns, as it has proposed, constitutes BACT. In particular, Mississippi Lime has now provided detailed cost information as appropriate for a Top-Down BACT

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[32] Because shutdown of a kiln starts with a hot kiln, which is at normal operating temperatures, a "shutdown fuel" is not used during the shutdown of a kiln. In preparation for a shutdown, the operating rate of a kiln is reduced to the lowest level at which normal operating temperatures may be readily maintained in the kiln. Shutdown of the kiln is then initiated by turning off the flow of fuel to the kiln and emissions from fuel combustion cease. The feed of limestone to the kiln is also stopped, the rotation rate of the kiln is reduced, and the operation of the fans that blow air through the kiln is reduced. The residual heat in the hot refractory of the kiln enables some of the limestone in the kiln at the start of the shutdown to continue to undergo calcination as the kiln slowly cools. At some point, further calcination ceases. Since the ductwork from the kiln will not include a bypass vent, particulate emissions during shutdown continue to be controlled by the baghouse.

[33] Milled coal and coke can only begin to be fed into a kiln when the temperatures are high enough that combustion of the stream of fuel blown into the kiln, once ignited by the flame of the startup fuel, is self-sustaining. The temperature of the refractory in the flame zone of the kiln is critical for combustion of solid fuel to be self-sustaining. Until the refractory is hot enough, the radiant loss of energy from the flame will be too great for combustion, i.e., the flame inside the kiln, to continue far enough for all of the solid fuel being blown into the kiln to be consumed. The temperature of the flue gas from the kiln is also important for combustion to be self-sustaining. A portion of this flue gas is diverted and used to blow the milled fuel into the kiln until hot air is available from the lime cooler for this purpose.

analysis that shows that use of natural gas or other feasible alternative clean fuels for startup would have excessive cost impacts. The Illinois EPA concurs with this finding. In particular, for use of natural gas, this is because the cost of obtaining natural gas service is large because several miles of pipeline would have to be constructed at Mississippi Lime's expense. The use of natural gas for startup would provide only small reductions in emissions compared to use of distillate oil.

Aspects of the emission control technology for the kilns for startup other than the startup fuel are not addressed in this discussion. These other aspects of control of emissions are the same as those during normal operation of the kilns and are addressed in the general BACT analyses for the kilns.[34]

TOP-DOWN PROCESS - STEP 1
(Identification of "Available" Control Technologies)

In Step 1 of the Top-Down BACT Process, all "available" control options with potential application for the pollutant and emission units that are the subject of the BACT analysis are identified. This supplemental BACT analysis is focused on the fuel that is used for the initial heating of the kilns during startup. As already noted, aspects of the emission control technology for the kilns for startup other than the selected fuel are the same as those for normal operation of the kilns and are addressed in the general BACT analysis for the kilns.

The emissions of various pollutants from the proposed kilns during startup may be minimized by the selection of a "cleaner" fuel for startup. Natural gas, propane, biodiesel and biomass fuels are all possible cleaner fuel alternatives to use of distillate oil during startup of these kilns. The use of these fuels would lower GHG emissions. Natural gas and propane contain less carbon and emit less CO_2 when burned. Biodiesel and biomass fuel are biogenic in origin. The use of these fuels during startup would also be expected to lower emissions of NO_x. The use of some of these alternative fuels would also result in slightly lower SO_2 emissions because they contain less sulfur than low sulfur distillate fuel oil.

TOP-DOWN PROCESS - STEP 2
(Evaluation of Technical Feasibility of Available Control Technologies[35])

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[34] For example, during startup of the kilns, as during normal operation, particulate emissions from firing of coal and coke will be controlled by the baghouses. Bypass of the kiln baghouse will not be allowed during startup and the ductwork from the kilns will not have bypass vents. SO_2 emissions will be controlled by the natural scrubbing of SO_2 by the kiln dust.

The preheaters on the kilns will also be loaded with limestone during startup. However, limestone will only begin to be fed into a kiln when the temperature at the feed end of the kiln approaches the normal operating temperature. Because the flow of exhaust gas from the kiln would be less than the normal flow, the limestone initially fed into the kiln would be cooler than during normal operation. The level of energy recovery from the flue gas provided by the preheaters would be lower than that during normal operation of the kilns, when the calcination process starts on the surface of the limestone in the preheater.

[35] In Step 2 of the Top-Down Process, an evaluation of the technical feasibility of the available control options is made to identify options that are not technically feasible.

The only available alternative fuel determined to not be technically feasible was biomass fuel. A commercial fuel with consistent fuel properties that is readily combustible is needed to safely heat a kiln during the initial phase of startup. Biomass fuels would not readily combust in a cold kiln, as is essential. They would not provide the responsiveness needed so that startups could be readily and reliably managed. They also have a comparatively low heat content which would result in inefficient, prolonged startups.[36] In summary, biomass fuel is not an alternative to the commercial fuels that are commonly used during the startup of lime kilns because of the operational requirements that must be met by a startup fuel.

Natural gas is commonly used as the startup fuel for lime kilns and is a technically feasible option for the proposed kilns. In addition, propane and biodiesel were determined to be technically feasible alternative fuels. Propane could be delivered by truck and stored onsite in pressurized storage tanks. Biodiesel could be delivered by truck and stored in storage tanks. Biodiesel storage tanks would require heaters to maintain the fuel in a liquid state.[37]

TOP-DOWN PROCESS – STEP 3
(Ranking Technically Feasible Alternatives by Control Effectiveness[38])

The projected emissions from use of alternative startup fuels for startup of the kilns and use of distillate oil, the fuel planned by Mississippi Lime, are provided below. Emissions are calculated based on standard emission factors for the combustion of the fuel, the maximum usage of startup fuel,[39] and the expected number of startups each year.[40] As described below, the use of natural gas or biodiesel as the startup fuel would lower emissions of NO_x, GHG and SO_2 compared to use of distillate oil. The use of propane would lower emissions of NO_x and GHG compared to use of distillate oil but would increase SO_2 emissions. For CO, the top alternative for the startup fuel is distillate oil. It will have lower emissions than use of natural gas, propane or biodiesel.

Those options can be eliminated from further consideration in the BACT analysis.

[36] In addition, biomass fuel is currently not a commercial fuel for which a continuing supply can reasonably be expected to be available on a continuing basis.

[37] Biodiesel has the disadvantage that at low temperatures it gels or coagulates more readily than distillate fuel oil.

[38] In Step 3 of the Top-Down Process, the emission performance level of each technology or control option that is considered feasible in Step 2 is established in consistent terms. A hierarchy of the control options is then developed in descending order starting with the most effective option and ending with the "baseline".

[39] For example, emissions for startup with natural gas are based on use of 583,300 scf per startup and standard emission factors for combustion of natural gas, in pounds per million scf, from AP-42, Chapter 1.4 (i.e., NO_x – 100 lbs, SO_2 – 0.6 lbs, CO – 84 lbs, and CO_2 – 120,000 lbs.

Emissions for use of distillate oil are based on use of 4,250 gallons of oil per startup and emission factors, in pounds per thousand gallons, for distillate oil from AP-42, Chapter 1.3 or, for GHG, the default emission factor for fuel oil from Table C-1 of 40 CFR 98 Subpart C. For biodiesel, emission factors developed by the Minnesota Pollution Control Agency were used.

[40] A total of four startups of the kilns would typically be expected annually (two startups per kiln).

Projected Emissions from Different Startup Fuels

	Natural Gas		Propane		Biodiesel		Distillate Fuel Oil	
Pollutant	Lb/Event	T/Yr	Lb/Event	T/Yr	Lb/Event	T/Yr	Lb/Event	T/Y
NO_x	58.33	0.12	85.0	0.17	64.8	0.13	102	0.20
GHG, as CO_2e	69,617	139	80,947	162	96,935	194	97,344	195
SO_2[41]	0.35	0.0007	6.5	0.01	--	--	0.9	0.0018
CO	49.0	0.10	49.0	0.10	32.8	0.07	21.3	0.04

For emissions of NO_x and GHG, the top alternative for the startup fuel for the kilns is natural gas. For SO_2 emissions, the top alternative is biodiesel. For emissions of NO_x and GHG, the control effectiveness[42] of natural gas compared to use of distillate fuel oil is 42.8 percent for NO_x and 28.1 percent for GHG. For SO_2, biodiesel has a control effectiveness of essentially 100 percent compared to use of distillate fuel oil.

TOP-DOWN PROCESS – STEP 4
(Evaluation of Most Effective Controls and Documenting Results[43])

For the proposed kilns, differences in energy and environmental impacts of the feasible alternative fuels being considered as the startup fuel for the kilns are not significant. However, the economic impact of the use of natural gas, propane, or biodiesel as the startup fuel for the kilns would be excessive, as summarized below. Accordingly, use of any of these other alternative fuels as the startup fuel is eliminated as BACT. Low-sulfur distillate fuel oil, the startup fuel proposed by Mississippi Lime, is BACT.

Summary of Cost-Effectiveness Analysis for Alternative Fuels[44]

Pollutant	Startup Fuel	Ton/Yr	Annualized Cost of Option ($/Yr)	Cost Effectiveness of Option ($/Ton removed)
GHG (as CO_2e)	Natural Gas	139	$396,402	$7,079
	Propane	162	$23,113	$700
	Biodiesel	194	$57,537	$57,537

41 Given the variability in the amount of residual limestone and lime dust present in the kiln system during startups and uncertainty about the actual level of SO_2 control, no control of SO_2 emissions is assumed with the startup fuel.

42 The "control effectiveness" for use of the alternate fuel is 1 minus the ratio of the alternative emissions and the baseline emissions, expressed as a percentage. For example, for NO_x, the control effectiveness of natural gas compared to distillate fuel oil is 42.8 percent $(1 - (0.1167/0.204)) \times 100 = 42.79, \approx 42.8$ percent.)

43 In Step 4 of the Top-down Process, the feasible control alternative are evaluated for energy, environmental, and economic impact to determine whether otherwise preferred options should not be required as BACT because of the impacts that would accompany it.

44 The cost effectiveness values in this table are all calculated compared to low-sulfur distillate fuel oil, the baseline fuel. Values of cost-effectiveness are not provided for CO because the CO emissions with distillate fuel oil will be lower than with natural gas, biodiesel or propane.

	Fuel Oil	195	---	---
SO_2[45]	Biodiesel	---	$57,537	$31,788,398
	Natural Gas	0.0007	$396,402	$357,118,919
	Fuel Oil	0.00181	---	---
NO_x	Natural Gas	0.117	$396,402	$4,556,345
	Biodiesel	0.130	$57,537	$777,527
	Propane	0.170	$23,113	$679,794
	Fuel Oil	0.204	---	---

For the startup fuel for the kilns, the top fuel control option for emissions of NO_x and GHG and 2nd option for SO_2 is natural gas. However, the cost impacts associated with use of natural gas as the startup fuel would be excessive. The total annualized cost[46] for use of natural gas, when compared to use of distillate oil is $396,402, resulting in an average cost-effectiveness[47] of over $4,500,000 per ton of NO_x removed and over $357,000,000 per ton of SO_2 removed. This conclusion is not altered when GHG is considered. This is because the upper bound on reasonable cost-effectiveness values for the control of GHG is in the range of $10 to $20 per ton of GHG controlled. Since the cost-effectiveness for GHG of use of natural gas for startup is over $7,000 per ton, use of natural gas is not cost-effective as a startup fuel to reduce GHG emissions.

Biodiesel is the top control option for SO_2, the 2nd option for NO_x control, and the 3rd option for GHG. However, the cost impacts associated with the use of biodiesel as the startup fuel would also be excessive. The cost-effectiveness of biodiesel is over $31,700,000 per ton removed for SO_2, over $700,000 per ton removed for NO_x, and over $57,000 per ton removed for GHG, and is therefore not cost-effective for control of these pollutants.

Propane is the 3rd control option for NO_x and the 2nd option for GHG control. However, the cost impacts associated with the use of propane as the startup fuel would also be excessive. The cost-effectiveness of propane is over $600,000 per ton removed for NO_x, and over $700 per ton removed for GHG, and is therefore not cost-effective for control of these pollutants.

In summary, while there are other alternative fuels that are feasible as the startup fuel for the kilns and would have lower emissions of various pollutants than distillate fuel oil, the cost impacts of all these alternative fuels are excessive. Accordingly these other alternatives are eliminated as BACT. BACT is use of low-sulfur distillate fuel oil as proposed by Mississippi Lime.

TOP-DOWN PROCESS - STEP 5
(Selecting Best Available Control Technology (BACT) Limit[48])

[45] A cost-effectiveness value for SO_2 is not provided for propane. This is because the SO_2 emissions of propane would be same or more than those of low-sulfur distillate oil.
[46] Total annualized cost is defined as the capital, direct, and indirect total annualized cost of purchasing, installing, and operating the proposed control alternative, NSR Manual, B.66.
[47] Average cost effectiveness, or cost effectiveness over baseline, is equal to the total annualized cost of the control option divided by the emissions reductions resulting from the uncontrolled baseline, NSR Manual, B.66.
[48] In the final step of the Top-Down BACT process, Step 5, the most effective control

Based on Step 4, the use of ultra-low sulfur oil as the startup fuel, as proposed by Mississippi Lime, is BACT. Use of natural gas, biodiesel or propane cannot be mandated as BACT because cost-impacts would be excessive. To accommodate possible changes in available fuels in the future, BACT for the startup fuel is proposed to be set as use of ultra-low sulfur oil, for which the specification for maximum sulfur content is 15 ppm by weight, or other similar, ultra-low sulfur fuel.

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option that is not eliminated in Step 4 is considered the BACT technology for the pollutant and emission unit. An emission rate or requirement is selected as BACT based on the use of that control option.

ATTACHMENT 2

Revised Analysis of Best Available Control Technology (BACT) for the Lime Kilns for SO_2 Emissions

INTRODUCTION

This discussion describes the revised analysis for Best Available Control Technology (BACT) that was conducted by the Illinois EPA for the proposed lime kilns for emissions of sulfur dioxide (SO_2). This analysis was performed using the five-step "top-down" BACT process as set forth in the NSR Manual.[49] Mississippi Lime provided further information to support this analysis.

Based on this analysis, the Illinois EPA is proposing that SO_2 BACT for the kiln systems be a limit of 0.50 pounds per ton of lime produced, 30-day average, based on the control of SO_2 emissions that is provided by from "natural scrubbing".[50]

BACKGROUND

The SO_2 emissions of the proposed kilns will be primarily due to the sulfur in the fuel that is fired in the kilns. During combustion of the fuel, this sulfur also combusts forming SO_2. While the limestone feed to the proposed kilns will also contain some sulfur,[51] it does not appear that this sulfur will have a significant role in SO_2 emissions of the kilns. This is because the limestone resource that this plant is being developed to process has low levels of organic sulfur.

In its application, Mississippi Lime has proposed to use a blend of Illinois Basin coal and petroleum coke (coke) as the fuel for the proposed kilns. These fuels are readily available locally in the area in which the plant would be located and would be able to be delivered to the plant by truck. Lime kilns that make general purpose lime, like the proposed kilns, are typically fired with coal that is available locally, supplemented with coke if it is available in a region. Higher quality fuels, which are more expensive, are not essential to make general purpose lime. Because coke is less expensive than coal, the use of coke will lower fuel costs. The use of coke will also facilitate manufacture of an acceptable product. Coke contains less ash than coal. High levels of ash in the fuel used in a lime kiln can negatively impact product quality. It can also disrupt the

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49 Refer to Chapter B – Best Available Control Technology, in the *New Source Review Workshop Manual*, USEPA, Office of Air Quality Planning and Standards, Draft, October 1990 (NSR Manual).

50 The BACT limit for the SO_2 emissions of the kilns in the original permit was 0.645 lb/ton lime, on a daily (24-hour) average.

51 Low levels of sulfur can be present in limestone as both inorganic compounds and organic compounds. The inorganic compounds, e.g., gypsum and ferrous sulfates, are present due to the SO_2 absorbed from the flue gas due to natural scrubbing, as well as due to the inorganic sulfur content of the raw stone. This sulfur is not driven off during processing of material in the kiln and becomes an impurity in the lime product from the kiln. Organic sulfur compounds, to the extent present, combusts during processing and the resulting SO_2 then behaves like fuel sulfur.

operation of a kiln.[52] The amount of coke that can be included in the fuel to the kilns is constrained by the sulfur content of the fuel. If the sulfur content of the fuel is too high, the quality of the lime product will be adversely affected because too much sulfur will be absorbed by the lime product. This acts to constrain the sulfur content of the blend of coal and coke fired in a kiln. Mississippi Lime indicates that the proposed kilns will be constrained to firing a blend of coal and coke that contains at most 3.5 percent sulfur.[53]

In practice, most of the SO_2 that is formed from the sulfur in the fuel fired in these kilns will not be emitted. The SO_2 will react with the limestone feed and with the limestone and lime dust in the kiln system. This dust will then be removed from the flue gas as particulate by the baghouse. The effect of the combination of the kiln system (i.e., the combination of the kiln, preheater and baghouse) to control SO_2 emissions is commonly referred to as "natural scrubbing."[54] The SO_2 emissions from lime kilns that produce high calcium lime, like the proposed kilns, are commonly addressed with natural scrubbing without use of add-on emission control equipment for SO_2.

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[52] The ash in solid fuel negatively affects lime quality as some of the ash becomes an impurity in the lime product. In addition, if the amount of ash entering a kiln with fuel is excessive, "ash rings" will form on the inside wall of the kiln disrupting the normal passage of material through the kiln. In severe cases, unscheduled shutdowns of a kiln may be needed to remove the ash rings and restore the normal functioning of the kiln. Blending coke, which has relatively low ash content, with coal acts to reduce the formation of ash rings, facilitating efficient operation of the kilns. An appropriate ash content in the blended fuel would be 5 to 10 permit. Because of these considerations, many lime kilns fire a blend of coal and coke.

[53] Based on a maximum sulfur content of 3.5 percent by weight in the blended fuel and the expected sulfur contents of the coal and coke, Mississippi Lime estimates that the fuel for the kilns would ideally contain about 80 percent coal and 20 percent coke.

[54] This phenomenon is referred to as "natural scrubbing" because it is similar to the scrubbers on coal-fired boilers, which use limestone or lime to control SO_2 emissions, except that this phenomenon is inherent in the operation of the kiln system and does not involve installation of a separate, add-on control device for SO_2 from coal-fired boilers and other sources of SO_2 emissions.

The occurrence of natural scrubbing at lime kilns is to be expected given the affinity of lime and limestone for SO_2. Indeed, both limestone and lime are used as the reactive material in add-on control equipment for SO_2 emissions.

Top-Down Process – Steps 1 and 2
Identification of "Available" Control Technologies and Evaluation of the Technical Feasibility of "Available" Control Technologies[55]

For the proposed kilns, two categories of SO_2 control techniques and technologies were identified and evaluated, including alternative fuels and add-on emissions control equipment.

1. Alternative Fuels

The SO_2 BACT analysis for the kilns considered alternative, lower-sulfur "clean fuels" as an approach to reduce the SO_2 emissions of the kilns compared to the proposed blend of local coal from the Illinois Basin[56] and petroleum coke (coke). The clean fuels evaluated included use of other fuels, e.g., bio-mass fuel and natural gas, use of coal from other regions of the country, and alternative fuel blends with less coke.

Use of Bio-mass Fuel

Biomass fuels contain less sulfur than coal and coke. However, the use of biomass fuel as the primary fuel for the kilns would be inconsistent with the purpose of the proposed plant, which is to commercially produce lime. To effectively make lime, a kiln must use fuels whose heat content and other physical properties are consistent. This would not be possible with currently available biomass fuels. As a general matter, the composition and properties of biomass fuels are significantly different than those of coal and coke. For example, biomass is not a friable material and cannot be pulverized like coal or coke. As such, biomass fuel would burn at a different rate in the kilns. The lower heat content of biomass fuel also results in it not being a suitable primary fuel for a process designed for high-heat content commercial fuels.

In addition, as the objective for the plant is to manufacture lime on a commercial basis, 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 commercial fuels. 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 fuels and their costs cannot be determined or predicted in a way that would enable it

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[55] In Step 1 of the Top-Down BACT Process, all "available" control options with potential application for the pollutant and emission units that are the subject of the BACT analysis are identified.
In Step 2 of the Top-Down BACT Process, an evaluation of the technical feasibility of the available control options is made to identify options that are not technically feasible. Those options can be eliminated from further consideration in the BACT analysis.
The discussions for these two steps are combined as the feasibility of control options can immediately be discussed following the more general discussion of the availability of the control options.

[56] The Illinois Basin extends over Southern Illinois and portions of Southwestern Indiana and Northwestern Kentucky. The sulfur content of the coal seams in the Illinois Basin that are commonly mined is approximately 3 percent. This coal can be trucked to the plant from a number of local mines in Southern Illinois.

to be considered an available fuel.[57] 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, sources are voluntarily accepting the uncertainty in the future availability and cost of material from the selected resource.[58] While biomass is contemplated as a desired fuel for future use in the lime industry, it is not considered a dependable fuel at this time.

These considerations, which preclude use of biomass as the required fuel for the proposed plant, also preclude a requirement that biomass be a component of the fuel for the plant. Accordingly, both use of biomass fuel and use of biomass blend fuels are deemed infeasible as BACT.[59]

Use of Natural Gas

The sulfur content of natural gas is extremely low and the SO_2 emissions of the kilns with natural gas would be minimal. While natural gas is not currently available at the plant site, a pipeline could be built. Natural gas is considered a technically feasible alternative fuel for control of SO_2 emissions. (At this stage of the BACT analysis, natural gas cannot be eliminated because of the higher emissions of NO_x that would accompany use of natural gas.)

Use of Distillate Fuel Oil

The sulfur content of low-sulfur distillate fuel oil is also much lower than that of coal and coke. Distillate oil will be delivered to the plant for use as the startup fuel for these kilns. It is also clearly a technically feasible fuel for routine operation of these kilns.

Use of Alternative Coals from Other Regions of the County

Coals that contain less sulfur than Illinois Basin coal are mined in other regions of the country.[60] Coals from these other regions could be transported by rail or barge to an existing terminal facility near the plant and then transferred to the plant by truck. Since the proposed plant would be

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[57] 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.

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

[59] It is also noteworthy that use of biomass fuels would also have undesirable consequences for the design and operation of the kilns. The capacity of the kilns would be lowered or the kilns would need to be larger to maintain the design capacity for the plant. With biomass fuel, the air flow through the kiln would need to be higher due to the lower heating content of the fuel and the higher moisture content in the combustion gases. This would be accompanied by an increase in electricity usage and a decrease in the overall energy efficiency of the kilns. A separate fuel handling system would also be needed for biomass fuel, with a separate area to store this fuel.

[60] The sulfur content, heat content and other characteristics of these alternative coals from different regions vary. The sulfur contents range from about 0.4 to 3.0 percent by weight and the heat contents range from 8,800 to 14,000 Btu per pound.

producing general purpose lime, these alternative coals are all considered to be technically feasible for the plant.

i. Powder River Basin (PRB) Coal: PRB coal from Wyoming and Montana is considered a very low sulfur content coal compared to Illinois Basin coals. It is used extensively at coal-fired power plants in Illinois, which receive it by unit train. However, this plant would not use enough coal to justify being served by unit trains.

ii. Uinta Basin Coal: Uinta Basin coal from Colorado and Utah is a lower sulfur coal. It is not currently being used in Illinois.

iii. Central Appalachian Coal: Central Appalachian coal from West Virginia and Kentucky is a lower sulfur coal. It could be transported by barge to a terminal near St. Louis and trucked to the plant.

iv. Northern Appalachian Coal: Northern Appalachian coal from West Virginia and Pennsylvania has middle range sulfur content. It could also be barge to a coal terminal near St. Louis and then trucked to the plant.

Use of an Alternative Blend of Coal and Petroleum Coke

Mississippi Lime has not shown that it is essential that the fuel for the kilns include coke. Therefore, use of Illinois Basin coal blended with less coke or without any coke is a feasible option for the kilns.

2. Add-On Control Technologies

The revised BACT analysis for SO_2 also considered use of add-on control equipment for SO_2. With add-on control equipment, the general means to control SO_2 is to introduce limestone, lime or hydrated lime into the flue gas at some point in the duct work to remove SO_2. This is done with different types of systems. These technologies are all feasible. However, as most of the SO_2 emissions will be controlled by natural scrubbing, use of an add-on control technology would only provide an incremental reduction in SO_2 emissions beyond the reduction that would be provided by natural scrubbing by itself.

Wet Scrubbing

In wet scrubbing, SO_2 is scrubbed out of flue gas with a liquid that contains a sorbent material or “reagent” that chemically reacts with the SO_2 transferring it into the liquid. In conventional SO_2 scrubbing systems, limestone or lime is commonly used as the reagent. The SO_2 control efficiency of wet scrubbing ranges from 90 to 98 percent. While wet scrubbing generally is not used on preheater lime kilns, it is technically feasible for the proposed kilns.

Semi-dry Scrubbing or “Dry Scrubbing”

In semi-dry scrubbing, also referred to as dry scrubbing or spray drying, SO_2 is controlled by introducing a slurry of lime or hydrated lime into the flue gas stream. The injection of the reagent material with water enhances the reaction of the sorbent with SO_2. In the flue gas, the water in the slurry then evaporates and the remaining dry material is then collected as particulate in a baghouse. The SO_2 efficiency of semi-dry scrubbers is in the range of 80 to 90 percent. This technology is feasible for the proposed kilns.[61]

Dry Sorbent Injection

Dry injection systems pneumatically feed a powdered sorbent, such as hydrated lime, into the flue gas to react with the SO_2. This material is then removed downstream as particulate by the baghouse or other particulate control device. Compared to scrubbing systems, dry sorbent injection systems are easier to install and operate but more sorbent is needed. Their SO_2 removal efficiency is typically only in the range of 50 to 75 percent.[62] This technology is feasible for the proposed kilns.

Top-Down Process - Step 3
Ranking Technically Feasible Alternatives by Control Effectiveness[63]

In this step of the analysis, feasible control options are ranked in order of effectiveness compared to the "baseline" for the subject pollutant. As summarized below, Mississippi Lime considered the control efficiency of each feasible alternative control option. It also calculated the additional reduction in SO_2 with the option based on the SO_2 emission rate that it would provide compared to the baseline emission rate.[64] For the proposed kilns, the baseline is the level of SO_2 emissions provided by natural scrubbing because natural scrubbing will be inherent in the operation of the kilns.[65] For this step in the BACT analysis, the baseline SO_2 emission rate used for natural scrubbing was 0.645 pounds/ton, 24-hour average, consistent with Mississippi Lime's BACT demonstration and proposed limit for SO_2 BACT. Even though this step of the BACT analysis was conducted using this baseline emission rate, the Illinois EPA subsequently selected a lower numerical BACT limit, 0.50 pounds/ton, 30-day average, for the proposed SO_2 BACT limit.

[61] Semi-dry scrubbing is being used on Kiln 7 at Graymont's Bellefonte (Pleasant Gap) plant. This rotary kiln makes a specialty lime and does not have a preheater. Given its particular circumstances, add-on scrubbing was found appropriate for control of SO_2 emissions.
[62] Given the performance of dry sorbent injection, it is unlikely that it will provide a significant further reduction in SO_2 emissions beyond that provided by only natural scrubbing.
[63] In Step 3 of the Top-Down Process, the emission performance level of each technology or control option that is considered feasible in Step 2 is established in common terms. A hierarchy of the control options is then developed in descending order starting with the most effective option and ending with the "baseline".
[64] The "additional reduction," as a percentage, is calculated as follows:

$$\text{Additional Reduction} = \{1 - (\text{Alternative } SO_2 \text{ rate}/\text{Baseline } SO_2 \text{ rate})\} \times 100.$$

For example, for wet scrubbing: $(1 - 0.050/0.645) \times 100 = 92.24, \approx 92.2$
[65] As explained in the NSR Manual, "When calculating the cost-effectiveness of adding post process emissions controls to certain inherently lower pollutant processes, baseline emissions may be assumed to be the emissions from the lower polluting process itself. In other words, emission reduction credit can be taken for use of inherently lower polluting processes." Page B.37, NSR Manual.

Control Technology Ranking

Control Option	Control Efficiency (%)	SO_2 Emission Rate (lbs/ton lime)	Additional Reduction (%)
Natural Gas	97.43*	0.000068	99.9
Distillate Oil	97.43*	0.000172	99.9
Wet Scrubber	99.80**	0.050	92.2
PRB Coal (0.4% S)	97.43*	0.090	86
Uinta Basin Coal (0.5% S)	97.43*	0.090	86
C. Appalachian Coal (0.8% S)	97.43*	0.136	79
Semi-Dry Scrubber	99.00**	0.251	61
N. Appalachian Coal (2.0% S)	97.43*	0.339	47
Illinois Basin Coal(3.0% S)	97.43*	0.565	12
Dry Injection Scrubber	97.50**	0.627	2.8
Baseline (3.5% S)	97.43	0.645	--

* The control efficiency for all of the “alternative fuel options” is the same as the baseline, i.e., 97.43 percent. This is because natural scrubbing is conservatively assumed to provide a constant level of SO_2 removal independent of the sulfur content of the fuel used in the kilns.

** The control efficiency for the “add-on control equipment options” is the combined efficiency from natural scrubbing and the add-on equipment. For this purpose, the natural scrubbing that occurs in the kiln and preheater, upstream of add-on control equipment, is assumed to provide only 90 percent removal of SO_2 emissions. The remaining 10 percent of the theoretical SO_2 emissions from the sulfur in the fuel would be available for control by the add-on control equipment, which would be located between the preheater and the baghouse.

Top-Down Process – Step 4
Evaluation of Most Effective Controls and Documenting Results[66]

Mississippi Lime evaluated the economic impacts of the feasible alternatives compared to its proposed baseline SO_2 emission rate, including both the average cost effectiveness and the incremental cost effectiveness of the alternatives.[67] For alternative fuels, the evaluation was based on publicly available data on the costs of different fuels. T he results of the evaluation of average cost-effectiveness are summarized below, with the cost impact of each alternative expressed in terms of dollars per ton of SO_2 removed.

[66] In Step 4 of the Top-down Process, the feasible control alternatives are evaluated for energy, environmental, and economic impact to determine whether otherwise preferred options should not be required as BACT because of the impacts that would accompany it.
[67] This step of this top-down analysis for SO_2 emissions focused on the economic impacts of the different alternatives. This is because the economic impacts were sufficient to complete the analysis without need to consider energy and environmental impacts.

Summary of Cost-Effectiveness Analysis

Control Option	Total Annualized Cost* ($)	Annualized Cost Over Baseline ($)	Potential Emission (Tons)	Emissions Removed (Tons)	Average Cost Effectiveness ($/Ton)
Natural Gas	17,377,085	8,929,839	0.03	282.5	31,613
Distillate Oil	96,366,414	87,919,168	0.08	282.4	311,306
Wet Scrubber	15,407,322	6,960,076	21.9	260.6	26,706
PRB Coal	13,085,250	4,638,004	39.4	243.1	19,079
Uinta Basin Coal	14,989,338	6,542,092	39.4	243.1	26,911
C. Appalachian Coal	16,208,523	7,761,277	59.6	222.9	34,820
Semi-Dry Scrubber	12,203,402	3,756,156	109.9	172.6	21,762
N. Appalachian coal	15,436,856	6,989,610	148.5	134.0	52,161
Illinois Basin coal	9,423,679	976,433	247.5	35.0	27,898
Dry Injection	10,018,770	1,571,524	274.6	7.9	198,927
Coal/Coke (Baseline)	8,447,246	---	282.5	--	--

* Total Annualized Cost includes direct costs and capital costs where applicable.

The incremental cost effectiveness was evaluated for the dominant control options, consistent with guidance for BACT analyses provided in the NSR Manual.[68] The dominant control options provide greater emission reductions with lower costs than the "inferior control options."[69] The evaluation of incremental cost effectiveness compared the cost impacts and emission reductions between the adjacent dominant control options, to determine values of incremental cost-effectiveness per ton of additional SO_2 removed.

Summary of Dominant Control Options and Incremental Cost-Effectiveness Analysis

Dominant Control Alternative	Total Annualized Cost[a] ($)	Potential Emission (Tons)	Average Cost Effectiveness ($/Ton)	Incremental Cost Effectiveness ($/Ton)
Natural Gas	17,377,085	0.03	31,613	90,067
Wet Scrubber	15,407,322	21.9	26,706	132,690
Powder River Basin Coal	13,085,250	39.4	19,079	12,508
Semi-Dry Scrubber	12,203,402	109.9	21,762	20,201

[68] The NSR Manual explains that "In calculating incremental costs, the analysis should only be conducted for control options that are dominant among all possible options." NSR Draft Manual, p. B.43.

[69] In particular, several of the control alternatives that were evaluated provide more control at lower cost than other "inferior" control alternative in this table. These control alternatives are referred as "dominant" control alternatives. For example, use of natural gas would provide more SO_2 emission reduction than the distillate oil alternative with considerably less total annualized cost. Similarly, PRB coal has two inferior alternatives, i.e., Uinta Basin coal and Central Appalachian Coal. Semi-dry scrubbing dominates Northern Appalachian coal and Illinois Basin Coal dominates the dry injection scrubber alternative. Each of these inferior alternatives have higher annualized costs than their dominant control alternative and would provide less reduction in SO_2 emissions than their dominant alternative. As such, these inferior alternatives are not considered in the evaluation of incremental cost effectiveness.

Dominant Control Alternative	Total Annualized Cost[a] ($)	Potential Emission (Tons)	Average Cost Effectiveness ($/Ton)	Incremental Cost Effectiveness ($/Ton)
Illinois Basin Coal	9,423,679	247.5	27,898	---
Coal/Coke (Baseline)	8,447,246	282.5	---	---

Given the reduction in SO_2 emissions provided by natural scrubbing, further add-on control equipment for SO_2 is not warranted. The costs associated with the add-on control alternative are all excessive. In particular, wet scrubbing, which would provide the greatest further reduction in emissions, would have an additional cost of $26,700 for each additional ton of SO_2 removed.[70] For semi-dry scrubbing, the cost is $21,700 for each additional ton of SO_2 removed.

Use of natural gas, which is essentially sulfur-free, would provide the lowest SO_2 emissions from the kilns. However, the use of natural gas is not warranted because of excessive cost impact at $31,600 per each additional ton of SO_2 removed. Use of natural gas would also significantly increase NO_x emissions. Given the role of NO_x emissions 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 of natural gas as BACT. In this regard, in the lime industry, natural gas is used for production of specialty lime[71] and as the start-up fuel for certain kilns that normally operate on solid fuel.

Use of alternative, lower sulfur coals or use of only Illinois Basin coal that is not blended with coke is also not warranted.[72] The cost impacts associated with these alternatives would be excessive. In particular, PRB coal would have an additional cost of $19,000 for each additional ton of SO_2 removed. The cost is even higher for the Illinois Basin coal, i.e., approximately $28,000 for each additional ton of SO_2 removed. With respect to the Illinois Basin coal, this is because it is more expensive than petroleum coke and the sulfur content and contribution of petroleum coke to SO_2 emissions are very similar to those of Illinois Basin coal.

With any of these alternative fuels, the proposed plant would also almost certainly no longer be viable from a commercial perspective. The plant would not be able to compete economically with other lime plants operating in the Midwest that produce standard lime using fuels that are locally available.

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[70] As the Illinois EPA is now proposing an SO_2 BACT limit that is numerically lower, than the BACT limit proposed by Mississippi Lime, the costs of the various alternatives are even greater. For example, the cost-effectiveness of using wet scrubbing would be over $34,000/ton ($26,700/ton x 0.645/0.50 = $34,443/ton). This is because the baseline annual SO_2 emissions would only be 219 tons, rather than 282.5 tons.

[71] While certain lime kilns that produce food grade lime are fired with natural gas, this does not show that this is appropriate for the proposed kilns, which are being developed for production of various types of standard lime.

[72] While certain lime kilns that produce standard lime are fired with low sulfur coal, this does not demonstrate that this is appropriate for the proposed kilns. The proposed kilns would not be located in a region in which low sulfur coal is both readily and reliably available. Lime kilns located in regions that have ample supplies of low sulfur coal may obtain this coal at a lower cost than kilns in which such coal is not available and importing such coal to the region would have additional transportation costs.

Top-Down Process - Step 5
Selecting Best Available Control Technology (BACT) Limit[73]

In this case, all BACT alternatives for the proposed kilns are eliminated in Step 4. Accordingly, natural scrubbing becomes the control technology that is BACT for the proposed kilns for SO_2 emissions. The remaining question is the limit that should be set as BACT for SO_2 emissions.

Based on the following considerations, the Illinois EPA is proposing to set an SO_2 BACT limit of 0.50 lbs SO_2 per ton of lime produced, on a 30-day average, rolled daily. This reflects natural scrubbing reducing SO_2 emissions by 98 percent, on a 30 day average.[74]

The proposed BACT limit is developed from information for existing lime kilns that are similar to the proposed kilns whose SO_2 emissions are controlled with natural scrubbing. These similar kilns all have preheaters and make standard lime from high calcium limestone. All these kilns also fire either coal or a blend of coal and coke. Because the sulfur content of the fuel fired by these kilns is not the same, it is appropriate to express the performance of natural scrubbing as an SO_2 removal efficiency, as if natural scrubbing were a control device.[75]

Information for the SO_2 removal efficiency of natural scrubbing for these similar kilns based on test data is provided below. The information shows that the actual reduction in SO_2 emissions provided by natural scrubbing is always greater than 90 percent and usually greater than 95 percent. For certain kilns, removal efficiencies greater than 99 percent are consistently achieved. Other kilns show a wide range of removal efficiency. This variation in the level of reduction cannot be explained from available information. This is because detailed information about these kilns and how they were operating during emission testing is not available.[76] However, the

[73] In the final step of the Top-Down BACT process, Step 5, the most effective control option that is not eliminated in Step 4 is considered the BACT technology for the pollutant and emission unit. An emission rate is selected as BACT based on the use of that control option.

[74] The proposed BACT limit reflects an SO_2 control efficiency of 98 percent, rather than 97.43 percent. This is because the proposed BACT limit would apply on a 30-day average, with compliance determined by continuous emission monitoring. It would not apply on a 3-hour average, as has historically been the practice, with compliance verified by a combination of periodic emission testing and operational monitoring to generally confirm proper operation of a kiln between tests. As such, the proposed BACT limit would be much more rigorous than the SO_2 limits that apply to existing kilns, for which only occasional snapshots of numerical data are available from the results of emission testing.

[75] Because the sulfur content of the fuels fired in different kilns is not the same, it would be unsound to simply consider the SO_2 emission rates of different kilns in pounds of SO_2 per ton of lime produced.

[76] Even if more information about the operation of the kilns during testing were available, it is likely that the variation in level of SO_2 control efficiency achieved by different kilns could not be fully explained. This is because of the variety of factors involved in the operation of lime kilns. In addition to the sulfur content of the fuel, which determines the loading of sulfur going into a kiln, other key factors are the friability of the limestone going into the kiln and the size of lime that is being made. These affect the amount and size of dust that is produced by mechanical action in the kiln. Unlike operating rate and fuel consumption and sulfur content,

available information is sufficient to assess the range of effectiveness of natural scrubbing on lime kilns and set a BACT limit for the SO_2 emissions of the proposed kilns.

Review of SO_2 Efficiency of Natural Scrubbing for Similar Kilns

Plant	Kiln	Removal Efficiency (percent)	
		Permitted or Design	Demonstrated Efficiency as derived from test data
Chemical Lime, O'Neal	Kiln 1	92	Estimated 99.35 (calculated from assumed 1.3% S fuel)
	Kiln 2	92	Estimated 94.65 (calculated from assumed 1.3% S fuel)
MLC, Verona*	Kiln 1	95	95.3 ave. (95.1 & 95.5)
Graymont, Superior**	Kiln 5	92	Dundee Limestone - 97.1 ave. (96.5, 97.4, 97.5) Burnt Bluff Limestone - 98.4 ave. (97.0, 99.0, 99.2) Unknown - 96.6
Graymont, Green Bay***	Kiln 1	Est. 93.7	94.6 ave. (93.5, 94.1, 94.3, 94.7, 96.6)
	Kiln 2	Est. 96	99.6 ave. (99.3, 99.3, 99.9, 99.9)

* Formerly Gallatin ** Formerly CLM *** Formerly Western Lime

The actual SO_2 emissions for any single kiln also vary significantly from test to test. This is apparent for the plants with multiple tests. Moreover, the tests for Graymont, Superior, which include testing of a kiln with limestone from different sources spread out over a period of less than six months, confirms that the properties of the limestone fed to a kiln affects the level of absorption of SO_2.[77] This body of information from testing does not lead to a conclusion that similar kilns at different plants would have similar control levels for SO_2. This is further evidence of the variation in control level for the lime kiln as there are a number of factors that affect SO_2 emission.

The kilns at Chemical Lime's O'Neal plant have tested SO_2 emission rates of 0.06 and 0.47 pounds per ton of lime, respectively, for Kiln 1 and Kiln 2. However, both of these kilns have identical capacities, 1500 tons of lime per day. The SO_2 emissions of Kiln 2 is approximately 8 times higher than presumably identical Kiln 1 at the same plant. Clearly, the size of a kiln is not a good predictor of SO_2 emissions of similar size kilns.

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these factors are not subject to standardized measurement during routine emission testing for purposes of verifying compliance.

[77] Based on the test reports, it appears that the source was evaluating use of limestone from different quarries in Kiln 5 as related to compliance with the applicable limit for CO emissions. In this regard, the amount of trace organic material in limestone can affect the level of CO emissions from a lime kiln.

The data shows significant variability in the SO_2 emission rates of individual kilns. This is seen for Kiln 5 at Graymont Superior. The tested SO_2 emissions of this kiln range from 0.04 to 0.20 pounds per ton of lime, while, based on test information, the operating rate of this kiln was consistently between 27 and 27.75 tons of lime per hour. The lowest and highest test results for this kiln vary by a factor of five. For Kiln 2 at Western Lime Green Bay, the range is even greater, i.e., 7 times from the lowest to highest rate achieved, with emissions ranging from 0.01 to 0.07 pounds per ton of lime.

The control level that is the basis of the proposed SO_2 BACT limit for the proposed lime kilns, i.e., 97.43 percent, is higher than the permitted range of control level for similar kilns, i.e., 90 to 95 percent. The actual performance data for lime kilns show that kilns routinely operate with actual levels of control for SO_2 that are higher than the levels of control relied upon in permitting. However, the actual performance data for kilns does not show that a level of control higher than the permitted level is achievable by existing kilns or, accordingly, for the proposed kilns. The test data for similar kilns shows a range of control for SO_2, i.e., 94.1 to 99.9 percent. For kilns with multiple tests, there is significant variation in the level of control in the different tests.

Recent SO_2 BACT limits for other lime kilns, expressed in pounds per ton of lime, were also compiled, as summarized below, for consideration in the development of the BACT limit for the proposed kilns. This information shows that the SO_2 BACT limits of most of these other kilns are not as stringent as the proposed limit. The limits for lime kilns at three plants are somewhat lower. However, the difference can be explained by the lower sulfur content of the locally available fuel and not to higher control efficiency being required for natural scrubbing.[78, 79] This information does not demonstrate that a lower SO_2 BACT limit is achievable by the proposed kilns.[80]

Comparison of BACT Limits for Similar Kilns[81]

Source (RBLC Entry No.)	Capacity (tons/day)	BACT Limit (lbs/hr)	Nominal SO_2 Rate (lbs/ton)
Proposed Plant	1200 (each, 2 kilns)	---	0.50 (30-day ave.)
Pete Lien – Kiln #3 (new)	600	45.0	1.80

[78] The NSR Manual explains that "when reviewing a control technology with a wide range of emission performance levels, it is presumed that the source can achieve the same emission reduction level as another source unless the applicant demonstrates that there are source-specific factors or other relevant information that provide a technical, economic, energy or environmental justification to do otherwise." NSR Manual, p. B.24.

[79] MLC Verona is located in Eastern Kentucky and uses southern Appalachian coal that is available locally.
Graymont Western, Pilot Peak, uses western coal that is available in Nevada.
Dakota Lime uses western coal that is available in Wyoming.

[80] As the proposed kilns would have lower SO_2 emissions and better fuel efficiency than these existing kilns, it is preferable from an environmental perspective that the demand for standard lime be met by the proposed plant.

[81] This table does not include lime kilns that make dolomitic lime.

(2008)			(3-hr average)	
MLC Verona (2007)		840 (each, 2 kilns)	13.65	0.39
Dakota Coal, Frannie (WY, 2006)		500	12.0 (3-hr test)	0.58
Graymont Western, Pilot Peak (NV-0040, 2006)	Kiln 1	600	14.0 (3-hr average)	0.56
	Kiln 2	800	21.0 (3-hr average)	0.60
	Kiln 3	1200	33.6 (3-hr average)	0.67
Graymont Western, Superior (WI-0233, 2006)		650	33.7 (3-hr average)	1.24
Western Lime, Port Inland (MI-0383, 2005)		870	60.2 (3-hr test)	1.66
Graymont, Bellefonte (PA-0241, 2004)	Kiln 6	1200	305.0 (3-hr block)	6.10
	Kiln 7	1050	92.83 (3-hr block)	2.12
Austin White, McNeil, Kiln 3 (TX-0452, 2003)		650	28.4 (3-hr test)	1.05

In conclusion, information on the required and actual performance of natural scrubbing shows that Mississippi Lime has proposed a stringent limit as BACT for SO_2. This information does not show that a level of performance better than that proposed by Mississippi Lime is achievable. It is appropriate that an SO_2 BACT limit for the productive operation of the proposed kilns be set starting from a control efficiency of 97.43 percent for natural scrubbing. This efficiency is only the starting point for the BACT limit because compliance with this limit would be determined by continuous emissions monitoring rather than by a combination of periodic performance tests and operational monitoring. This enables a BACT limit to be set that applies on longer averaging time or compliance period.[82] The Illinois EPA is proposing that the compliance time period for the SO_2 BACT limit now be 30 days. A longer averaging time will enable a lower limit because the effect of short-term variation in performance is greatly reduced by a longer averaging time. USEPA has used a 30-day averaging time for the SO_2 and NO_x standards in its New Source Performance Standards for boilers, 40 CFR 60 Subparts Da and Db, where continuous emission monitoring is required. When considered on a 30-day average, natural scrubbing will be able to achieve a control efficiency of 98 percent, significantly higher than 97.43 percent control.[83] The proposed SO_2 BACT limit becomes 0.50 lbs SO_2/ton lime, on a 30-day average.

[82] The SO_2 test data for lime kilns that was considered in the BACT analysis reflects productive operation of kilns in the normal range of operating load. Emission testing is not conducted when kilns are operating at low levels of production because this is not representative of the typical operation of the kiln.

[83] The relationship between the duration of the averaging period on which SO_2 emissions are determined and the average SO_2 emissions compared to the applicable SO_2 emissions limit of coal-fired utility units was addressed by USEPA in *Final Report: Development of Annualized SO_2 Emissions Conversion Factors*, June 5, 1991, EPA/400/1-91/029. As shown this report, Table 3, the longer the averaging period of an SO_2 emissions limit, the closer the limit can approach the actual annual or long-term emission rate of a unit.

Because this SO_2 BACT limit would be expressed in terms of the SO_2 emissions per ton of lime produced, an alternative or "secondary" BACT limit is needed during non-productive operation of a kiln, i.e., periods when a kiln is not producing any lime or is operating at less than 30 percent of capacity.[84] For this purpose, the mass limits for short-term SO_2 emissions that would be set by the permit are proposed to be BACT limits for SO_2 emissions. These limits, i.e., 32.3 lbs/hour, 3-hour average and 40 lbs/hour, 1-hour average, are the emission rates for the kilns used in the air quality analyses conducted for the project.[85]

[84] In the original permit, the Illinois EPA selected 20 percent of capacity as the operating level of the kilns that would distinguish productive operation, with saleable, commercial product, and non-productive operation of the kilns, e.g., startup and shutdown. This is because the Illinois EPA was confident that the kilns would not be producing saleable lime when operating at less than 20 percent capacity. Mississippi Lime has now clarified that the lowest operating rate at which a kiln would be able to produce saleable product would be 30 percent of capacity, measured as lime output from the kiln. The SO_2 BACT limit, in pounds/ton, is predicated on normal operation of the kilns with production of saleable product. Accordingly, the dividing line between the primary BACT limit, in pounds SO_2/ton product, and the secondary BACT limit, in pounds SO_2/hour, has been raised to 30 percent.

[85] When a lime kiln is operating at low levels, proportionally more of the fuel heat input to the kiln system is used in heating the kiln system rather than being used in the conversion of limestone into lime. Other aspects of operation of the kiln are also affected by low-level operation. With less material in the kiln system, less dust is present as relevant to the effectiveness of natural scrubbing. With less exhaust flow from the kiln, the amount of heat available to be recovered by the preheater is also less than during normal or "productive operation" of a kiln

ATTACHMENT 3

Further Analysis of BACT for Nitrogen Oxide (NO_x) Emissions of the Kilns for Periods Other Than Startup

INTRODUCTION

A further evaluation of BACT was conducted by the Illinois EPA for the proposed lime kilns for emissions of NO_x, as directed by the Remand Order.

For the original permit, the BACT control technology for the NO_x emissions of the proposed kilns was determined to be combustion management and energy efficiency, as provided by the use of preheaters and other features of the proposed kilns. The Remand Order directed the Illinois EPA to further evaluate and support the BACT limit for NO_x that was selected. The Illinois EPA has now conducted this further evaluation as directed by the Remand Order. This evaluation expanded on Step 5 of the five-step Top-Down Process in which the actual BACT limit for a pollutant is selected.[86] This further evaluation was supported by additional information assembled by Mississippi Lime and the Illinois EPA concerning the NO_x emissions of lime kilns.[87, 88]

The Illinois EPA's further evaluation concludes that the NO_x BACT limit for the proposed kilns should be a limit of 3.50 pounds per ton of lime produced, 30-day average, based on the use of the selected control technology for NO_x

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[86] For a description of the five step, Top-Down Process for determination of BACT, refer to Chapter B, Best Available Control Technology, in the USEPA's *New Source Review Workshop Manual*, Draft, October 1990 (NSR Manual).

[87] Mississippi Lime submitted additional material regarding NOx emissions of the proposed lime kilns. The data gathered included a listing of other new lime plants and their NOx BACT limits as well as stack test data from certain lime kilns. The emission information for the two kilns at Chemical Lime's O'Neal plant in Calera, Alabama included both test data and average monthly data collected by continuous emission monitoring. Mississippi Lime Supplemental Remand Analysis, July 2012, Section 4.

To collect this information, Mississippi Lime made "freedom of information" requests, with accompanying on-site file reviews, for other state permitting authorities around the country. It was successful in gathering NO_x emission data for six operating lime kilns located in Alabama, Kentucky and Wisconsin. Requests made to other permitting authorities did not yield any NO_x emission data.

[88] The Illinois EPA also contacted a number of states in an attempt to obtain relevant information about the emissions of lime plants, including Alabama, Indiana, Kentucky, Michigan, Nevada and Wisconsin. These efforts were generally unsuccessful. The emission test data that was received was not accompanied by complete information about the operating conditions during testing, including limestone feed or lime production rate, fuel usage rates and the fuel mix.

Information was received that confirmed that setting limits for the emissions and operation of a kiln that are appropriate, i.e., are not overly restrictive, can be difficult. Graymont, Superior pursued a revision to its permit following emission testing that did not show compliance (New Source Review Permit Application, May 2008.) Graymont also requested revision of the permit for a facility in Nevada to eliminate a requirement on the sulfur content of fuel as the low sulfur fuel was no longer available in the region. It opted to conduct continuous emission monitoring for SO_2 in place of limits on the sulfur content of the fuel for the kilns.

emissions.[89] Like the original permit, this limit would not apply during startup, shutdown and other periods when a kiln is operating at a very low level.[90] This is because this BACT limit would be expressed in terms of lime production of a kiln.[91] This proposed BACT limit for NO_x was developed from the information that has been assembled for the permitted and actual NO_x emissions of existing rotary lime kilns equipped with preheaters, like the proposed kilns.

TOP-DOWN PROCESS - STEP 5
(Selecting the Best Available Control Technology (BACT) Limit)

In Step 5 of the Top-Down BACT Process, the BACT limit for a pollutant is selected based on the use of the control technology that had been previously selected as BACT technology in Step 4 of the BACT analysis.[92]

Information has been assembled for the BACT limits for NO_x emissions and actual NO_x emissions of other new lime kilns. These other new kilns are generally similar to the proposed kiln, having the same control technology for NO_x as would be used by the proposed kilns.

The data that has been assembled on NO_x emissions of lime kilns is summarized in the tables at the end of this discussion. The NO_x emission limits that have been set for other new lime kilns are listed in Table 3-1. The BACT limits for NO_x are readily available from USEPA's *RACT/BACT/LAER Clearinghouse*. For these other new kilns, the lowest limit set as BACT for NO_x is 3.5 pounds per ton of lime produced, with compliance generally subject to verification by emission testing. This limit applies to four of the 20 new kilns for which BACT or other NO_x limits are known. The other new kilns are subject to less stringent NO_x limits, up to 4.8 pounds per ton of lime.

This information does not suggest that a limit lower than 3.5 pounds per ton of lime, the lowest limit that has previously been set, should now be considered achievable. The evaluations of technical feasibility and control effectiveness of control options for NO_x, in Steps 2 and 3 of the Top-Down BACT Process did not identify developments or improvements in the NO_x control technology of lime kilns that would now be used for the proposed kilns, as compared to that of other new lime kilns. Thus improvements in NO_x control

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[89] The NO_x BACT limit for the proposed kilns in the original permit would have been 3.5 pounds per ton of lime produced on a 24-hour average, with compliance determined by continuous emissions monitoring. The permit also provided that if the Illinois EPA subsequently determined that continuous emission monitoring for NO_x was not necessary or appropriate, this limit would apply on a 3-hour average, with compliance verified by emission testing. (See Conditions 2.1.3-2 and 2.1.8-1(e) of the original permit.)

[90] Like the original permit, during periods when the proposed output-based BACT limit would not apply, the Illinois EPA is proposing that the hourly limit on NO_x emissions of the kilns would serve to constitute NO_x BACT.

[91] For periods when a kiln is operating at less than 30 percent of the capacity, the 3.5 pounds per ton limit would not apply. This is because the BACT limits would be expressed relative to production. Instead, during these periods, the hourly emission rate used in the NO_x air quality analysis would apply as a secondary BACT limit.

[92] In the final step of the Top-Down Process, Step 5, the most effective control option that is not eliminated in Step 4 is considered the BACT technology for the pollutant and emission unit. An emission rate is selected as BACT based on the use of that control option.

technology do not provide a basis to find that a lower limit would now be achievable for the proposed kilns.[93] Accordingly, the other basis upon which to establish a lower NO_x limit for the proposed kilns would be data for the actual NO_x emissions of kilns if it shows that existing NO_x control technology is more effective and reliable such that a lower NO_x BACT limit may now be established.[94]

For this purpose, the information that has been assembled for actual NO_x emissions of lime kilns as measured by stack tests is presented in Tables 3-2 and 3-3. Table 3-2 only includes data from tests in which emissions of CO or other pollutants are not known to have been exceeded. The results of "non-compliant" testing are provided separately in Table 3-3. This is because the NO_x emission rates measured in these tests cannot be considered to be representative or reliable because of the presence of operational conditions in a kiln that led to the exceedances of the CO limit.

The relevant stack test information, as presented in Table 3-2, shows that NO_x emission rates of lime kilns as measured by testing are routinely less than the applicable permit limits or emission rates, sometimes by a significant amount.[95] However, by itself, this is not sufficient to conclude that a lower BACT limit should be set for the proposed kilns for NO_x. It is appropriate that the measured NO_x emission rates of lime kilns be less than the applicable limits and rates by some degree. This is because it is appropriate for BACT limits and other emission limits to be set with a "reasonable safety margin" to assure that they are achievable considering normal variation in the operation of an emission unit and emission control technology when properly operated and maintained. Further review of the data for the measured NO_x emission rates of lime kilns is needed to determine whether a NO_x BACT limit lower than 3.5 pounds per ton of lime should be achievable by the proposed kilns.

The collected data for the tested NO_x emission rates of lime kilns spans a wide range, ranging from less than 50 percent of the applicable limit to as much as 95 percent of the applicable limit. As a general matter, information is not available that would indicate that the range of measured NO_x emissions of kilns is anything other than the normal variation in NO_x emissions that is present for lime kilns that are properly operated and maintained.[96] In this

[93] If improvements in NO_x control technology were available for lime kilns, an engineering assessment could be made for the reduction in the NO_x emissions of the proposed kilns that would be provided with the use of such technology.

[94] It should be noted that a substantial, credible body of emission test data would be needed to adjust the BACT limit based on that data. This is because of the number of factors that may affect the NO_x emission rate of a lime kiln, which go beyond the fuel combustion system to the overall operation of the kiln system.

[95] Considering measured NO_x emissions of the existing lime kilns as a percentage of the relevant NO_x limit or rate that applies to the kiln, in pounds/ton of lime produced, the measured NO_x emissions of lime kilns are routinely at least 10 percent lower than the relevant limit or rate. The measured emissions are rarely more than 50 percent lower than the relevant limit or rate. For kilns for which data from multiple tests is available, the various measured NO_x emission rates are often similar, differing by at most 20 percent. However, a greater range is shown in the measured emissions of certain kilns, particularly when data was available from stack tests that were conducted over a period of many years.

[96] The NO_x emissions of lime kiln can be affected by a number of factors independent of the purposeful operation of the kiln to reduce NO_x emissions. First, the NO_x

regard, the information for the measured NO_x emissions of lime kilns was not accompanied by detailed information about how these kilns were operating during emission testing. This information, which might have provided insight on the differences in measured NO_x emissions, was not included in the stack test reports.[97] As such, the assembled data generally does not provide a sound basis to set a lower BACT limit for the NO_x emissions of the proposed kilns. Indeed, as the highest measured NO_x emission rates are above or only slightly below 3.5 pounds per ton of lime, this data confirms that the 3.5 pounds per ton of lime is an appropriate BACT limit for the proposed kilns.[98, 99]

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emissions of a kiln may be affected by the operating rate of a kiln and the type of lime that is being produced. Emissions may also be affected by changes in the sources of the limestone and fuel being used in the kiln. Then, on a short-term basis, there is normal variation in the composition and condition of stone feed and fuel and in the operation of the limestone preparation system, the fuel preparation and feed system, the calcination process in the kiln, the preheater, etc. Then, on a longer-term basis, the NOx emissions of a kiln are affected by the condition of the various components, most critically as related to the length of time since routine maintenance was last performed. This is because of gradual wear and drift of the various systems and components, such as mills, feed devices, kiln seals, refractory, etc., between maintenance. All these factors combine to affect both the fuel combustion process in the kiln and the thermal efficiency or heat losses from a kiln. That is, they determine how much fuel must be fired in the kiln and how well it can be combusted to minimize formation of NOx.

[97] In fact, it was necessary to make assumptions about the operating rate of certain lime kilns to convert the emission data in test reports, which was provided in pounds per hour, to pounds per ton of lime. The operating rates of these kilns during testing, i.e., the amount of lime being produced, was not available for these tests. The operating rate of an emission unit is commonly considered a fundamental aspect of the operation of a unit during testing. It indicates whether a unit was operating at or near its design or normal rate during testing, so measured emissions are reflective of emissions at maximum load, or whether the measured emissions may be influenced by operation of the unit below its normal rate or the design capacity of the unit.

[98] The data for actual NOx emissions that is critical for selecting the limit that is set as NOx BACT for the proposed kilns are the higher emission rates. This is because BACT limits are to be reasonably achievable. In the absence of information showing that a high measured emissions rate was "higher than necessary," e.g., it reflects poor operation of a kiln system as related to NOx emissions, it is indicative of the lowest emission rate that may appropriately be set as BACT for NOx. This is because emission rates above such values were not measured and presumably never occurred.

In this case, the highest value of measured NOx emissions, 3.81 pounds per ton, is above 3.5 pounds per ton (MLC, Verona, July 2010). This emission rate will arbitrarily be considered to not be representative and disregarded. It may be significant that this rate was compliant as this kiln's NOx limit is 4.0 pounds per ton.

The next highest emission rates for actual NOx emissions of lime kilns indicate that an emission limit of 3.5 pounds per ton of lime is appropriate as NOx BACT. The second and third highest NOx emission rates measured at existing kilns are both 3.45 pounds per ton of lime (Chemical Lime, O'Neal, Kiln 2, June 15, 2007, and MLC, Verona, September 2008). These emission rates are only slightly below 3.5 pounds per ton. Moreover, the applicable NOx emission rate for Chemical Lime, O'Neal, Kiln 2, is 3.69 pounds/ton, so that the NOx emissions measured during the June 2007 test were only 93.5 percent of the applicable rate.

[99] Considered as a whole, in the absence of further explanatory information concerning the various lime kilns and the testing conducted at those kilns, only a very simple conclusion should be drawn from the data on actual NOx emissions of lime kilns. It is common for the measured NOx emissions of a lime kiln as determined by a stack test to be significantly lower than the limit that applies to the kiln. Overall, considering

As already mentioned, some of the NO_x emission data for lime kilns that was assembled was from stack tests during which the applicable CO limit was exceeded. This emission data is presented in Table 3-3. In particular, for Graymont's lime plant in Superior, Wisconsin, a series of tests was conducted for Kiln 5 after an emission test showed exceedances of the applicable CO limit with poor combustion conditions in the kiln.[100] Again, as with the other emission test reports, the available information does not indicate the specific cause of poor combustion, e.g., improper operation, failure of operational instrumentation or flawed operating procedures. This test data highlights the relationship that exists between the NO_x emissions and CO emissions of a lime kiln. There is a trade-off between NO_x and CO, wherein poor combustion with higher levels of CO emissions will be accompanied by lower levels of NO_x emissions. These "noncompliant" tests confirm that permit limits for CO emissions may act to constrain the permit limits that may be set for NO_x emissions. Moreover, the emissions of the proposed kilns will be further constrained as they are also subject to BACT for GHG emissions. This is not the case for the new lime kilns for which data on actual NO_x emission was collected. As a consequence, Mississippi Lime will not be able in practice to "detune" or operate the proposed kilns less efficiently to comply with the limit that is set as BACT for NO_x. This is possible at the other new kilns. Moreover, for the "older" new kilns, the thermal efficiency of the kilns may be lower and GHG emissions may inherently be higher so that lower NO_x limits may in practice be achievable for those kilns.

In addition to data from stack tests, the NO_x emissions data that was assembled also includes data from continuous monitoring systems for two kilns.[101] This data is presented in Table 3-4. This data provides important further insight on the NO_x emissions of lime kilns as it directly addresses the variation in emissions of the subject kilns.[102, 103] This monitored data

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the information in Table 3-2 for the measured NOx emission rate of lime kilns, the average NOx rate is 79.1 percent of the applicable limit.

[100] Similarly, a stack test was conducted for Kiln 2 at Graymont's Green Bay plant that showed compliance with the NOx emission limit but exceedance of the CO limit, as well as the limits for PM and SO_2. In particular, in this test on February 14, 2002, the measured NOx emission rate was 17.3 pounds/hour, which complied with the applicable limit. However, the CO emissions measured during this test were 937 lbs/hr, compared to a limit of 102 lbs/hr and measured CO emissions of 22.5 lbs/hr in the subsequent "retest".

[101] As a general matter, air pollution control agencies do not receive the detailed emission data that is collected by continuous emissions monitoring systems. The data that is reported to agencies involves exceedances of applicable standards and operation of the monitoring system. The data for actual emissions for periods when an emission unit is in compliance, which is voluminous, is retained by the source.

The data that was assembled for Chemical Lime's O'Neal plant was available because it was submitted by Chemical Lime as part of the support for an application for a revision to a permit.

[102] As compared to continuous emission monitoring, stack testing is commonly characterized as a snapshot of the emissions of a unit. This is because stack testing narrowly addresses the emissions of an emission unit at a specific time under particular operating conditions.

[103] As reiterated by the USEPA's Environmental Appeals Board in its decision in *re: Russell City Energy Center, LLC*, PSD Appeal Nos. 10-01, 10-02,10-03,10-04 and 10-05:

> In essence, Agency guidance and our prior decisions recognize a distinction between, on the one hand, measured "emissions rates," which are necessarily

confirms substantial variation in NO_x emissions of lime kilns over the course of a year. During the course of a year, the monthly, 30-day average NO_x emission rates of one kiln range from 55 to 132 percent of the applicable limit. The NO_x emission rates of the second kiln range from 46 to 123 percent of the applicable rate. In addition, this data directly confirms that a NO_x limit lower than 3.5 pounds per ton should not be set for the proposed kilns. For both kilns, the highest NO_x emission rates exceed 3.5 pounds per ton (4.63 and 4.555 pounds per ton). The second highest rates are consistent with a BACT limit of 3.5 pounds per ton (3.06 and 3.52 pounds per ton).

The other matter on which this continuous monitoring data provides important insight is the averaging time associated with the NO_x BACT limit as it is to be accompanied by continuous emissions monitoring. As this is the only data for which continuous monitoring data is available, the BACT limit for the proposed kilns should be set on the same averaging time, a 30-day average.[104] The monitored data also indicates additional variability in the NO_x emission rates of existing kilns, which may not have been captured or identified when NO_x emissions are only measured by stack testing.

In conclusion, information on the required and actual performance of lime kilns for emissions of NO_x shows that Mississippi Lime has proposed a stringent limit as BACT for NO_x. This information does not show that an emission limit better than that proposed by Mississippi Lime is achievable. It is appropriate that the NO_x BACT limit for the productive operation of the proposed kilns be set at 3.5 pounds per ton of lime produced, 30-day average.

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data obtained from a particular facility at a specific time, and on the other hand, the "emissions limitation" determined to be BACT and set forth in the permit, which the facility is required to continuously meet throughout the facility's life. Stated simply, if there is uncontrollable fluctuation or variability in the measured emission rate, then the lowest measured emission rate will necessarily be more stringent than the "emissions limitation" that is "achievable" for that pollution control method over the life of the facility.

Newmont, 12 E.A.D. at 441-42 (citations updated); *see also Prairie State*, 13 E.A.D. at 55-56 (quoting many of these same principles).

15 E.A.D., pp 78 - 79

[104] Given the magnitude of the permitted NOx emissions of the proposed kilns, it is appropriate that continuous emission monitoring be used to determine compliance with the NOx BACT limit that is set for the proposed kilns. Moreover, the range of NOx emissions measured at existing lime kilns, as measured by both stack testing and continuous monitoring, further supports requiring continuous emissions monitoring for NOx for the proposed kilns.

Table 3-1: Comparison of NO_x BACT Limits/Rates for Similar Kilns

Source (RBLC Entry No.)		Capacity (tons/day)	BACT Limit/Rate (lbs/hr)	BACT Limit/ Nominal Rate (lbs/ton)
Proposed Mississippi Lime – Kilns 1 & 2		1200 (each)	---	3.50
Synergy, Monon - Kilns 1 & 2 (IN, 2010)		900 (each)	131	3.50
Pete Lien, Rapid City - Kiln 3 (SD, 2008)		600	100.0 (24-hr ave.)	4.00
Graymont, Superior - Kiln 5 (WI-0250, 2009)(WI-0233, 2006)		650	98.8 (3-hr ave.)	3.66
Martin Marietta, (OH-0321, 2008)		900	673.43 Ton/yr (12-month ave.)	4.10
Graymont, Cricket Mountain (UT, 2007) (Kiln 5)		1400	210	3.60
MLC, Verona – - Kilns 1 & 2 (KY, 2007)		840 (each)	---	4.00
Dakota Coal, Frannie (WY, 2006)		500	85 (24-hr ave.)	4.10
Graymont Western, Pilot Peak (NV-0040, 2006)	Kiln 1	600	120	4.80
	Kiln 2	800	160	4.80
	Kiln 3	1200	200	4.00
Arkansas Lime, Batesville (AR-0082, 2005)		687	---	3.50 (30-day ave.)
Western Lime, Port Inland (MI-0383, 2005)		870	132.6 (24-hr ave.)	3.66
Chemical Lime, O'Neal (AL-0220, 2005)	Kiln 1	1500	196.9	3.50
	Kiln 2	1500	216.9*	3.69*
Graymont, Bellefonte (PA-0241, 2004)	Kiln 6	1200	205 (30-day ave.)	4.10
	Kiln 7	1050	179 (30-day ave.)	4.10
Austin White, McNeil, Kiln 3 (TX-0452, 2003)		650	-	4.40

* The NO_x emission limit for Kiln 2 at Chemical Lime, O'Neal, is not a BACT limit. For this project the increase in NO_x emissions from the project was not significant, i.e., less than 40 tons/year. The project was subject to PSD for CO, PM and SO_2.

Table 3-2: "Compliant" Test Results for NO_x Emissions of Other Similar Kilns[x]

Plant	Kiln	Data	NO_x Emissions Lb/Hr	NO_x Emissions Lb/Ton Lime	Percent of Limit
Chemical Lime, O'Neal	1	BACT Limit	196.9	3.5	--
		Stack Test Nov. 10, 2005	133.49 ave. (141, 134, 125)	2.43 ave. (2.57, 2.44, 2.29)	69.4
		Stack Test May 10, 2006	167.85 ave. (158, 160, 186)	3.01 ave. (2.84, 2.86, 3.33)	86.0
		Stack Test March 26, 2007	149.96 ave. (97, 135, 167, 175, 154, 155, 157, 140, 143)	2.35 ave.[d]	67.1
	2[e]	Permit Limit	-	3.69	---
		Stack Test June 15, 2007	65.2 ave. (69, 75, 80, 67, 65, 57, 53, 57, 63)	3.45 ave.[f]	93.5
MLC, Verona[a]	1	BACT Limit	140.0	4.00 (calc.)	--
		Stack Test Sep. 3, 2008	120.8 ave. (134, 125, 103)	3.45 ave.[g]	86.3
		Stack Test July 21, 2010	133.4 ave. (121, 142, 137)	3.81 ave.[g]	95.3
Graymont, Superior[b]	5	BACT Limit	98.8	3.66	--
		Stack Test April 8, 2008	51.93 ave. (51, 53, 52)	1.92 ave.[h]	52.5
Graymont, Green Bay[c]	1	Permit Limit	-	3.8	
		Stack Test July 11, 2002	36.8 ave. (37, 39, 35)	3.37 ave. (3.37, 3.56, 3.19)	88.7
		Stack Test August 3, 2004	35.3 ave. (35, 37, 34)	3.17 ave. (3.11, 3.33, 3.06)	83.4
		Stack Test Oct. 17, 2006	23.4[i] (21.7, 24.3, 24.3)[i]	2.17 ave. (2.01, 2.25, 2.25)	57.1
		Stack Test August 19, 2008	23.9[j]	2.30 ave.	60.5

Plant	Kiln	Data	NO_x Emissions		Percent of Limit
			Lb/Hr	Lb/Ton Lime	
	2[k]	Orig. Permit Limit	40.8	2.28 (calc.)	--
		Stack Test August 12, 1993	33.2 ave. (35, 30, 34)	2.17 ave.	95.2
		Rev. Permit Limit	60.0	2.88 (calc.)	--
		Stack Test Oct. 30, 1997	56.0 ave. (55, 59, 54)	3.09 ave.	107.3
		Stack Test Report April 25, 2002	43.2 ave. (45, 42, 42)	2.18 ave.	75.7
		Stack Test March 10, 2004	33.3 ave. (37, 37, 26)	1.75 ave.	60.8
		Stack Test Feb. 11, 2005	39.2 ave. (42, 38, 38)	2.06 ave.	71.5
		Stack Test Jan. 19, 2006	47.0 ave. (47, 49, 45)	2.80 ave. (2.8, 3.0, 2.6)	97.2
		Stack Test Nov. 28, 2007	43.5 ave. (38, 45, 48)	2.20 ave. (1.9, 2.3, 2.4)	76.4
					Ave. 79.1

Notes:

General: Conversions from tons of stone feed to tons of lime produced are based on two tons of feed per ton of lime.

a Formerly Gallatin

b Formerly CLM

c Formerly Western Lime

d Calculated based on nominal rated capacity of kiln, 62.5 tons lime/hour

e Kiln 2 at Chemical Lime's O'Neal plant was not subject to PSD for NO_x. This kiln was permitted as a non-major project for NO_x, based on a contemporaneous decrease in NO_x emissions provided by Kiln 1.

f Calculated based on nominal rated capacity of kiln, 35 tons lime/hour

g Calculated based on nominal rated capacity of kiln, 35 tons lime/hour h Calculated based on highest operating rate of kiln, 27 tons lime/hour

i Calculated based on nominal rated capacity of kiln, 10.8 tons lime/hour

j Calculated based on nominal rated capacity of kiln, 10.4 tons lime/hour

k The NO_x emission data from a test on February 14, 2002 is not included in this summary. Although, the measured NO_x emission rate was 17.3 pounds/hour, the PM, CO and SO_2 emissions measured during this test exceeded applicable limits. In particular, the measured CO emission rate was 937 lbs/hour , compared to a limit of 102 lbs/hour and measured CO emissions of 22.5 lbs/hour in the subsequent "retest" on April 25, 2002 (also shown in Wisconsin DNR records as occurring on April 4, 2002).

Summary results for emission tests, 26.0 and 18.0 lbs NO_x /hour, conducted on November 10, 2009 and October 27, 2012, respectively, are also not included. This is because they were not accompanied by copies of the results from the test reports to confirm that the data was properly summarized, e.g., the data does not represent NO_x emissions per ton of stone feed.

Table 3-3: "Non-Compliant" Test Results for NO_x Emissions of Other Similar Kilns[a]
(Compliant test data for these kilns is also provided)

Plant	Data	NO_x Emissions		Notes, if "Noncompliant"
		Lb/Hour	Lb/Ton Lime	
Graymont, Superior[b] Kiln 5	BACT Limit	98.8	3.66	
	Test Jan. 15, 2008	56.14 ave. (58, 58, 52)	2.08 ave.[h]	Noncompliant CO limit exceeded during test
	Test Feb. 5-6, 2008	49.7 ave. (45, 49, 51, 49, 49, 51, 53, 51, 50)	1.90 ave.[h]	Noncompliant CO limit exceeded during test
	Test March 26, 2008	53.09 ave. (56, 55, 49)	1.84 ave.[h]	Noncompliant PM limit exceeded during test
	Test March 27, 2008	51.06 ave. (49, 54, 51)	1.97 ave.[h]	Noncompliant CO and PM limits exceeded
	Test April 8, 2008	51.93 ave. (51, 53, 52)	1.92 ave.[h]	"Compliant"[l]
	Test April 9, 2008	48.60 ave. (47, 48, 50)	1.80 ave.[h]	Noncompliant CO limit exceeded during test
Graymont, Green Bay[c] Kiln 2[?]	Orig. Permit Limit	40.8	2.28 (calc.)	
	Test August 12, 1993	33.2 ave. (35, 30, 34)	2.17 ave.	
	Rev. Permit Limit	60.0	2.88 (calc.)	
	Test Oct. 30, 1997	56.0 ave.	3.09 ave.	"Compliant"[m]
	Test Feb. 14, 2002	17.3 ave.	0.43 (calc.)	Noncompliant CO, PM and SO_2 limits exceeded
	Test Report April 25, 2002	43.2 ave.	2.18 ave.	
	Test March 10, 2004	33.3 ave.	1.75 ave.	
	Test Feb. 11, 2005	39.2 ave. (42, 38, 38)	2.06 ave.	Noncompliant PM (Front Half and Total)
	Test Jan. 19, 2006	47.0 ave. (47, 49, 45)	2.80 ave. (2.8, 3.0, 2.6)	
	Test Nov. 28, 2007	43.5 ave. (38, 45, 48)	2.20 ave. (1.9, 2.3, 2.4)	

Notes:

a Conversions from tons of stone feed to tons of lime produced are based on two tons of feed per ton of lime.

b Formerly CLM.

c Formerly Western Lime.

d Calculated based on nominal rated capacity of kiln, 62.5 tons lime/hour.

f Calculated based on nominal rated capacity of kiln, 35 tons lime/hour.

g Calculated based on nominal rated capacity of the kiln, 35 tons lime/hour.

h Calculated based on highest operating rate of the kiln, 27 tons lime/hour.

i Calculated based on nominal rated capacity of the kiln, 10.8 tons lime/hour.

j Calculated based on nominal rated capacity of the kiln, 10.4 tons lime/hour.

k The PM, CO and SO_2 emissions measured during this test exceeded applicable limits. In particular, the measured CO emission rate was 937 lbs/hour, compared to a limit of 102 lbs/hour and measured CO emissions of 22.5 lbs/hour in the subsequent “retest” on April 25, 2002 (also shown in Wisconsin DNR records as occurring on April 4, 2002).

l The PM limit in gr/scf was exceeded, at 0.013 gr/scf, compared to a limit of 0.012 gr/scf.

m The measured NO_x emission complied with limit in permit, however, the calculated lb/ton of lime was exceeded at 3.09 lbs/ton lime, compared to 2.88 lb/ton lime.

Table 3-4: Review of 2008 Monitored Emission Data for NO_x for Chemical Lime, O'Neal

Kiln	Type of Data	Lb/Hour	Lb/Ton Lime
1	BACT Limit	196.9	3.5
	CEM Data (30 day ave.)	85.03 ave. (108, 91, 80, 77, 73, 83, 89, 89, 69, 75, 88, 100)	2.38 ave. (2.55, 2.13, 1.91, 2.12, 1.96, 2.16, 4.63, 2.30, 2.53, 2.42, 3.06, 2.73)
2 1200 tpd	Permit Limit	---	3.69
	CEM Data (30 day ave.)	77.68 ave. (61, 84, 75, 65, 81, 73, 95, 97, 68, 92, 73, 65)	2.23 ave. (2.6, 2.42, 1.79, 1.8, 1.80, 1.69, 4.55, 2.17, 1.93, 2.75, 2.35, 3.52)

ATTACHMENT 4

BACT Determination Particulate Emissions of the Kilns

INTRODUCTION

The proposed BACT limit for the PM emissions of the kilns is 0.14 pounds/ton of lime based on use of filtration technology or baghouse.[105] Filters or baghouses are widely recognized as the appropriate control technology for particulate emissions of new lime kilns, as addressed in the original permit for this plant. This proposed BACT limit for PM is based on operation of baghouses to comply with a PM exhaust grain loading of 0.01 grains per dry standard cubic foot of exhaust (gr/dscf).[106] This level of performance is consistent with the most stringent exhaust grain loading at which new kilns have been permitted. In addition, this proposed limit reflects the construction and operation of modern, energy efficient kilns, which would be designed for lower flue gas flow rates, in dscf per ton of lime, than less efficient older kilns. In this regard, the measures that will reduce the fuel usage and greenhouse gas (GHG) emissions of the proposed kilns, such as computerized kiln operating systems, fully adjustable variable speed fans[107] and a kiln seal management program, will also act to lower the gas flow rates of the kilns. As such, these measures also act to lower the BACT limits that may be set for the particulate emissions of the proposed kilns.

DISCUSSION

Mississippi Lime has submitted additional information and discussion regarding the particulate emissions of the lime kilns to support the BACT limits for the proposed kilns. The data gathered includes a listing of permitted lime facilities and the applicable BACT limits for PM and PM_{10}. Recent permitting actions for rotary lime kilns have set BACT limits for PM emissions that, when expressed in pounds per ton of lime produced, range from 0.15 to 0.50 pounds/ton of lime produced. These limits reflect exhaust grain loadings from the fabric filters or baghouses on the kilns of 0.01 to 0.021

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[105] The proposed BACT limits for PM_{10}, 0.18 pounds/ton lime, and $PM_{2.5}$, 0.105 pounds/ton lime are developed from the proposed BACT limit for PM. They are different because they address the combination of filterable particulate (either filterable PM_{10} or $PM_{2.5}$) and condensable particulate. The projected amount of condensable particulate is more than the fraction of the PM that is projected to be larger than PM_{10}, which would not be PM_{10}. Accordingly, the proposed BACT limit for PM_{10} is 0.04 pounds/ton bigger than the proposed BACT limit for PM. The proposed BACT limit for $PM_{2.5}$ is smaller than the BACT limit for PM by 0.035 pounds/ton because the projected amount of PM that is larger than $PM_{2.5}$ is greater than the amount of condensable particulate.

[106] Exhaust grain loadings, in grains per dry standard cubic foot (gr/dscf), address the rate of particulate emissions from a process or control device in terms of the weight of particulate per volume of exhaust. The weight is expressed in "grains". (There are 7,000 grains in one pound.) The volume of exhaust is expressed in "dry standard cubic feet", excluding the volume of water in the exhaust and at standard conditions, e.g., 70°F and one atmosphere.

The required and actual performance of baghouses and other control devices for emissions of filterable PM are commonly expressed as exhaust grain loadings.

[107] In older kilns, dampers are used to control the air flow through the kiln.

gr/dscf.[108] This data generally confirms that a stringent BACT limit is proposed for PM emissions.

In order to determine if a more stringent BACT limit should be set based on the actual performance of lime kilns, the methodology used by the USEPA to determine Maximum Achievable Control Technology (MACT) for lime kilns was considered. USEPA addressed particulate emissions of lime kilns as part of its rulemaking in 2002 adopting National Emission Standards for Hazardous Air Pollutants (NESHAP) for Lime Manufacturing Plants, 40 CFR 63 Subpart AAAAA. In this rulemaking, in accordance with the provisions of Section 112(d) of the Clean Air Act, USEPA made regulatory determinations of Maximum Achievable Control Technology (MACT) for emissions of hazardous air pollutants (HAPs) from lime kilns. These rules set MACT limits for the PM emissions of lime kilns since USEPA determined that it was appropriate to use PM emissions as a surrogate for emissions of particulate HAPs. USEPA examined the relationship between emissions test data and permit limits for PM emissions of lime plants in this rulemaking and found that the permit limits were indicative of the variability in the long-term performance of the emission controls. Accordingly, USEPA set the MACT floor for PM emissions of new lime kilns at 0.10 pounds per ton of stone feed.[109] This is equivalent to 0.20 pounds per ton of lime produced.[110]

The methodology used by USEPA to establish the MACT floor is explained in the preamble to this rule. The USEPA examined both emission limits and PM test data from 47 lime kilns and determined that the most accurate approximation of performance achieved by and achievable by the average of the best 12 percent of existing sources was the permit limit. In its study, USEPA examined multiple sets of PM emissions data from individual kilns to assure that the permit limit did not understate the emission control capabilities of the kilns for PM emissions. The USEPA found that the test data for the “best controlled kiln” demonstrated that the permitted level of 0.10 pounds per ton of stone feed (0.20 pounds per ton of lime), appropriately represented the level of performance that is consistently achievable by new lime kilns.

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[108] A small number of permits also address emissions of filterable PM_{10}, with PM_{10} limits that range from 0.15 to 0.20 pounds/ton lime, based on exhaust grain loadings for PM_{10} that range from 0.010 to 0.012 gr/dscf.

A limit that would clearly apply to PM_{10} emissions, including both filterable and condensable particulate, is only set by the permit for a project proposed by Synergy Management at a site near Monon, Indiana. That permit limits total emissions of PM_{10} to 0.20 lbs/ton lime. This limit also applies to total emissions of $PM_{2.5}$.

[109] The "MACT floor" is the initial determination of the MACT standard for a category of source. It provides the minimum level of HAP emission control required for new and existing sources. The MACT floor for new sources is equivalent to the level of HAP emission control achieved by the best-controlled similar source. The MACT floor for existing sources is the average level of HAP emission control achieved by the top 12% of the currently operating sources in the source category. At a minimum, a MACT standard must achieve, throughout the source category, a level of emissions control that is at least equivalent to the MACT floor. Under the Clean Air Act, USEPA can establish a more stringent standard or “go beyond the floor” when this can be justified after consideration of costs and any negative health or environmental impacts.

[110] The ratio, by weight, of the limestone feed to a kiln to the lime produced by the kiln is nominally 2:1. Accordingly, a PM emission rate of 0.10 pounds/ton stone feed for a kiln is equivalent to a PM emission rate of 0.20 lbs/ton of lime produced.

USEPA also determined that it would not go "beyond the floor" because no technologies existed that would enable a lower emission limit to be set.

Since 40 CFR 63 Subpart AAAAA was adopted, only 11 permits have been issued for new lime kilns. Limits for PM emissions that are lower than the limit that is now proposed have not been set in these permits. The permit for the "best controlled kiln," which was issued in 2010, explicitly requires that the PM emissions of the kiln comply with a limit in terms of exhaust grain loading of 0.01 gr/dscf.[111] This is also the value for exhaust grain loading that is the basis of the BACT limit that is now being proposed. However, because of the lower design gas flow rate of these kilns, the resulting emission limit for PM_{10} in pounds per ton of lime is lower that the limit set in the permit issued to Synergy Management in 2010, 0.14 lbs/ton compared to 0.15 lbs/ton.

In conclusion, the proposed BACT limit appropriately considers the design of these kilns, as they would be more energy efficient and have a lower gas flow rate, and the performance of the baghouses on the kilns for PM emissions, in gr/dscf.

[111] In December 2010, the Indiana Department of Environmental Management issued a permit to Synergy Management for a proposed dolomitic lime plant near Monon, Indiana, which has not yet been built. The BACT limits for the particulate emissions of the plant's two kilns were: 0.01 gr/dscf for PM and $PM_{10}/PM_{2.5}$ (filterable) for the baghouses on the kilns; 0.15 lb/ton lime, 3-hr average, for PM and $PM_{10}/PM_{2.5}$ (filterable); and 0.20 lb/ton lime, 3-hr average, for $PM_{10}/PM_{2.5}$ (filterable and condensable).

ATTACHMENT 5

Analysis of Best Available Control Technology (BACT) for Emissions of Greenhouse Gases (GHG)

ANALYSIS OF GHG BACT FOR THE KILNS

INTRODUCTION

This discussion describes the analysis of Best Available Control Technology (BACT) that has now been conducted by the Illinois EPA for the proposed lime kilns for emissions of greenhouse gases (GHG).[112] This analysis was performed using the five-step "top-down" BACT process as set forth in the NSR Manual.[113] Mississippi Lime provided supplemental material to support this analysis to demonstrate that the kilns would use BACT for emissions of GHG.[114]

Based on this analysis, the Illinois EPA is proposing that technology for BACT for GHG emissions be process energy efficiency, with use of preheaters on the kilns and other measures for improved energy efficiency and lower their fuel consumption. The BACT limit for GHG is proposed to initially be set at 2744 pounds of GHG, as carbon dioxide equivalents (CO_2e), per ton of lime produced, annual average, rolled monthly. Because of the limited data that is available for the actual GHG emissions of modern lime kilns, this BACT limit would be subject to further evaluation based on the actual performance of the proposed kilns to determine whether a BACT limit that reflects 10 percent better fuel efficiency is achievable.

BACKGROUND

Most of the GHG emissions from the proposed plant would be from the two proposed rotary lime kilns. These emissions (CO_2, CH_4 and NO_2) would result from combustion of fuel in the kilns and from the calcination process or conversion of limestone into lime, which releases CO_2.[115]

Each kiln would be a refractory-lined steel tube that rotates along its horizontal axis. The kiln would be aligned on a slight incline, with the feed

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[112] The proposed plant is now subject to PSD for GHG emissions pursuant to USEPA's Greenhouse Gas Tailoring Rule. Beginning January 2, 2011, this rule provides that proposed new sources that are otherwise subject to PSD are also subject to PSD for GHG emissions if they have potential GHG emissions of 75,000 tons/year or more, measured as carbon dioxide equivalents (CO_2e). This plant meets this criterion, with potential GHG emissions of about 1,200,000 tons/year, as CO_2e. Therefore a BACT determination is now required for GHG emissions. *See* USEPA, *PSD and Title V Greenhouse Gas Tailoring Rule; Final Rule*, 75 FR 31514 - 31608 (June 3, 2010).

[113] Refer to Chapter B, Best Available Control Technology, in the USEPA's draft *New Source Review Workshop Manual*, USEPA, Office of Air Quality Planning and Standards, October 1990 (NSR Manual).

[114] Application supplement, "Supplemental GHG BACT Analysis with Clarifications," submitted by Mississippi Lime on July 1, 2013 (2013 GHG Supplement).

[115] The emergency engines at the plant would also have GHG emissions. BACT would generally be required for GHG as these engines would be "emergency engines". GHG BACT for these engines is further addressed at the end of this discussion.

end being higher than the discharge end. The burner, which would provide the heat for the calcination process, would be located at the discharge end (or burner end). The combustion gases would be in direct contact with the limestone for effective heat transfer and calcination. The limestone feed would tumble and roll through the kiln toward the burner end as it undergoes calcination to become lime. The operation of the kiln (i.e., internal temperatures, rotation rate, air flow, and fuel and stone feed rates) would be maintained to produce material that meets commercial specifications for lime. The selected fuel must supply adequate heat and burn at a consistent rate. Excessive heat would reduce reactivity of the product, while insufficient heat would lead to incomplete conversion to lime and a material that is not saleable. Since the combustion gases from the burner would be in direct contact with the limestone feed, the composition of the fuel and combustion characteristics can directly affect the quality of the lime product. It must also not contain excessive ash or other impurities that would be absorbed into the lime and contaminate the finished lime product. To improve the energy efficiency of each kiln, the flue gases from each kiln would pass through a separate preheater device, to preheat the limestone feed to the kiln, before entering a filter or baghouse for controls of particulate matter emissions.

In the BACT analysis for GHG, the Illinois EPA considered potentially applicable control technologies for lowering GHG emissions, including inherently lower-emitting processes/practices/designs; add-on controls; and combinations of design and add-on controls following the five-step “top-down” process described by USEPA in the NSR Manual and the further guidance provided by USEPA in March 2011 in its *PSD and Title V Permitting Guidance for Greenhouse Gases* (GHG Permitting Guidance).[116]

The rationale for the Illinois EPA’s proposed BACT determination for the kilns for GHG is set out below. This determination relies on Mississippi Lime’s revised BACT demonstration, which reflects its experience and knowledge of the manufacture of lime. The Illinois EPA concurs with Mississippi Lime’s selection of control technologies as they represent demonstrated technologies, which are commonly used at modern lime plants, to effectively control GHG emissions.

The potential annual emissions of CO_2 and GHG, as CO_2e, from the kilns with the proposed control measures are summarized below, as calculated from the operation of the kilns and their minimum fuel efficiency[117] and Global Warming Potentials (GWP) from 40 CFR 98 Subpart A. The GHG emissions of the kilns will be almost entirely CO_2, with CO_2 making up over 99 percent of the GHG emissions of the kilns as CO_2e. The emissions of methane (CH_4) and nitrous oxides (N_2O), which are also components of GHG emissions, along with CO_2, will make less than one half percent of the GHG emissions of the kilns.

[116] *PSD and Title V* Permitting Guidance *for Greenhouse Gases*, USEPA, EPA-457/B-11-001, March 2011.

[117] In its 2013 GHG Supplement, Mississippi Lime used detailed mass balance calculations to determine the potential GHG emissions of the kilns from their projected fuel usage.

Summary of Potential GHG Emissions from the Two Kilns (tons/year)

Pollutant	Emissions	Emissions as CO_2e
CO_2 – Fuel	497,650	--
– Process	700,931	--
Total	1,119,581	1,119,581
Methane (CH_4)	47	1,175[118]
Nitrous oxide (N_2O)	7	2,086[7]
Total		1,201,842

PROJECT DESIGN CONSIDERATIONS

In its application, Mississippi Lime discussed its business objective for the proposed plant and the reasons for proposing horizontal rotary lime kilns for the plant. Mississippi Lime's fundamental business objective for this plant is to produce "standard lime" from high calcium limestone from the adjacent mine that it also owns.[119] The plant would compete in the broad-based regional markets for lime, including lime for steelmaking, wastewater treatment, flue gas desulfurization and construction. Accordingly, the plant would need the capability to readily produce a range of lime products.[120] The plant would also need a lime production capacity of 876,000 tons per year (2,400 tons per day) to effectively participate in this marketplace.

These objectives are readily met with conventional horizontal rotary kilns. Rotary kilns are capable of producing lime in different size ranges.[121] They

[118] The emissions of methane (CH_4) and nitrous oxides (N_2O) as carbon dioxide equivalents, as presented here, are calculated using the new values for global warming potential (GWP) in Table A-1 of USEPA's Mandatory Greenhouse Gas Reporting Rule, 40 CFR Part 98. The new GWP values for CH_4 and N_2O, which became effective on January 1, 2014, are 25 and 98, respectively. Accordingly, the emissions of methane as CO_2e are 1,175 tons/year (47 tons/yr x 25 tons CO_2e/ton CH_4 = 1175 tons/yr). The emissions of N_2O as CO_2e are 2,086 tons/year (47 tons/yr x 298 tons CO_2e/ton N_2O = 2,086 tons/yr).
These emission rates are different than those used by Mississippi Lime in the 2013 GHG Supplement. This supplement uses the values for GWP that were in effect prior to January 1, 2014, i.e., 21 and 310 for CH_4 and N_2O, respectively. With new values for GWP, the calculated potential GHG emissions of the kilns, as CO_2e, are slightly higher, 1,201,842 instead of 1,201,738 tons/year, a difference of 104 tons/year.

[119] Mississippi Lime reports that the calcium carbonate content of this reserve is in the range of 95 to 97 percent.

[120] Standard quicklime, i.e., lime that has not been reacted with water or "hydrated" to convert it to calcium hydroxide ($Ca(OH)_2$) is sold commercially in a number of size ranges including large lump lime (maximum eight inches in diameter), crushed or pebble lime (from about ¼ to 2½ inches), ground lime (1/4 inches and smaller), and pulverized lime (passing a No. 20 sieve).

[121] To make lime, crushed limestone from a suitable quarry or mine is screened to separate the limestone into various size ranges. Limestone in the appropriate size range to obtain the desired size of lime product is then fed to the kiln. The size of the limestone fed to the kiln must be kept within a given range to produce lime with uniform characteristics. If undersize material were included in the feed, it would be subjected to more heat and be less reactive than the rest of the lime. If oversize material were included in the feed, it would not be heated thoroughly and the interior of the material would not be calcined. A rotary kiln can be readily adjusted to process different sizes of limestone feed and make lime in different size ranges. This is done by changing the feed rate, firing rate and rotational speed of the kiln,

can also produce lime products with different reactivities.[122] Two rotary kilns would be needed to meet the target for the capacity of the plant. Rotary kilns are commonly used to produce standard lime, which makes up approximately 90 percent of the commercial lime produced and sold in the United States.[123]

The issue for the design of the proposed kiln is whether shaft or vertical kilns should be required to be used as BACT. For GHG emissions, a vertical kiln would be a "lower emitting process" than a rotary lime kiln. Vertical lime kilns are static, refractory lined, vertical tubes that are entirely filled with limestone. Calcination occurs as the limestone gradually passes downward through the kiln.[124] The fuel efficiency of vertical kilns is better than that of rotary kilns so vertical kilns have lower GHG emissions per ton of lime produced.[125]

Notwithstanding their better fuel efficiency, vertical kilns have critical disadvantages compared to rotary kilns. Vertical kilns can only produce lime in a narrow range of reactivity, which is set by the length and diameter of the kiln. Accordingly, vertical kilns are usually designed to make a specific lime product. In practice, vertical kilns are used almost exclusively to produce specialized high purity lime for the food, pharmaceutical, chemical and plastics industries from reserves of very high quality limestone with very low levels of magnesium, sulfur and other impurities.[126]

Other disadvantages of vertical kilns are a consequence of how the fuel is fired and heat is transferred to the limestone feed. The combustion gases in a vertical kiln must flow uniformly up through the packed bed of stone in the

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thereby adjusting the retention time or the rate at which material passes through the kiln.

[122] In rotary kilns, the temperature and retention time can also be readily adjusted to produce lime with different levels of reactivity. Most lime that is produced is "soft burned lime," which has a high reactivity, reacting quickly when used. Less reactive lime is also needed for certain applications. "Hard-burned lime" has moderate reactivity. It is commonly used as a flux in the steelmaking industry. "Dead-burned" is the least reactive lime. It is produced by very high temperatures in the kiln, which causes a hard shell to form on the surface of the lime. The chemical and thermal properties of dead-burned lime make it ideal for use in certain refractory brick.

[123] USEPA, Office of Air Quality Planning and Standards, *Lime Production: Industry Profile*, Research Triangle Park, NC, September 2000, p. 2-5.

[124] In a vertical kiln, limestone is charged at the top of the kiln and is calcined as it slowly descends through the upper portion of the kiln to ultimately discharge at the bottom of the kiln. Vertical kilns are fired by a number of lances around the circumference of the tube part way up the kiln that extend into the limestone bed. Because the combustion gases pass through the interstices or voids in the limestone that fills the kiln, coal cannot be used as a fuel without degrading the quality of the lime that is produced.

[125] In the upper portion of a vertical kiln, the combustion gases efficiently heat the limestone fed to the kiln as the gases rise through the bed of limestone. The hot lime in the lower portion of the kiln also heats the combustion air, which is introduced at the bottom of the kiln, to further improve the fuel efficiency of the kiln.

[126] At this time, there are six operating vertical kilns in the United States. Four of these kilns are located near Prairie du Rocher in Sainte Genevieve, Missouri. The regional market for the specialty lime produced by vertical kilns is already satisfied by these four existing nearby kilns.

kiln for proper heat transfer. This requires that the limestone feed for a vertical kiln be relatively uniform in size and large enough that there is space between the stones for the passage of the combustion gases. As a consequence, from a material efficiency standpoint, vertical kilns can use less of the limestone output of a mine compared to rotary kilns, with more of the raw limestone from the mine becoming waste. The limestone feed to a rotary kiln does not need to be as uniform and can include smaller material. For the same amount of lime output, the use of vertical kilns for the plant would necessitate mining more limestone with more of that high quality limestone becoming waste.

Finally, since combustion gases cannot readily penetrate farther than one meter into the bed of limestone in a vertical kiln, the greatest diameter of a vertical kiln is only two meters. This restricts the capacity of a vertical kiln. Rotary kilns can be sized for significantly more capacity than vertical kilns. The larger vertical kilns currently in operation have a capacity of only about 500 tons of lime per day. As a consequence, at least five vertical kilns would be needed to have the same capacity as the plant that Mississippi Lime has proposed.[127]

Based on these considerations, the use of vertical kilns would not meet Mississippi Lime's fundamental objectives for the proposed plant.

TOP-DOWN BACT PROCESS – STEPS 1 AND 2

(Identification of Available Control Technologies and Evaluation of the Technical Feasibility of Available Control Technologies[128])

Discussion

The control options for the GHG emissions of the proposed kilns that are available and feasible are: 1) Energy efficiency options including preheater, refractory selection, kiln seal maintenance management and computerized process control systems; and 2) Fuel substitution with natural gas. These control options would directly reduce the CO_2 emissions of the kilns. The energy efficiency options would also act to indirectly reduce the emissions of methane (CH_4) and nitrous oxides (NO_2) as they would reduce the amount of fuel used by the kilns.[129] These control options are further evaluated in Steps 3 and 4 of the BACT analysis.

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[127] Vertical kilns also have higher maintenance costs than rotary kilns. This is due to abrasion of the refractory shell as feed material passes down along the wall of the kiln. The fuel lances are also subject to wear and damage from the passage of material.

[128] In Step 1 of the Top-Down BACT Process, all "available" control options with potential application for the pollutant and emission units that are the subject of the BACT analysis are identified.

In Step 2 of the Top-Down BACT Process, an evaluation of the technical feasibility of the available control options is made to identify options that are not technically feasible, which can be eliminated from further consideration in the BACT analysis.

The discussions for these two steps are combined as the feasibility of control options can immediately be discussed following the more general discussion of the availability of the control options.

[129] While a control option to directly reduce CH4 emissions was identified, oxidation, this option would not be technical feasible for the proposed kilns. Control options that would directly reduce N_2O emissions were not identified.

Although carbon capture and sequestration (CCS) was not found to be a feasible control technology at this time, CCS was also carried forward in the BACT analysis, with a cost analysis conducted for CCS. CCS consists of the capture or collection of the CO_2 from a source, processing of the collected CO_2 for transport, the actual transport of the CO_2, and finally the sequestration or geological disposal of the CO_2. While these technologies are at their infancy and still in the process of being developed, CCS is appropriately considered available for the proposed kilns. In this regard, in its GHG Permitting Guidance, USEPA indicates that it considers CCS to be a GHG control technology that is generally available for facilities emitting large amounts of CO_2.

There are, however, significant technical and logistical hurdles that would have to be overcome for CCS to be used for the proposed kilns. Technology for the capture of CO_2 emissions from lime kilns has not been developed much less demonstrated. To then sequester CO_2, a suitable geological reservoir for sequestration would have to be identified. Appropriate property would have to be acquired above this reservoir, along with the legal rights to sequester CO_2 under that property and the surrounding area far enough out to accommodate the CO_2 captured from the plant over its lifetime. Appropriate permits would have to be obtained to develop the sequestration facility and then sequester CO_2. Lastly, a right-of-way would have to be acquired to construct the pipeline to connect the plant to the sequestration facility. These factors suggest that CCS is generally not a feasible control technology for the proposed kilns.

With regard to technical feasibility of CCS for a proposed project, USEPA indicates in its guidance that:

> …CCS may be eliminated from a BACT analysis in Step 2 if the three components working together are deemed technically infeasible for the proposed source, taking into account the integration of the CCS components with the base facility and site-specific considerations (e.g., ….access to suitable geologic reservoirs for sequestration, or other storage options).
>
> GHG Permitting Guidance, p. 35

Since there are no storage options at this time, Mississippi Lime concluded that CCS is not technically feasible. While the Illinois EPA agrees that CCS is not feasible, CCS has nevertheless been further evaluated as if it were technically feasible.

<u>Review of Control Technologies for GHG Emissions</u>

1. Energy Efficiency:

   The combination of a preheater, refractory selection, a kiln seal management program, and a computerized control system is referred to as the energy efficiency option. Each measure to improve energy efficiency results in lower emissions of GHG, including CO_2, CH_4 and NO_2, and other combustion-related pollutants, i.e., SO_2, NO_x, and CO.

   i. Preheater

A preheater is a device that uses heat in the flue gas from a kiln to heat the limestone feed before it is introduced into the kiln.[130] This lowers the fuel usage of the kiln per ton of lime produced compared to a kiln without a preheater. The lower fuel usage acts to lower emissions of GHG and other combustion-related pollutants per ton of lime produced.[131] Use of preheaters on the proposed kilns is not inconsistent with the production of standard lime.

Between the two types of rotary kiln systems, namely kilns without preheaters or "long kilns" and kilns with preheater or "short kilns", a preheater kiln is significantly more energy efficient, nominally using 15 to 20 percent less fuel per ton of lime produced.[132]

The use of preheater technology is the standard practice for new lime kilns that produce standard lime. It is clearly a feasible technology for the proposed kilns and is part of Mississippi Lime's plans for the plant.

ii. Refractory selection (kiln insulation)

The refractory for a kiln is selected on the basis of the heat value and combustion characteristics of the fuel and the abrasiveness and hardness of the limestone feed to minimize abrasion, heat losses and to protect the outer shell of the kiln against corrosion in the kiln. It is clearly a feasible means of improving the fuel efficiency of the proposed kilns and lowering GHG emissions.

iii. Kiln seal management/maintenance program

Reducing heat loss by minimizing leakage from the seals at the inlet and outlet of a kiln can provide modest improvements in the energy efficiency of the kiln. The implementation of a kiln seal

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130 In a preheater, the hot flue gases from the kiln pass counter-current through a bed of limestone feed. This raises the temperature of the limestone feed to the kiln, reducing the amount of heating that must occur in the kiln. The pre-heater is designed to maintain a steady flow of limestone feed to the kiln while not disrupting the flow of combustion gases and the calcination process in the kiln itself.

Rotary kilns with preheaters are shorter than kilns without preheaters. This is because the preheater takes the place of the initial section of the kiln where the limestone would otherwise have to be heated before any calcination would occur.

131 Rotary kilns that do not have a preheater (also sometimes referred to as "long" kilns) are generally older or are used to produce a particular specialty lime. An example of a specialized long kiln is Kiln 7 at Graymont's lime plant in Bellefonte (Pleasant Gap), Pennsylvania. This kiln is used to produce low-sulfur lime for the specialty steel industry.

132 A report addressing the GHG emissions of lime kilns conducted for the European Union reports that the energy efficiency or fuel consumption of rotary kilns with preheaters ranges from 4.4 to 6.7 mmBtu per ton of lime. The energy consumption of long rotary kilns without preheaters ranges from 5.5 to 7.9 mmBtu/ton of lime. *Methodology for the Free Allocation of Emissions Allowances in the EU ETC Post 2012 - Sector Report for the Lime Industry*, Fraunhofer Institute for Systems and Innovation Research, Öko-Institute, November 2009.

maintenance program is certainly a feasible work practice that can be used for the proposed kilns.

iv. Use of a computerized process control system

A computerized process control system would automatically adjust the operation of the burner (fuel feed rate and air flow) and other operating parameters of the kiln (e.g., stone feed and kiln rotation rates) based on the operational data for the kiln. This will improve the operation of the kiln, including its fuel efficiency. Use of a computerized process control system is feasible for the proposed kilns.

2. Generation (Energy Recovery for Heat or Power)

For kilns, co-generation is the use of the hot flue gas from a kiln to produce steam. his steam is then used at the source either for heating or in a steam turbine generator to make electricity for the source.[133] Cogeneration is technically feasible for kilns without preheaters.

In this project, the kilns will be equipped with preheaters. This will significantly improve the energy efficiency of the plant compared to use of kilns without preheaters. With preheaters, the thermal energy or heat in the flue gases of the kilns will be directly used for the initial step in the calcination process, heating the limestone toward the temperature at which the calcination reaction begins. The use of preheaters is inherent in Mississippi Lime's plans for the proposed plant. It seeks to build a plant whose energy efficiency is equal to or better than that of existing plants that produce standard lime, which necessitates use of preheaters.

The energy efficiency of using a preheater to directly utilize the heat in the flue gases of the kilns to heat the limestone feed is superior to using this heat for cogeneration. Moreover, use of cogeneration would increase the amount of fuel that would be used by the plant and the GHG emissions of the plant. This is because more fuel would have to be used to supply the energy for the actual calcination process. The additional fuel would make up for the heat in the flue gases that would be used for cogeneration rather than preheating the limestone feed to the kiln. Accordingly, cogeneration is not a technology that would reduce the GHG emissions of the proposed kilns.

3. Alternative Fuels:

Fuel selection or alternative fuels are a means to lower GHG emissions from combustion of fuel. Since fuels vary in their carbon content, use of a lower-carbon fuel lowers CO_2 emissions. Fuel substitution does not affect the CO_2 emissions from lime kilns from the calcination process.

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[133] At Graymont's lime plant in Bellefonte, Pennsylvania, a cogeneration system is used on Kiln 7. This kiln is a long kiln, without a preheater, is used to produces specialty lime. The long kiln process is less fuel efficient in terms of fuel consumption per ton of lime produced. However, this is mitigated by the use of co-generation on this kiln to generate electricity for that plant.

a. Use of natural gas

Use of natural gas would reduce GHG emissions because the carbon content of natural gas on a heat input basis is lower than that of coal and petroleum coke, resulting in lower CO_2 emissions.[134] Even though a lengthy pipeline would have to be constructed to supply natural gas to the plant site, natural gas is considered technically feasible for the proposed kilns.

b. Use of various blends of coal/petroleum coke

Use of a fuel blend in the kilns that contains more coal and less petroleum coke, up to 100 percent coal, is feasible.[135] This would act to reduce GHG emissions if coal contains less carbon than the coke. However, the overall carbon content of the various coal/coke blends would not vary significantly. This is because the CO_2 emissions are directly related to the carbon content of the fuel relative to its heat content.[136] While the 80/20 fuel blend was projected as having slightly less CO_2 emissions than 100 percent coal, the carbon content of these fuel blends is similar and the calculated difference in GHG emissions between them is slight, such that the relative control effectiveness between 100 percent coal and a 80/20 fuel is not significant.[137]

c. Use of biomass fuels

Due to the lower heat content of biomass as compared to coal and coke, the kilns would need 25 to 36 tons of biomass per hour. At this time, there is not an available supply of biomass in the area that meets this need on a long-term basis. The use of biomass during startup may prolong the start-up period and bringing the kiln on line at the required temperature.

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[134] To appropriately compare the CO_2 emissions of different fuels, the carbon contents of the fuels must be compared in terms of their heat content of the heat energy that they would provide when combusted. On this basis, the carbon content of natural gas is about half that of coal and petroleum coke. This is because the ratio of hydrogen to carbon is much higher in natural gas and more of the heat energy produced from combustion of natural gas is from combustion of hydrogen.

[135] As discussed as part of the discussion of BACT for SO_2, the coal/coke blend for the candidate fuels for the proposed kilns is constrained by the amount of sulfur that can be introduced into the kilns. The specifications for sulfur content of lime restrict the coal/coke blend to a maximum of about 3.5 percent sulfur, which corresponds to a nominal blend of 80 percent coal and 20 percent coke.

[136] The 80/20 fuel blend has a nominal heat content of 12240 Btu/lb compared to a heat content for 100 percent coal of 11800 Btu/lb. The carbon content of the 80/20 fuel is estimated at 86.2 percent compared to 84 percent for 100 percent coal. When expressed on a heat content basis, the 80/20 blend provides 70.4 lbs carbon/mmBtu compared to 100 percent coal at 71.2 lbs carbon/mmBtu. (0.862 x 1,000,000/12,240 = 70.4 lbs/mmBtu; 0.84 x 1,000,000/11,800 = 71.2 lbs/mmBtu)

[137] In the above calculation, the difference in carbon content of the 80/20 coal/coke blend and 100 percent coal was about 1 percent, resulting in a 1 percent calculated difference in CO_2 emissions. Fuel emissions account for less than half of the total CO_2 emissions for the kilns, reducing this difference to less than 0.5 percent overall. This difference is not significant because the actual carbon content for individual batches of coal and coke may vary by larger percentages.

Co-firing biomass with coal would require lower quantities of biomass. However when co-firing, unacceptably high ash is produced due to the higher combustion temperatures. The ash negatively affects the lime quality during calcination by introducing impurities. Additionally an “ash ring” may be produced in the kiln which could force unscheduled shutdowns.

Since there is no consistently available, high quality biomass fuel suitable for 100 percent replacement or for co-firing in the kilns, use of biomass is not technically feasible.

4. Carbon Capture and Sequestration (CCS):

Carbon Capture and Sequestration (CCS) consists of the capture or collection of the CO_2 from a source, compression of the collected CO_2 for transport, the actual transport of the CO_2, and, lastly, the sequestration or geological disposal of the CO_2. While the technologies for capture and sequestration are at their infancy,[138] CCS is appropriately considered available for the proposed kilns. As already discussed, USEPA indicates in its GHG Permitting Guidance that it considers CCS to be a control technology for GHG that is available for facilities emitting large amounts of CO_2. As already noted and as addressed further below, there are significant technical and logistical hurdles that would have to be overcome for CCS to be feasible for the proposed kilns. These hurdles suggest that CCS is generally not a feasible control technology for the proposed kilns.[139] Nevertheless, CCS has been carried on to Step 3 of the ACT analysis and further evaluated as if it were technically feasible.

a. Capture of CO_2:

i. Pre-combustion capture or gasification

Pre-combustion capture or gasification involves processing a solid fuel material to convert it into a gas before the material is actually used as a fuel. The conversion of the material facilitates purification of the fuel material before it is burned. This includes removal of some or most of the carbon in the material as a high-purity CO_2 stream, which can then be sequestered. Depending on the design of the gasification process, the resulting gaseous fuel stream

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[138] The intermediate steps of CCS, i.e., CO_2 compression and transport by pipeline, can be readily accomplished using available and demonstrated technology. As such, the technological feasibility of these steps is not a consideration for the feasibility or infeasibility of CCS. The ability to acquire a suitable right-of-way for the construction of a pipeline to transport CO_2 to a sequestration facility may be a consideration for whether CCS is feasible as a practical matter.

[139] Perhaps most significantly, unlike coal-fired boilers, lime kilns have not been the focus of work that is occurring on an international basis to develop technology to be able to cost-effectively extract or capture CO_2 from the flue gases so that it may then be geologically sequestered. Any use of CO_2 capture technology on the proposed lime kilns would be a “first-of-its-kind” application, effectively being a technology demonstration project. Its actual cost and ultimate effectiveness would be highly uncertain, far more than associated with use of a technology that has progressed beyond the demonstration phase to the “replication” phase.

may be composed primarily of hydrogen or the purified gas stream may be further processed into methane.

Gasification is a complex chemical process. This necessitates development at least above a minimum scale if it is to be practical.[140] Gasification would involve also the presence of additional emission units for the gasification process. The providers of gasification technology are not pursuing its development for use for lime kilns. Even if gasification could generally be considered to be within the scope of the basic objectives for the proposed plant, it is not a feasible technology for the proposed plant because of the relatively small amount of solid fuel that would be used by this plant. Moreover, gasification would not control any of the CO_2 emissions from the lime kilns that are from calcination, which contributes more than 50 percent of the CO_2 emissions from the kilns.

ii. Post-combustion capture

Post-combustion capture removes CO_2 from the exhaust gases by adsorption in a liquid. Post-combustion capture would address CO_2 from both the calcination process and from fuel combustion.[141] Lime kilns do not inherently produce the high-purity CO_2 streams needed for sequestration. Technologies to produce high-purity CO_2 streams from the exhaust from combustion units are still at the research and development stage, focusing on coal-fired utility boilers. They have not yet been developed for application to lime kilns.

iii. Oxy-combustion

140 While the Taylorville Energy Center is no longer being pursued by Christian County Generation, it is an example of a coal gasification project. As last proposed, that plant would have produced substitute natural gas and generated electricity. The design coal usage of the plant would have been about 1.85 million tons per year, over ten times the fuel usage of the proposed plant.

Power Holdings of Illinois is another example of a gasification project proposed for Illinois that is no longer being pursued. It would have produced substitute natural gas. The design coal usage of this plant would have been about one million tons per year, over six times the fuel usage of the proposed plant.

141 Post-combustion CO_2 capture is different than the reaction with CO_2 that occurs during the manufacture of “precipitated calcium carbonate”. In this process, a water solution of hydrated lime is carbonated, i.e., infused with CO_2 laden flue gas from a kiln, to convert the hydrated lime back to calcium carbonate. This results in a very fine form of calcium carbonate with particular physical properties that are different from those of the mineral limestone that was originally fed to the kiln.

The manufacturing process for precipitated calcium carbonate would not serve as an alternative GHG control technology for the proposed kilns. This is because the objective for the kilns is to produce standard lime, not precipitated calcium carbonate, for which there are limited markets. Moreover, this process would effectively only recover the CO_2 that was originally contained in the limestone, not the CO_2 associated with fuel combustion in the kilns.

With oxy-combustion technology, air is processed by an air separation unit to remove nitrogen producing an almost pure oxygen stream that is then used for combustion of fuel in a boiler or other combustion device. Some of the flue gases from the device are also recycled back through the combustion device. This yield a concentration of CO_2 in the final flue gases from the device is much higher than with conventional combustion. As a consequence, the CO_2 in the flue gases may be more readily captured, purified, compressed and sequestered. Oxy-combustion technology is being pursued for coal-fired utility boilers, where it is not yet a demonstrated technology.[142] Use of this technology at a lime kiln would face additional technical obstacles. This is because the concentrations of CO_2 and oxygen in the flue gases of a lime kiln are factors in the effective calcination of lime. As such, oxy-combustion is not a feasible technology for the proposed lime kilns.

b. CO_2 sequestration

i. Geological CO_2 sequestration

As a broad matter, geological sequestration of CO_2 is considered feasible in the southern portion of Illinois. Archer Daniels Midland Company is engaged in a demonstration project for CO_2 sequestration at its manufacturing complex in Decatur. Sequestration of CO_2 is also a component of the FutureGen projects.[143]

These circumstances do not demonstrate that sequestration is feasible at the plant site or in the vicinity of Prairie du Rocher. Prairie du Rocher is on the western edge of the geological formation that has been targeted for CO_2 sequestration in Illinois, the Mt. Simon sandstone. At its edges, this formation is relatively thin which poses concerns for both sequestration capacity and migration of CO_2 through the formation. Prairie du Rocher is also is in the Mississippi River Valley, which may pose additional obstacles to sequestration. Accordingly, for purposes, of further evaluating the cost-effectiveness of using CCS for the proposed plant, it was assumed that a suitable sequestration facility could be developed within 100 miles of the plant and a pipeline would be used to transport CO_2 to the sequestration facility.[144]

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[142] The proposed FutureGen2.0 Project at the Meredosia Energy Center in Illinois would be a demonstration project for use of oxy-combustion technology by a coal-fired utility boiler. The project would also include sequestration. It is not a commercial project and would be supported financially by the United State Department of Energy.

[143] The FutureGen2 project would sequester CO_2 at a facility in eastern Morgan County, about 30 miles east of the Meredosia Energy Center. The original FutureGen project, which is no longer being pursued, would have been developed at a site near Tuscola, Illinois, with sequestration of CO_2 occurring nearby.

[144] Mississippi Lime indicates that transport of compressed CO_2 from the plant by truck would involve more than 100 truckloads per day.

ii. Enhanced oil recovery (EOR)

In enhanced oil recovery (EOR), CO_2 is used at an existing oil field to recover additional crude oil that has not been recovered during the initial phases of crude oil production. The injection of compressed CO_2 into the oil field facilitates the movement of the oil underground to then be pumped from the reservoir by other wells serving the field. The CO_2 is ultimately sequestered in the reservoir. However, there are currently no active EOR projects utilizing CO_2 injection within 100 miles of Prairie du Rocher. Even if there were such projects, the continued existence of such projects could not be assured as the EOR process is completed. Accordingly EOR cannot be relied upon as a means to sequester CO_2 from the kilns at the proposed plant.

5. Mineral Carbonation

Mineral carbonation entails converting CO_2 back into solid form as a silicate or a carbonate material. This is the natural process by which certain carbonate minerals are formed. As a control technology for CO_2, the process is dependent on the availability of reserves of a suitable metallic oxide that can be used as a feedstock as well as the development of equipment and techniques to rapidly carry out this process on an industrial scale.[145] Mineral carbonation is only a theoretical technology for application to the proposed kilns and is not technically feasible.

6. Oxidation Add-on Control

The kilns would potentially emit methane (CH_4) as a result of incomplete combustion of fuel. Given the combustion conditions in the kilns (temperature, residence times and oxygen levels), it is uncertain whether methane emissions will actually be at levels at which they would be measurable during typical emission testing. However, Mississippi Lime conservatively quantified methane emissions in its application.[146] It also addressed methane in its BACT demonstration, considering the following oxidation options. These options would theoretically provide further combustion, which would act to lower emissions of methane, converting it to CO_2. Since CO_2 has a lower global warming potential than methane, the overall result would be a reduction in the GHG emissions of the kilns as CO_2e.

a. Thermal Oxidation:

[145] An example of a company that is currently engaged in mineral carbonation is Calera Cement in California. It uses an industrial waste that is a suitable feedstock for mineral carbonation that has been accumulated at a site to make a cement product. The scale of operation is small, reported as 10 tons of product per day. The existence of this facility and other similar facilities of this type, whose purpose is to utilize existing reserves of waste materials, does not show that mineral carbonation is available as a control technology for emissions of CO_2.

[146] Mississippi Lime calculated methane emissions using a factor of 0.0243 lb/mmBtu.

Thermal oxidizers involve secondary combustion chambers with firing of additional fuel to facilitate more complete combustion of the emissions of organic material from a process. As such, thermal oxidation is a technology that is theoretically available to reduce organic material emissions of the kilns. However, given the low levels of methane that result from fuel combustion in the lime kilns, further reduction in methane emissions would not be achieved with thermal oxidation. Thermal oxidation is not applicable for control of the very low levels of organic products of incomplete combustion in the emissions of units like lime kilns.[147] Thermal oxidation is not a feasible technology for control of the methane emissions of the lime kilns.

b. Oxidation Catalyst:

Catalytic oxidation also provides for further combustion like thermal oxidizers but with the use of a catalyst to enable this combustion to occur at a lower temperature, ideally at the temperature of the flue gas stream without firing additional fuel. Catalytic oxidation is not feasible for the kilns for the same reasons that thermal oxidation is not feasible. In addition, catalytic oxidation is not applicable for a flue gas that contains high loading of mineral particulate, like lime kilns. This is because the particulate would obstruct the catalyst. Catalytic oxidation is not a feasible technology for control of the methane emissions of the lime kilns.

TOP-DOWN BACT PROCESS - STEP 3
(Ranking of Technologies)

Step 3 of the Top-Down BACT Process requires a ranking of the feasible control technologies in order of their ability to reduce GHG emissions. The baseline for GHG emissions is the nominal 80/20 fuel blend proposed by Mississippi Lime with all the energy efficiency measures discussed above. The use of natural gas would reduce GHG emissions by 23 percent compared to the baseline. CCS would theoretically reduce GHG emissions by 95 percent compared to the baseline. As such, the top control alternative for GHG emissions is CCS.

Ranking of Feasible Control Technologies		
Control Technology	GHG Reduction (Tons/Year, as CO_2e)	Reduction Effectiveness
Carbon Capture and Sequestration (CCS) (Add-on control)	1,138,652[148]	95 percent
Alternative Fuel	225,032	23 percent

[147] Because the combustion of fuel for thermal oxidation would occur outside the kiln, it would not be as efficient as combustion in the kiln. Accordingly, the combustion of fuel for thermal oxidation could contribute to additional emissions of methane, as well as to additional CO_2 emissions.

[148] With baseline annual CO_2 emissions of 1,198,581 tons, 95 percent control efficiency would remove 1,138,652 tons of CO_2. (1,198,581 x 0.95 = 1,138,652)

(Natural gas)		
Energy Efficiency (Preheater, refractory selection, kiln seal management and computerized process control system)	--	--

TOP-DOWN BACT PROCESS - STEP 4
(Evaluation of Most Effective Controls)

Using the Top-Down BACT process, the feasible controls were evaluated for energy, environmental and economic impacts, as summarized below.

The top option, CCS, is not cost effective. To analyze the economic impact of CCS, a 100 mile pipeline was assumed since CO_2 would have to be piped to a location that is suitable for sequestration. The estimated cost for the CCS option is $47,000,000 per year for a minimum cost-effectiveness of $41.28/ton.[149] This cost would render the entire project cost-prohibitive, as the proposed plant would not be cost competitive and would not be constructed. Given that the capture of CO_2 from lime kilns has not been demonstrated, $41.28/ton almost certainly greatly understates the actual costs that would be associated with use of CCS by the proposed plant.

The next option, use of natural gas as the fuel for the kilns would reduce GHG emissions by 23 percent. Natural gas is significantly more expensive than the solid fuel proposed by Mississippi Lime. In addition, since gas service is not currently available at the plant site, a pipeline would need to be built at Mississippi Lime's expense to supply natural gas to the plant. Overall, the estimated annual cost is $8,929,839 per year. The resulting cost effectiveness, $39.68/ton of GHG removed, is considered excessive. This cost would also render the project cost-prohibitive, as the proposed plant would not be cost-competitive.[150, 151]

Mississippi Lime has not identified any costs or adverse impacts associated with the various measures that would improve the energy efficiency of the kilns and lower the fuel use of the kilns (i.e., use of a preheater,

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[149] The cost estimate for CCS was based on the low-end estimate in the European Cement Research Academy Cement Sustainability Initiative study (*Development of State-of-the-Art Techniques in Cement Manufacturing: Trying to Look Ahead*, June 4, 2009, Dusseldorf, Germany) plus costs of construction of CO_2 pipeline. Initial investment, operation, and capture cost was estimated in the study to range from $33 to $134 million. An additional estimated $14 million per year for the CO_2 pipeline added to the $33 million low end estimate results in $47 million per year. The cost effectiveness is the annualized cost of the control option divided by the annual reduction in emissions from the baseline. ($47,000,000 ÷ 1,138,652 tons = $41.28 per ton removed)

[150] The use of natural gas would significantly increase the cost of production of lime by the proposed plant. ($8,929,839/year ÷ 876,000 tons/year = $10.19/ton) Because baghouses would still be needed to control the particulate emissions of the kilns and kiln dust would still need to be handled, the savings from elimination of solid fuel handling with the use of natural gas would be small. These savings would not meaningfully affect the disparity in the cost of solid fuel and natural gas.

[151] Based on information about the formation of NOx in cement kilns, use of natural gas would act to significantly increase the NOx emissions of the proposed lime kilns. As such, it would have a number of adverse environmental impacts given the role of NOx in air quality for ozone and fine particulate matter and in acid rain.

implementation of a kiln seal management program, appropriate refractory selection and operation of a computerized process control and management system). Accordingly, all of these measures will be required as BACT for emissions of GHG.

Cost Effectiveness Analysis for GHG, as CO_2e			
Control Option	Emissions (T/Yr)	Annualized Cost of Option ($/Yr)	Cost Effectiveness of Option ($/T removed)
CCS	63,086	47,000,000	41.28
Use of Natural Gas	926,470	8,929,839	32.44
Energy Efficiency	1,201,738	--	--

TOP-DOWN BACT PROCESS - STEP 5
(Selecting BACT[152])

As discussed, Mississippi Lime has not demonstrated that the costs or other impacts associated with the identified measures that would improve the energy efficiency of the kilns would be excessive. Accordingly, all of these measures will be required as BACT for emissions of GHG.[153]

It is still necessary to establish a BACT limit for GHG that reflects the use of these measures. BACT limits for a proposed emission unit are commonly set after review and consideration of the emission rates and/or reductions in emissions of a pollutant that are achieved by existing units using the technology that has been selected as BACT. Such data provides a basis to verify the emission rate or the reduction in emissions that is really achievable with the selected control technology. However, data is not available for GHG emission rates, in pounds of GHG per ton of lime produced, of existing lime kilns.[154] An alternative form of such information is data

[152] In the final step of the Top-Down BACT process, Step 5, the most effective control option that is not eliminated in Step 4 is considered the BACT technology for the pollutant and emission unit. An emission rate is selected as BACT based on the use of that control option.

[153] The control measures for the kilns for GHG emissions would also be secondary control measures for emissions of pollutants other than GHG for which BACT must be established. This is because they reduce fuel consumption and accordingly would act to reduce emissions of NO_x, CO, VOM and SO_2, which are also linked with combustion of fuel in the kilns.

[154] Data for the GHG emission rates of lime kilns, in pounds of GHG emitted per ton of lime is not collected by the Mandatory Greenhouse Gas Reporting rule. While this rule requires that lime plants report their GHG emissions, it does not require reporting of production. Production data would also be needed to calculate GHG emission in pounds per ton of lime from the emission data that is required to be reported.

More generally, information about the GHG emission rates of lime kiln has competitive value. It provides a basis to accurately calculate and compare ones fuel costs with those of ones competitors. Fuel costs are a key component in the costs of making lime. Accordingly, operators of existing lime kilns have not made data for actual GHG emission rates publicly available. In this regard, this data is not "emission data", which is required to be available to the public. This is because emission standards have not been adopted for the GHG emission rates of lime kilns. Finally, because GHG only became a regulated NSR pollutant in January 2011, there is not a body of new lime kilns with construction permits with BACT limits set in terms of the rate of GHG emission.

that has been assembled for the lime industry as a whole that provides insight on the range of energy efficiency and GHG emissions across an industry. As such information specifically addresses the best performing plants, it provides a "benchmark" or a point of reference against which to compare the energy efficiency of any lime plant.[155] In its GHG Permitting Guidance, USEPA points toward performance benchmarking as a useful tool when evaluating control technologies that involve energy efficiency, as is the case for the GHG emissions of the proposed kilns.

> An available tool that is particularly useful when assessing energy efficiency opportunities and options is performance benchmarking. Performance benchmarking information, to the extent it is specific and relevant to the source in question, may provide useful information regarding energy efficient technologies and processes for consideration in the BACT assessment. Comparison of the unit's or source's energy performance with a benchmark may highlight the need to assess additional energy efficiency possibilities. To the extent that benchmarking an emissions unit or source shows it to be a poor-to-average performer, the permitting authority may need to document and evaluate whether greater efficiencies are achievable. To ensure that the source is constructed and operated in a manner consistent with achieving the energy efficiency goals determined to be BACT, consideration should be given to the individual and overall impact of the various measures under consideration.
>
> GHG Permitting Guidance, pp 21 – 22

USEPA has not developed performance benchmarks for the GHG emissions of lime kilns. However, such data is available from a report that contains information about the range of fuel consumption of lime kilns in Europe.[156] This report indicates that the range of fuel consumption of rotary kilns with preheaters ranges from 5.1 to 7.8 Gigajoules per tonne of lime, or 4.4 to 6.7 mmBtu per ton of lime.[157] The fuel consumption rate of the best performing kilns, 4.4 mmBtu per ton, is the rate that was used by Mississippi Lime in its GHG BACT supplement. Accordingly, it is appropriate that the BACT limit for GHG be developed using this rate of fuel consumption.[158]

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[155] The focus of benchmarking is on existing sources. It enables existing sources to compare their energy intensity to sources that use "best practice" and to identify changes that they can implement to improve energy-efficiency. "Best practice" is defined as the plants with the most energy efficient, commercially-available technologies for a manufacturing process, with appropriate consideration of factors that constrain energy efficiency, such as product, feedstocks and location. However, as benchmarking provides information on the energy intensity of existing sources using best practices, it also provides insight on the level of energy intensity that should be expected at a new source that uses best practice.

[156] Ecofys, *Methodology for the Free Allocation of Emission Allowances in EU ETS Post 2012 – Sector Report for the Lime Industry,* Fraunhofer Institute for Systems and Innovation Research, Öko-Institut, November 2009.

[157] Table 3, p 5 of the Ecofys report. In particular, 5.1 GJ per tonne of lime is equivalent to 4.4 mmBtu per ton of lime. (5,100,000,000 J/tonne x 0.893 tonne/ton x 0.00000000094799 mmBtu/J = 4.4 mmBtu/ton lime)

[158] Information in a report by the National Lime Association to the United States Department of Energy also confirms that the proposed lime kilns would be expected to be significantly more energy efficient than existing lime kilns in the United States.

With a fuel consumption rate of 4.4 mmBtu per ton of lime, using the methodology in USEPA's rule for Mandatory Greenhouse Reporting, 40 CFR Part 98.[159] Mississippi Lime determined that the GHG emissions rate of the proposed kilns would be 2,744 pounds of CO_2e per ton of lime produced. As explained in the 2013 GHG Supplement, this emission rate combines the GHG emissions due to fuel combustion, as calculated from the design fuel usage rate and the carbon content of the fuel, and the CO_2 emissions from calcination, determined from the calcium and magnesium carbonate contents of the limestone that would be fed to the kilns. It is proposed that this emission rate be set as the BACT limit for the GHG emissions of the proposed kilns, as it reflects the emission that will be achievable with the technology that has been selected as BACT for GHG emissions.

Given short-term variability in the operation of the kilns, including variability in fuel efficiency as well other factors that affect CO_2 emissions, it is appropriate that this limit be applied as an annual average, rolled monthly. This also means that this limit will address the GHG emissions of the kilns during startups and shutdowns. It is not considered appropriate to separately address GHG emissions during these periods for purposes of BACT. Presumably, the data for the fuel consumption rates of lime kilns is developed from long-term data for fuel usage and lime production, which data would include periods of startup and shutdown.[160] Compliance with this GHG limit would appropriately be required to be determined using the methodology in 40 CFR Part 98, including continuous emission monitoring for CO_2 emissions.[161] In this regard, 40 CFR Part 98 now provides an authoritative methodology to determine the GHG emissions of various types of sources, including lime kilns,

The draft permit would also provide that the BACT limit for the kilns for GHG emissions would potentially be subject to downward adjustment based on the demonstrated performance of the kilns. This is appropriate given the dearth of data that is available for the GHG emissions of lime kilns, much less data for lime kilns that that use best practices for enhanced energy efficiency. In particular, considering the conservative nature of engineering design, it is reasonable to expect that a fuel consumption rate lower than the design rate of 4.4 mmBtu per ton of lime will be demonstrated in practice by the

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In this report, the members of the National Lime Association committed to reducing their average fuel-related CO_2 emissions from 0.68 to 0.63 tons per ton of lime produced. As would be indirectly allowed by the draft permit, the fuel-related CO_2 emissions of the proposed kilns would be 0.57 tons per ton of lime produced (4.4 mmBtu/ton lime x 259 lbs CO_2/mmBtu = 0.57 tons CO_2/ton lime).

[159] 40 CFR Part 98 Subpart C, General Stationary Fuel Combustion Sources, and 40 CFR Part 98 Subpart S, Lime Manufacturing.

[160] In any case, the consumption of fuel associated with startup and shutdown of the kilns will be small compared to their total fuel usage. During startup, the firing rate of a kiln is below its normal firing rate. During shutdown, fuel is not fired, since the first step in shutdown is stopping fuel flow fuel to a kiln.

[161] The technology for continuous monitoring of CO_2 emissions is well established and can be applied to the kilns. Accordingly, continuous emissions monitoring for CO_2 will be required for the kilns given the magnitude of their CO_2 emissions.

Technology for continuous monitoring of the emissions of CH_4 and N_2O of the kilns is not developed. It would not be justified in any case given the low levels of emissions of these pollutants. Accordingly, periodic testing would be required for the CH_4 and N_2O emissions of the kilns.

proposed kilns. It would be unrealistic to expect that the actual performance will be 10 percent than the design performance. Accordingly, the draft permit would provide that a BACT limit that reflects as much as a 10 percent decrease in the fuel consumption of the kilns can be set after a "demonstration period". The target value for the BACT limit based on such a downward adjustment would be 2630 pounds per ton of lime.[162] The duration of the demonstration period would be five year from the date of initial startup of a kiln, with provision for an additional year if needed to effectively set a revised BACT limit for GHG. This amount of time is appropriate because a BACT limit is proposed for GHG that would apply as an annual average. The actual demonstration phase for GHG also cannot begin until shakedown of the kiln is complete. It should also go well beyond the initial period of operation of the kilns. Based on that initial period of operation, Mississippi Lime may take actions to improve the fuel efficiency. There also may be phenomena that negatively impact fuel efficiency that only develop gradually over time but are inherent to the performance of a lime kiln.

[162] The fuel-related component of the proposed GHG BACT limit for the kilns is 1140 pounds per ton of lime produced. If the actual performance of the kilns is much better than the design performance, i.e., 10 percent better, the reduction in the GHG emissions of the kilns would be 114 pounds/ton of lime. This sets the objective for the GHG emissions of the kilns at 2630 pounds/ton of lime (2744 – 0.9 x 1140 = 2630).

ANALYSIS OF GHG BACT FOR THE EMERGENCY ENGINE GENERATORS

Each of the proposed kilns will have a diesel oil-fired engine generator, with a capacity of less than 1200 horsepower, to supply emergency power. The purpose of these units will be to maintain the rotation of the lime kilns when the plant loses electric power from the grid. These units will not be large enough to maintain the actual operation of the kilns during electrical outages. The kilns will immediately shutdown when the plant loses power from the grid.[163] During the shutdown of a rotary kiln, the kiln must continue to be rotated. Otherwise, the refractory lining and metal shell of the kiln may be severely damaged due to the stresses and warping that result from uneven cooling. The emergency engine generators would serve to prevent such damage by providing an alternative supply of power for the motors that rotate the kilns. Other than during actual power outages, these engine generators will only be operated periodically, typically weekly, to confirm operational readiness. Each readiness check will be brief, usually no more than 30 minutes, as its only purpose will be to confirm that a unit will start in the event of an actual power outage.

Given the function of these engine generators, the operation and potential GHG emissions of these engines will be minimal. The engines in these units will be subject to the requirements in the NSPS for Reciprocating Internal Combustion Engines that apply to emergency engines. These requirements were developed by USEPA to assure that appropriately designed engines are used for emergency applications and that such engines are properly operated and maintained. Mississippi Lime has proposed that BACT for these engines be compliance with the applicable requirements of the NSPS, 40 CFR 60 Subpart IIII.[164] For these engines, as the regulatory requirements of the NSPS constrain emissions of the engines and require proper operation and maintenance of the engines, these regulatory requirements are also proposed to constitute BACT for GHG emissions, as well as BACT for other pollutants that are subject to PSD.

[163] The kilns will need electricity to operate. The various systems that feed limestone and fuel to the kilns and the fans that provide the air flow for the kilns are all powered by electric motors.

[164] Application supplement, “BACT Analysis for Emergency Generators,” submitted by Mississippi Lime on August 21, 2013 (Engine Supplement).

ATTACHMENT 6

Further BACT Analysis for the Processing and Handling of Lime (Loadout of Quick Lime)

Introduction

Mississippi Lime submitted supplemental information for the emission units involved in the processing and handling of lime.[165] This information included further consideration of the load out of quick lime from the plant by truck, rail and barge. The original permit did not contemplate any uncaptured emissions from these operations since it would not have allowed any visible emissions from any operation involving handling or loadout of materials. In this supplemental information, Mississippi Lime addresses uncaptured emissions of particulate matter from the loadout operations for quick lime.

The proposed truck and rail loadout operations would be partially enclosed inside covered sheds with open ends. Baghouses will be employed in conjunction with "dust controlled" loading spouts with extended heads and vacuum tips to reduce dust emissions from drop loading. At the beginning and end of the loading of each truck or rail car when the loading spout is being extended or retracted, these measures may not capture some particulate emissions, which would then be discharged through the ends of the sheds that partially enclose these operations.

A baghouse and a dust controlled spout with telescoping head and vacuum tip will also be employed to reduce emissions from the proposed barge loading operation. Some particulate emissions would not be captured and would be discharged directly to the atmosphere. Since a barge cannot be enclosed during loadout and this operation would be directly impacted by the wind, the percentage of the emissions from barge loadout that would be uncaptured would potentially be much greater than for truck and rail loadout.

Mississippi Lime has provided information that supports establishment of BACT limits for loadout of quick lime that provide for some emissions of particulate matter directly to the atmosphere. For truck and rail loadout of quick lime, the proposed BACT limit is no more than 2.5 minutes of visible emissions during a 60 minute period. This reflects at least 99 percent capture of emissions. For barge loadout of quick lime, the proposed BACT limit is 20 percent opacity. This reflects at least 90 percent capture of emissions. These limits would be applicable for all load out of quick lime, including off-specification material, which that does not meet established specifications for product lime. The Illinois EPA is proposing to accept these limits as a component of BACT for the loadout of quick lime.[166, 167]

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[165] *Lime Process and Handling Addendum to Supplemental Remand Analysis*, December 4, 2013.

[166] The factors for uncontrolled emissions of particulate emission from loading of barges, in the absence of any control measures, are less than those for loading of trucks and railcars. In barge loading, material is being placed in a larger cargo space, which is much deeper and broader than the cargo space of a truck or rail car. More material is handled, which provides for more consistent operation of the loading spout. Accordingly, after considering differences in capture efficiencies that will be achieved for the two classes of loadout operations, the emission factor for uncaptured emissions from barge loading is only twice that for truck and rail car loading, i.e., 0.006 lbs/ton compared to 0.003 lbs/ton.

Top-Down Process - Step 1
Identification of "Available" Control Technologies[168]

There are three basic approaches to the control of uncaptured emissions of particulate matter from loadout of material: 1) Effective capture of emissions with the technology for loadout; 2) Effective capture with a combination of partial enclosure and loadout technology; 3) Complete capture as a consequence of the technology used for loadout; and 4) Complete capture through enclosure of the loadout operation.

Effective Capture with Loadout Technology

Various systems are available to reduce the amount of dust generated by loadout of material such as quick lime. These systems have some common features. The spouts extend to reduce the distance that the material drops during loadout. This also enables the tip of the loading spout to be below the level of the sides of receiving vessel during most of the loadout operations Vacuum or aspiration of air is present at the tip to collect air at the tip of the spout, which would contain dust. This dust is then directed to a control device or reintroduced into the stream of the material being loaded out.

Effective Capture with a Combination of Partial Enclosure and Loadout Technology

Partial enclosure of the load out operations enhances the effectiveness of the loadout technology by reducing the effects of air currents and wind.

Complete Capture by the Loadout Technology

Loadout of fine, powdery materials, like flour and Portland cement, is conducted using closed loadout systems. These materials are poured into closed tank truckers, like a liquid. All displaced air, with entrained particulate, is passed through a control device before being discharged to the atmosphere. The hydrated lime produced by the proposed plant would be loaded out in this manner, without the potential presence of uncaptured emissions.

Complete Capture by the Enclosure of the Loadout Operation

Enclosures may be constructed around certain manufacturing operations, which would not otherwise necessarily be completely enclosed. For example, this is

[167] Changes are not proposed to requirements of the original permit for loadout of hydrated lime and kiln dust (i.e., the dust or particulate matter collected by the baghouses on the kilns). Loadout of these materials would still be required to be conducted without any visible emissions to the atmosphere, so as to reflect complete capture of emissions. Mississippi Lime has not indicated that this is not feasible for these materials, which are fine, powdery materials that can be handled with tanker trucks and hopper rail cars.

[168] In Step 1 of the Top-Down BACT Process, all "available" control options with potential application for the pollutant and emission units that are the subject of the BACT analysis are identified.

now a common practice for coating and printing lines that use coatings and inks containing organic solvents and use afterburners or carbon adsorptions systems to control emissions of organic material. In the absence of the enclosure, the operation would be open to the rest of the building in which the operations was located and only a portion of the emissions of organic material would be captured.[169] Complete or total capture of emissions is achieved by the design of the enclosure and the size of the control device so that negative pressure is maintained in the enclosure.[170] As a result, all air that contains organic material passes through the control device. To accomplish this, the total area of openings in which raw material or finished product enters or leaves the enclosure must be small and doorways and other entrances in the enclosure that provide access for personnel and equipment must normally be closed.

Top-Down Process – Step 2
Evaluation of Technical Feasibility of Available Control Technologies[171]

The only feasible control technology for loadout of quick lime by truck and rail is effective capture with a combination of enclosure and loadout technology. The only feasible control technology for loadout of quick lime by barge is effective capture with loadout technology.

Partial enclosure is standard practice for loadout of quick lime by truck and rail. It enables loadout to take place when it is raining or snowing, which would not be possible if the operation were not protected from wet weather. Partial enclosure is not feasible for loading of barges.[172] The barges will necessarily be moored in the Mississippi River while they are being loaded. They will not be on plant property. A structure cannot be constructed in the Mississippi River to partially enclose a barge.

Complete capture of emissions by the loadout technology is not feasible because of the physical form of the quick lime that the plant would produce. The quick lime will not be a fine, powdery material. It will include both "pebbles" and granular material. The output from the kilns will be screened so as to be able to supply customers with pebble lime in specific size ranges, potentially from as large as 2 inches to as small as 1/2 inch in size.[173] Because the quick lime is not a fine, powdery material and will

[169] In the absence of total enclosure, emissions would only be captured from the equipment on the line would be ducted to the control device, typically the drying or curing oven, and capture hoods would be located over certain equipment, such as ink rollers. The effectiveness of capture would depend of the fraction of the emissions generated by the areas of the line with capture and the effectiveness of capture on those areas.

[170] For coating and printing lines, USEPA and the Illinois EPA have established criteria that an enclosure must meet to be considered to provide total enclosure. For example, refer Appendix B, Procedure T in 35 IAC Parts 218 and 219.

[171] In Step 2 of the Top-Down Process, an evaluation of the technical feasibility of the available control options is made to identify options that are not technically feasible. Those options can be eliminated from further consideration in the BACT analysis.

[172] Because loading of barges cannot be protected from the weather, barges are not loaded with lime during wet weather.

[173] The product specifications for pebble lime include limits for the amount of fines. The pebble material would be screened to remove fines, which would become part of the feed stock for production of hydrated lime.

include pebbles, quick lime cannot be handled with loadout technology that provides for complete capture of emissions, as can be used for loadout of hydrated lime and certain other types of commodities.

Complete capture of emissions from truck and rail loadout of quick lime is not feasible because the size of the truck and railcars that are being loaded. Because of the operational need to move these large vehicles in and out of the enclosure, the enclosure would not provide complete capture of emissions. Emissions that are entrained in the volume of air escaping the enclosure each time that a vehicle enters or leaves the enclosure would enable emissions to the atmosphere. In addition, unlike total enclosure of most manufacturing operations, these loadout operations would not be further enclosed within a larger building or structure.

In summary, the feasible emission control technology for loadout of quick lime by truck and rail is effective capture with a combination of enclosure and loadout technology. The only feasible emissions control technology for loadout of quick lime by barge is effective capture with the loadout technology. These are the emission control technologies that Mississippi Lime has proposed to use for loadout of quick lime.

Top-Down Process - Step 3
Ranking Technically Feasible Alternatives by Control Effectiveness[174]

For loadout of quick lime, a ranking of control technologies is not possible. For both loadout by truck and rail and by barge, the baseline control option, as proposed by Mississippi, includes all feasible control technologies. For truck and rail load, the effectiveness of capture/control or is projected to 99 percent. For barge loadout, the effectiveness of capture/control is projected to be 90 percent.

Top-Down Process - Step 4
Evaluation of Most Effective Controls and Documenting Results[175]

For loadout of quick lime, as discussed, the most effective control technologies that are feasible have been selected and are proposed as the control technology for BACT.

The specification for granular lime is less than 3/8 inch in size.

[174] In Step 3 of the Top-Down Process, the emission performance level of each technology or control option that is considered feasible in Step 2 is established in consistent terms. When there are a number of distinct control options, a hierarchy of options is then developed in descending order starting with the most effective option and ending with the "baseline".

[175] In Step 4 of the Top-down Process, when there are multiple control alternatives, the feasible control alternative are evaluated for energy, environmental, and economic impacts to determine whether otherwise preferred options should not be required as BACT because the impacts that would accompany it would be excessive.

Top-Down Process – Step 5
Selecting Best Available Control Technology (BACT) Limit[176]

For truck and rail loadout of quick lime, the BACT limit that is proposed to reflect achievement 99 percent capture of emissions is no more than 2.5 minutes of visible emissions during a 60 minute period. This will restrict the occurrence of uncaptured to less than 5 percent of the time. It will effectively only allow uncaptured emissions to occur during those portions of the loading cycle of a truck or railcar when the loading spout in unable to completely capture emissions.[177] This proposed limit is identical to the limit that was established in 2006 for loadout of lime truck by truck at a lime plant in Superior, Wisconsin that is now Graymont Superior.[178]

For barge loadout of quick lime, the BACT limit that is proposed to reflect achievement 90 percent capture of emissions is 20 percent opacity. This limit will accommodate periods during the loading of a barge when the when the loading spout in unable to completely capture emissions. It will also accommodate the effect of winds, which when strong or gusty would interfere with effective capture of emissions by the loading spouts. Because of the measures that will be needed maintain the opacity from barge loadout to below 20 percent during these periods, the proposed opacity limit will require very effective capture of emissions during other periods and phases of loading barges.

[176] In the final step of the Top-Down BACT process, Step 5, the most effective control option that is not eliminated in Step 4 is considered the BACT technology for the pollutant and emission unit. An emission rate is selected as BACT based on the use of that control option.

[177] Since the loading of each truck takes about 30 minutes, this limit would only allow occasional occurrence of visible emissions, with such emissions occurring when the spout is being extended into a truck at the beginning of loadout, the spout is being repositioned during loadout or the spout is being retracted when loadout is complete.

[178] For truck loadout of lime, Construction Permit 05-DCF-412 for CLM Corp, Superior, issued by the Wisconsin Department of Natural Resources in August, 2006, provides that "If any visual emissions are greater than zero (0), then the observer shall continue until(i) The accumulation of one (1) hour of observation without accumulating greater than 2.5 minutes of visible emissions to demonstrate compliance, or (ii) The accumulation of 2.5 minutes of visible emissions; and therefore, demonstrating out of compliance."

ATTACHMENT 7

Further BACT Analysis for the Processing and Handling of Lime (Performance of Filters)

Introduction

Mississippi Lime submitted a supplemental analysis for the emission units involved in the processing and handling of lime.[179] This analysis included a further evaluation of BACT for the filter air pollution control devices that would control emissions of particulate matter from these operations. For these filters, the original permit also would have set an erroneous value for the control of emissions or the level of performance that these devices would be required to achieve, expressed as the mass of particulate in grains per standard cubic foot of exhaust (gr/scf). Mississippi Lime has proposed a corrected value for the required performance of these devices, 0.005 gr/scf, rather than 0.0002 gr/scf. The corrected value would be identical to the performance requirement that has been set for the filter devices that would be used to control emissions from the material handling operations for limestone and solid fuel

Mississippi Lime has provided information that supports setting the BACT limit for the filter devices for handling of lime at 0.005 gr/scf.

Top-Down Process – Step 1[180] and Step 2[181]
Identification of "Available" Control Technologies
Evaluation of Technical Feasibility of Available Control Technologies

Filter control devices are commonly used as the particulate matter control devices for handling of lime. They are considered the best control devices for these operations. To address, the performance limit for the filters used for the lime handling operations at the proposed plant, Mississippi Lime evaluated three levels of performance for these devices, as would be achieved through selection of the filter media or the filtration technology. These control options were: 1) Use of a standard filter fabric to achieve a limit of 0.005 gr/scf; 2) Use of an enhanced filter fabric with a surface membrane to achieve a limit of 0.002 gr/scf; and 3) Use of two-stage filtration, including a high-efficiency particulate air (HEPA) filter to achieve a limit of 0.0002 gr/scf. These options are all feasible and reasonably address the range of performance that is available for filter devices.

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179 Mississippi Lime, *Lime Process and Handling Addendum to Supplemental Remand Analysis*, December 4, 2013.

180 In Step 1 of the Top-Down BACT Process, all "available" control options with potential application for the pollutant and emission units that are the subject of the BACT analysis are identified.

181 In Step 2 of the Top-Down Process, an evaluation of the technical feasibility of the available control options is made to identify options that are not technically feasible. Those options can be eliminated from further consideration in the BACT analysis.

Top-Down Process – Step 3
Ranking Technically Feasible Alternatives by Control Effectiveness[182]

The effectiveness of these control options are directly ranked as they have been defined in terms of the emission rates, in gr/scf, that are achieved.

Top-Down Process – Step 4
Evaluation of Most Effective Controls and Documenting Results[183]

Mississippi Lime evaluated the economic impacts of the feasible alternatives compared to its proposed baseline option, including both the average cost-effectiveness and the incremental cost-effectiveness of the alternatives. In its calculations, Mississippi Lime conservatively assumed that the baseline control option would in practice achieve exactly the limit that represents the control option, rather a lower emission rate that reflects normal operation.

The changes in average cost-effectiveness do not provide a meaningful tool to assess the cost impacts of the alternatives because of the large amounts of particulate that are controlled by the baseline option.[184] The cost impacts of the alternative are appropriately evaluated relative to the incremental cost impacts.[185] The incremental cost impacts of the alternatives, are excessive. For alternative fuels, the evaluation was based on publicly available data on the costs of different fuels. The results of the evaluation of average cost-effectiveness are summarized below, with the cost impact of each alternative expressed in terms of dollars per ton of SO_2 removed.

[182] In Step 3 of the Top-Down Process, the emission performance level of each technology or control option that is considered feasible in Step 2 is established in consistent terms. A hierarchy of options is then developed in descending order starting with the most effective option and ending with the "baseline."

[183] In Step 4 of the Top-down Process, when there are multiple control alternatives, the feasible control alternative are evaluated for energy, environmental, and economic impacts to determine whether otherwise preferred options should not be required as BACT because the impacts that would accompany it would be excessive.

[184] For example, using the quantification of particulate emissions provided by Mississippi Lime, the baseline option would annually control about 2,370 tons of PM, with emissions of at most 23.9 tons of PM to the atmosphere. As such the alternative options would at most further control the remaining 23.9 tons. However, the additional cost of the alternative options when considering the average cost-effective is unreasonably affected by the 2,370 tons of PM that would be controlled by the baseline option, and does not reasonably address the small amount of additional emissions that would potentially be controlled. In this regard, even if the alternative options only controlled 1.0 more ton of PM, the calculations for average cost-effectiveness would show a cost of $452 per ton of PM controlled.

[185] In this regard, the first alternative control option, 0.002 gr/scf, could represent the level of performance that is typically achieved by a filter on a lime handling operation that is subject to an emission limit of 0.005 gr/scf.

Summary of Cost-Effectiveness Analysis

Control Option	Total Annualized Cost ($)	Annualized Cost Over Baseline ($)	Potential Emission (Tons)	Emissions Removed (Tons)	Cost Effectiveness ($/Ton)	
					Average	Incremental
PM						
0.0002 gr/scf	1,743,596	897,820	0.96	2,393.1	729	77,882
0.002 gr/scf	1,072,249	226,473	9.58	2,384.5	450	15,771
0.005 gr/scf (base)	845,776	---	23.94	2,370.1	357	---
Uncontrolled	---	---	2,394	---	---	---
PM_{10}						
0.0002 gr/scf	1,743,596	897,820	0.56	1,394.9	1,250	133,734
0.002 gr/scf	1,072,249	226,473	5.58	1,389.9	771	27,058
0.005 gr/scf (base)	845,776	---	13.95	1,381.5	612	---
Uncontrolled	---	---	1,395	---	---	---
$PM_{2.5}$						
0.0002 gr/scf	1,743,596	897,820	0.27	683.3	2,552	272,905
0.002 gr/scf	1,072,249	226,473	2.73	680.8	1,575	55,103
0.005 gr/scf (base)	845,776	---	6.84	676.7	1,250	---
Uncontrolled	---	---	683.5	---	---	---

Top-Down Process - Step 5
Selecting Best Available Control Technology (BACT) Limit[186]

The particulate matter emission limit for the selected control option, 0.005 gr/scf, is implicit in this option. This limit is proposed as BACT for the filters used to control lime handling operations at this plant. This limit is at the lower end of the range of permit limits set for the filters for lime handling operations at lime plants, which range from 0.005 gr/scf to 0.015 gr/scf.

[186] In the final step of the Top-Down BACT process, Step 5, the most effective control option that is not eliminated in Step 4 is considered the BACT technology for the pollutant and emission unit. An emission rate is selected as BACT based on the use of that control option.

Appendix A

Planned Response to Deficiencies Identified in the Remand Order

(Footnotes in the Remand Order have been omitted from the provisions of the Remand Order that are included in this attachment.)

Deficiency 1

"IEPA failed to provide sufficient justification for determining BACT for kiln startup and shutdown emissions. IEPA eliminated natural gas as a control option because of the proposed plant site's distance from the existing natural gas pipeline. IEPA's determination that natural gas was 'not commercially feasible' lacks support and does not consider the average and incremental cost-effectiveness of natural gas."
(Remand Order, page 2)

"On remand, IEPA is ordered to prepare a revised BACT analysis for startup and shutdown emissions and to reopen the public comment period to provide the public with an opportunity to review and comment on that analysis. The BACT analysis shall comply fully with the top-down method and all of its steps, including adequate step 2 and step 4 analyses."
(Remand Order, page 17)

Response – A further BACT analysis has been prepared for startup of the proposed kilns following the Top-down Process. This further BACT analysis, as discussed in Attachment 1 of this Supplemental Project Summary, does not address shutdown of the kilns because fuel would not be fired during shutdown. This further analysis for startup of the kilns includes information on the costs that would accompany use of natural gas and other fuels as an alternative to use of low-sulfur distillate fuel oil during startup of the kilns, as proposed by Mississippi Lime. This analysis shows that the cost impacts associated with use of natural gas or other alternative fuels would be excessive and should not be required as BACT. Accordingly, use of low-sulfur distillate fuel oil during startup, as planned by Mississippi Lime, would be proposed to be accepted as BACT.

Deficiency 2a

"IEPA failed to provide sufficient justification for the permit's BACT emissions limitations for SO_2, NO_x, and PM.

a. IEPA failed to adequately support its determination that a 3.5% sulfur content design fuel, consisting of both coal and petroleum coke, was BACT for SO_2, particularly when IEPA had already concluded that among the technically feasible coals, coal with 3.2% sulfur content was cost effective. In declining to consider the performance test data at existing kilns that Sierra Club had identified, IEPA fundamentally misunderstood that its role as permit issuer requires the agency to investigate and examine recent regulatory determinations."
(Remand Order, page 2)

"On remand, IEPA is ordered to prepare a revised BACT analysis for SO_2 and to reopen the public comment period to provide the public with an opportunity to review and comment on this analysis. In conducting this analysis, IEPA should follow and fully comply with the top-down method or another defensible BACT analysis."
(Remand Order, page 24)

Response - Mississippi Lime has submitted an revised BACT demonstration for the SO_2 emissions of the kilns. This material directly addresses the sulfur content of the fuel used in the kilns, which is proposed to be a blend of Illinois coal and petroleum coke with a maximum nominal sulfur content of 3.5 percent. Based on this demonstration and its independent evaluation. The Illinois EPA has prepared a new BACT analysis for SO_2 for the kilns. The Illinois EPA is now proposing that BACT for the SO_2 emissions of the kilns be 0.50 pounds/tons of lime produced, 30-day average when the kiln is producing lime. An alternative limit, in pounds/hour, based on the air quality analysis, is proposed for other modes of operation.

<u>Deficiency 2b</u>

"IEPA failed to provide sufficient justification for the permit's BACT emissions limitations for SO_2, NO_x, and PM. …

b. IEPA's administrative record does not support IEPA's assertions that compliance margins were necessary for the NO_x, filterable PM, and PM_{10} BACT limits due to variations in the effectiveness of the chosen control measures. IEPA explained neither how it derived the numerical values for the margins nor the technical or scientific bases for the margins. The BACT analyses for these pollutants also do not sufficiently assess data from other facilities that might support the proposed compliance margin. IEPA was obligated to conduct a more thorough evaluation of comparable facilities, including those that Sierra Club cited."
(Remand Order, page 2)

"On remand, IEPA must explain how it derived the BACT limit for NO_x, filterable PM, and PM_{10}, and demonstrate that the limits constitute BACT. IEPA must also either (1) provide sufficient rationales for including compliance margins, as well as sufficient rationales for the sizes of any such margins, fully consistent with the Board's precedents, or (2) remove the compliance margins from the permit. Should IEPA choose to retain compliance margins, it must reopen the public comment period to provide the public with an opportunity to submit comments."
(Remand Order, page 33)

Response - Mississippi Lime has submitted additional material to support its BACT demonstrations for the emissions of NO_x, filterable PM and PM_{10} from the kilns. The additional material directly addresses variability in emissions of these pollutants, reflecting variability in the operation of a lime kiln and associated emission control technology. Based on these demonstrations and its independent evaluations. The Illinois EPA has prepared supplemental BACT analyses for the kilns. The Illinois EPA is now proposing that BACT for the NO_x emissions of the kilns be 3.50 pounds/tons of lime produced, 30-day average when the kiln is producing lime. The proposed BACT limits for filterable PM and PM_{10} are 0.14 and 0.18 pounds/ton lime produced, 3-hour average, respectively. Alternative limits, in pounds/hour, that are consistent with the air quality analysis, are proposed for other modes of operation when the kiln is not producing lime.

Deficiency 3

"IEPA failed to provide sufficient justification for determining that emissions from the proposed source will not cause or contribute to a violation of the one-hour SO_2 NAAQS. Although it was not improper for IEPA to use a SIL in the culpability analysis for the one-hour SO_2 NAAQS, it is unclear from the administrative record what SIL value IEPA used in the culpability analysis. U.S. Environmental Protection Agency ('EPA') guidance provides an interim one-hour SO_2 SIL of 7.85 $\mu g/m^3$, which is supported in the administrative record as a de minimis concentration, but IEPA did not explain whether or how this SIL was applied. IEPA further failed to identify whether two other values that appear in the administrative record, 7.9 $\mu g/m^3$ and 10 $\mu g/m^3$, were applied as the one-hour SO_2 SIL in the culpability analysis. Finally, to the extent that IEPA applied either 7.9 $\mu g/m^3$ or 10 $\mu g/m^3$ as the one-hour SO_2 SIL, IEPA did not demonstrate that those values represent de minimis concentrations."
(Remand Order, page 3)

"IEPA's administrative record is unclear as to which SIL the agency applied in its culpability analysis for the one-hour SO_2 NAAQS. In addition to this lack of clarity, to the extent that IEPA employed a 7.9 $\mu g/m^3$ or 10 $\mu g/m^3$ one-hour SO_2 SIL, IEPA failed to substantiate the reason for doing so. Accordingly, the permit is remanded on this issue."
(Remand Order, page 41)

Response – New modeling was conducted to address this deficiency. The cause and contribute analysis or "culpability analysis" that was conducted as part of the new modeling analysis for 1-hour SO_2 impacts used a SIL of 7.85 $\mu g/m^3$, consistent with the SIL that has now been formally adopted by USEPA in its modeling guidance.[187, 188] For the receptors at which the full impact modeling showed exceedances of the one hour SO_2 NAAQS, this further culpability analysis found that proposed plant's contribution did not equal or exceed 7.85 $\mu g/m^3$ for each such modeled exceedance.

Deficiency 4

"IEPA failed to provide sufficient justification for not establishing SO_2 and NO_x emissions limits based on one-hour averages to protect the one-hour SO_2 and the one-hour NO_2 NAAQS. IEPA's explanations for not including emission limitations for SO_2 and NO_x based on one-hour averages – that the results of other state agencies' models have 'overstated impacts to such a degree that they cannot be considered credible' and that the proposed control technology at the proposed plant cannot catastrophically fail – are unsupported and anecdotal at best. In light of the EPA directive to include emission

[187] USEPA, *General Guidance Concerning the Implementations of the 1-hr SO_2 NAAQS in PSD Permits, Including an Interim 1-hour SO_2 Significant Impact Level,* August 23, 2010
[188] USEPA, *Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour NO_2 NAAQS*, March 1, 2011

limitations based on one-hour averages, IEPA's unsupported reasoning for not doing so is inadequate."
(Remand Order, page 3)

"The permit is therefore remanded on this issue. On remand, IEPA must either include maximum allowable hourly emissions limitations for SO and NO_x and explain how it concluded that the limitations are protective of the respective one-hour NAAQS or provide sufficient rationale for not including such emissions limitations. In either case, IEPA must reopen the public comment period to provide the public with an opportunity to submit comments."
(Remand Order, page 45)

Response - The new draft permit would set hourly emission limits for both the SO_2 and NO_x emissions of the kilns as directed by the EAB. The limits would correspond to the emission rates used in the air quality modeling that was conducted to address the hourly NAAQS for SO_2 and NO_2.

For NO_x, the 1-hour limit is the emission rate used in the original modeling, 175 lbs/hour per kiln. The new draft permit would require each kiln to comply with this NO_x emission rate on an hourly basis.

For SO_2, a new modeling analysis was conducted by Mississippi Lime, as discussed, to directly address the 1-hour SO_2 NAAQS. This analysis found that an hourly SO_2 limit of 40 lbs/hour per kiln is protective of the 1-hour SO_2 NAAQS. The new draft permit would require each kiln to comply with this SO_2 emission rate on an hourly basis.

Appendix B

Listing of Significant Changes Between the Original Construction Permit and the New Draft Permit

Findings

Revised Finding 3(a)(i) – Applicability of PSD for PM and PM_{10}
This finding, which addresses applicability of PSD to the proposed plant, now indicates that this plant is subject to PSD for PM and PM_{10} as a major source of emissions. This will correct an error in the original findings, which indicated that PSD was applicable for PM and PM_{10} because the potential emissions of these pollutants are significant.

New Finding 3(a)(ii) – Applicability of PSD for GHG
This new finding indicates that the proposed plant is subject to PSD review for emissions of GHG because the potential GHG emissions of the plant would be major. This change was made because GHG are now a regulated pollutant under the PSD rules.

Deleted Note: The note, which indicated that GHG were not yet a regulated pollutant under the PSD rules, has been removed because it is no longer correct.

Section 1: Plant-Wide Conditions for the Lime Plant

1. Compliance with Emission Limitations – New Condition 1.2(c)i):

   This new condition provides that the GHG emissions of the proposed lime kilns shall be determined in accordance with the applicable methodology of the USEPA's Rule for Mandatory Reporting of Greenhouse Gases, 40 CFR Part 98. This change was made because GHG are now a regulated pollutant under the PSD rules and the permit would set limits for the GHG emissions of the kilns. The actual text of this new condition is adapted from Condition 2.1.9(b)(ii) of the original permit

2. Requirements for Ancillary Equipment – New Condition 1.4-2:

   This new condition explicitly addresses the emergency engine generators at the plant, as well as other ancillary equipment at the plant. This condition was added to the permit because the original permit did not specifically address the emergency engine-generators, which would keep the kilns rotating to prevent structural damage in the event of a power outage. The condition would explicitly require the engines to be operated as emergency engines, to comply with applicable requirements of the NSPS for reciprocating engine, and to be fired on ultra-low sulfur diesel fuel or other very low sulfur fuels.

Section 2.1: Permit Conditions for the Lime Kilns

1. BACT Technology for GHG Emissions – Revised Condition 2.1.3-2(a)(i):

The description of required control technology for GHG emissions is expanded to include the selection of refractory and a kiln seal management program, as well as use of preheaters. The design values for the CO_2 and GHG emissions of the kilns are also removed as they would be replaced with a BACT limit for GHG emissions, as addressed below. These changes were made because GHG are now a regulated pollutant under the PSD rules and an evaluation of BACT has now been made for GHG emissions.

2. BACT Limit for SO_2 Emissions – Revised Condition 2.1.3-2(b)(i)(D):

The SO_2 BACT limit is now 0.50 pounds/ton of lime, on a 30-day average. In the original permit, the SO_2 BACT limit was 0.645 pounds per ton, on a daily, 24-hour average. This change is a consequence on the new analysis of BACT for SO_2 emissions. This analysis concluded it is appropriate to set a more stringent numerical limit for SO_2 BACT that applies on a longer averaging time.

3. BACT Limit for NO_x Emissions – Revised Condition 2.1.3-2(b)(i)(E):

The NO_x BACT limit is 3.50 pounds/ton of lime, on a 30-day average. In the original permit, this limit applied as a daily, 24-hour average. This change is based on the further analysis of BACT for NO_x. This analysis found that it is appropriate for this BACT limit to apply on a longer averaging period.

4. BACT Limit for GHG Emissions – New Condition 2.1.3-2(b)(iii):

This new condition would set an initial BACT limit for the GHG emissions of the kilns, i.e., 2,744 pounds of GHG, as CO_2e, per ton of lime produced, rolling 12-month average. This condition would also provide for a more stringent limit to be set for GHG, as addressed by new Condition 2.1.11, from the actual performance of the kilns and the measures that would be used to enhance their energy efficiency and reduce their fuel usage. A target would be set for this more stringent limit for GHG, 2630 pounds of GHG, as CO_2e, per ton of lime produced. This target reflects the reduction in emissions that would accompany a 10 percent reduction in the fuel usage of the kilns due to the measures that are required for enhanced energy efficiency. This condition was added to the permit because GHG are now a regulated pollutant under the PSD rules and a BACT determination has now been made for GHG emissions.

5. Alternative BACT Limits – Revised Condition 2.1.3-2(b)(ii):

The criterion for non-productive operation of a kiln is proposed to be set at 30 percent of capacity, rather than at 20 percent capacity, as in the original permit. During non-productive operation of a kiln, the normal BACT limits for particulate matter, SO_2, NO_x and CO cannot reasonably be applied because no lime is being produced. This is because these BACT limits are expressed on a relative basis, in pounds per ton of lime produced by a kiln. Instead, during periods of non-productive operation of a kiln, which would include periods of startup, shutdown and certain transitory process breakdowns, the emissions of these pollutants from the kiln must be limited on an absolute basis, in pounds per hour. The absolute emissions limits on the emissions of the kilns, which would apply during periods are found in Condition 2.1.6(a) of the permit, which defines the permitted emissions of the kilns. This change would be made because Mississippi Lime has determined, based on a review of the operation of its existing lime kilns, that the proposed kilns would not be able to productively make lime during periods when they are operating at less than 30 percent of capacity.

6. Fuel Specified As BACT for Startup – Revised Condition 2.1.3-2(c)(ii):

This condition now specifies that the auxiliary fuel, which must be used to heat a kiln during startup before beginning to fire solid fuel, must be ultra-low sulfur diesel fuel or other ultra-low sulfur fuel. This change would be made because the revised BACT evaluation for startup of the kiln shows that ultra-low sulfur diesel fuel, the startup fuel proposed by Mississippi Lime, constitutes BACT.

7. Operational Limit for the Kilns – Revised Condition 2.1.4(a):

This condition, which limits the lime production of the proposed kilns, no longer indicates that lime production shall be "determined as oxides (CaO and MgO)". This change was made because the output of the kilns is being limited in terms of "lime" using the common meaning of that term. It is unnecessary and potentially confusing to further indicate that the lime output of the kilns shall be determined as the calcium oxide and magnesium oxide content of that material.

8. Emissions Limitations for SO_2 and NO_x – Revised Condition 2.1.6(a):

Hourly limits are added for the SO_2 and NO_x emissions of the kilns. These limits would be set to protect the 1-hour SO_2 and NO_x NAAQS. The proposed SO2 limit, 40 pounds/hour per kiln, is the hourly SO_2 emission rate used in the new modeling for the 1-hour SO_2 NAAQS. The 3-hour average and annual limits for SO_2 were not changed. The new hourly NO_x limit, 175 pounds/hour, is the short-term limit in the original permit but it would now apply on an hourly basis, rather than a 3-hour average.

A lower limit is set for annual SO_2 emissions, 219 tons/year, rather than 283 tons/year. The lower limit would be a consequence of the lower BACT limit that would be set for SO_2 emissions by revised Condition 2.1.3-2(b)(i)(D).

9. Emissions Limitations for GHG – New Condition 2.1.6(b):

An annual limit for GHG emissions is set for the kilns. This change would be made because GHG are now a regulated pollutant under the PSD rules.

10. Scope of Emission Testing – Revised Condition 2.1.7(a)(i)(B):

Various changes to the scope of the required testing are made compared to the original permit. Testing for emissions of hydrogen chlorine is no longer required. This is because the kilns are subject to the NESHAP for Lime Plants, 40 CFR 63 Subpart AAAAA, and this NESHAP does not set a standard for emissions of hydrogen chloride. Emission testing is now required for emissions of methane and nitrous oxide. These GHG compounds would be emitted by the kilns, in addition to CO_2. Testing of the emissions of these pollutants is a necessary element of the compliance procedures for the limits that would be set for GHG emissions. A separate requirement for testing emissions of lead is removed. Such testing is already provided for by the testing that is generally required for metals. That testing is to be conducted with USEPA Method 26, which will provide data for emissions of lead, as well as other heavy metals.

11. Future Testing for Emissions of NO_x – Revised Condition 2.1.7(a)(iii):

This condition no longer addresses the possibility of future testing for NO_x emission, as would be needed in the event that continuous emission monitoring is no longer conducted for NO_x. This is because the permit (Condition 2.1.8-1(e)) would not address or contemplate circumstances in which such monitoring would not be necessary. Among other things, this is because a 30-day averaging period would now be set for the NO_x BACT limit, which will necessitate collection of emission data by continuous monitoring systems.

12. Content of Emissions Test Report – Revised Condition 2.1.7(d)(i)(E):

This condition no longer requires that the operating information for the baghouses in the reports for emission testing of the kilns include output data from a bag leak detector system. This is because the permit (Condition 2.1.8-3(c)(iii)) would no longer require use of baghouse leak detector systems. That change would be made for consistency with the NESHAP for Lime Plants, 40 CFR 63 Subpart AAAA, which requires either use of a bag leak detector system or continuous opacity monitoring for the baghouse on a lime kiln.

13. Emission Monitoring for CO_2 – Revised Conditions 2.1.8-1(a), (b) and (d):

These conditions now provide for continuous emission monitoring for the for the CO_2 emissions of the kilns, in addition to monitoring for emissions for SO_2, NO_x, and CO. For this purpose, CO_2 monitoring must be conducted in accordance with the relevant provisions of USEPA's Mandatory Reporting Rule for GHG Emissions, for CFR Part 98. These changes would be made because GHG are now a regulated pollutant under the PSD rules and continuous monitoring of CO_2 emissions would be needed to verify compliance with the BACT limit that would be set for GHG emissions.

14. Emissions Monitoring for NO_x - Revised Condition 2.1.8-1(e):

This condition no longer addresses future circumstances in which continuous emissions monitoring for NO_x potentially would not be necessary. Among other things, this is because a 30-day averaging period would now be set for the NO_x BACT limit. Compliance with an emission limit that will apply as a 30-day average will necessitate collection of NO_x emission data by continuous monitoring systems.

15. Operational Monitoring for Oxygen - Revised Condition 2.1.8-3(b):

This condition now provides that the oxygen level in the flue gases of the kilns may be monitored either before or after the preheater. This is because the dust loadings in the flue gas before the preheater would likely rapidly foul or clog the probe of these monitoring systems making it impractical for such monitoring to be conducted before the preheaters.

16. Operational Monitoring for the Baghouses - Revised Condition 2.1.8-3(c):

This revised condition would not require use of bag leak detector systems. These systems would instead be addressed as an alternative technique for monitoring the ongoing operation of the baghouses, instead of operational monitoring for the pressure drop across the individual compartments of the baghouses. This change would be made for consistency with the NESHAP for Lime Plants, which requires either use of bag leak detector systems or continuous opacity monitoring for the baghouse on a lime kiln (see Table 3 to 40 CFR 63 Subpart AAAA). In this regard, the NESHAP accommodates circumstances in which the use of baghouse leak detector systems would be impractical as is probable for the proposed kilns given the stringent BACT limit set for filterable emissions of particulate matter. The NESHAP also does not require use of baghouse leak detector systems in circumstances in which continuous opacity monitoring is required, which is the case for the proposed kilns as they are also subject to the NSPS for Lime Plants, 40 CFR 60 Subpart HH.

17. Records for Design CO_2 and CO_2e Rates - Revised Condition 2.1.9(b)(ii):

This revised condition no longer specifies that the required record for design emission rates of the kilns for CO_2 and CO_2e must be based on the applicable methodology of the USEPA's Rule for Mandatory Reporting of Greenhouse Gases, 40 CFR Part 98. While it is appropriate that the actual CO_2 and CO_2e emissions of the kilns be determined using this methodology it is not appropriate that the permit dictate the manner in which the kilns are designed. This is particularly true as the permit would now set limits for the actual GHG emissions of the proposed kilns.

18. Summary Records for Emissions - Revised Condition 2.1.9(g)(ii):

The revised condition now requires that records that the summary records that the source must keep for the emissions of the kilns must include emissions of GHG, as CO_2e. This is because the annual GHG emissions of the plant would be limited by the permit. Records for emissions of HAPs are not required. This is because the plant is being permitted as a major source for HAP emissions. Summary records for HAP emissions are not needed to verify status as a minor source for emissions of HAPs.

19. Quarterly Compliance Reports – Revised Condition 2.1.10(c)(i):

This revised condition no longer requires the quarterly compliance reports for the kilns to include information for the usage and sulfur content of fuels. Continuous emission monitoring for SO_2 will directly verify compliance with applicable SO_2 emission limits by. Information about the usage and sulfur content of fuel would not provide further insight on the compliance status of the kilns for SO_2 emissions. In addition, as this information would be relevant for a monitored exceedance or violation of the applicable SO_2 limit, such information would need to be provided to the Illinois EPA as the monitored exceedance or violation would be a deviation, for which event-specific reporting of a deviation would be required.

20. Semi-Annual Monitoring Reports – New Condition 2.1.10(d):

This new condition, which would take the place of Condition 2.1.9(c)(iv) of the original permit, requires the source to submit semi-annual monitoring reports for the monitoring that it is required to conduct for the kilns.

21. Revision of the BACT Limit for GHG Emissions – New Condition 2.1.11:

This new condition addresses the process by which a more stringent limit would be set for the GHG emissions of the kilns, as provided for by new Condition 2.1.3-2(b)(iii)(B), based on the actual performance of the kilns and the measures that would be used to enhance the energy efficiency of the kilns. It provides the source with four year to evaluate whether a more stringent limit is achievable. The Illinois EPA may provide up to two more years for the evaluation if the source shows that additional data is needed to effectively set a revised limit for GHG emissions. If the source does not conduct the evaluation or does not complete the evaluation in a timely manner, the target limit of GHG emissions would automatically take effect.

Section 2.2: Permit Conditions for Handling of Limestone and Solid Fuel

1. BACT for Particulate Emissions – Revised Condition 2.2.3-2(b)(ii):

A clause has been added to the beginning of this condition that indicates that the BACT limits in this provision are only applicable for units equipped with capture systems. This condition addresses BACT for stack emissions from certain raw material handling operations units, which are addressed in Section 2.2 of the permit, that are not “processed stone handling operations” so are not subject to NSPS Standards for Non-Metallic Mineral Processing Plants, 40 CFR 60 Subpart OOO, or the NESHAP Standards for Lime Plants, 40 CFR 63 Subpart AAAA. The additional clause further emphasizes that the limits in Condition

2.2.3-2(b)(ii) only apply to such emission units that are equipped with capture systems so that they would be considered to have stack emissions under the provisions of the cited NSPS and NESHAP standards. This condition then sets BACT for the stack emissions from such emission units.

2. Applicability of NSPS and NESHAP – Revised Condition 2.2.3-3:

   Changes are made to wording to be more consistent with the relevant wording of the NESHAP for Lime Plant, 40 CFR 63 Subpart AAAA.

Section 2.3: Permit Conditions for Lime Processing and Handling Equipment

1. BACT for Particulate Emissions –

   Revised Condition 2.2.3-2(a):
   Changes were made to the scope and content of this condition because of the need to separately address loadout of quick lime. This condition now addresses all elements of BACT for all subject units other than loadout of quick lime. The revised condition continues to contain the various elements of the BACT determination for these units that was made in the original permit. The use of enclosure and filters as the control technology is now specified by Condition 2.2.3-2(a)(i), rather than by Condition 2.2.3-2(a)(i). Visible emissions of fugitive particulate are now prohibited by Condition 2.2.3-2(a)(ii), rather than by Condition 2.2.3-2(b)(i) and, for handling of kiln duct, Condition 2.3.3-2(d). The limits for stack emissions are now in Condition 2.2.3-2(a)(iii) rather than Condition 2.2.3-2(b)(ii). In addition, the emission limit for stack emissions would now be set as 0.005 gr/scf as PM, rather than 0.0002 gr/scf, as erroneously specified by the original permit. Incidentally, this correction does not result in changes to the permitted emissions of the subject units as set forth in Condition 2.3.6. This is because the potential emissions of the subject units were not calculated using the erroneous emission rate of 0.0002 gr/scf.

   Revised Condition 2.2.3-2(b):
   This condition now addresses all elements of BACT for loadout by truck and rail of quick lime, including both material that meets product specifications and material that does not meet product specifications. The use of partial enclosure, filters and appropriate work practices as the BACT control technology is now specified by Condition 2.2.3-2(b)(i). In the original permit, these were specified by Condition 2.2.3-2(c). Emissions of fugitive particulate are now addressed by Condition 2.2.3(b)(ii). This condition would provide that the total duration of visible emissions in any one-hour period from each of these operations shall not exceed 2.5 minutes. This appropriately addresses the capture of emissions from these operations. This is different than Condition 2.3.3-2(b)(i) in the original permit, which would have prohibited any visible emissions from these operations. The limits for stack emissions from these operations are now in Condition 2.2.3-2(c)(iii) rather than Condition 2.2.3-2(b)(ii). The mass limit for stack emissions would now be set as 0.005 gr/scf as PM, rather than 0.0002 gr/scf, as was erroneously specified by the original permit.

Revised Condition 2.2.3-2(c):
This condition now addresses all elements of BACT for loadout of quick lime by barge. The determination of BACT control technology is now in Condition 2.2.3-2(c)(i). It provides that emissions must be controlled by a telescoping loading spout with suction or aspiration at the discharge end and a filter system. In the original permit, the control technology for barge loading was identical to that specified for truck and rail loadout in Condition 2.2.3-2(c), i.e., use of partial enclosure, filters and appropriate work practices. The more developed determination of BACT technology for barge loading is a consequence of the revised approach to barge loading in Condition 2.2.3(c)(ii). This condition would now provide that the opacity of fugitive emissions from barge loadout shall not exceed 20 percent opacity. This appropriately addresses the capture of emissions from the barge loadout operation. It is different than Condition 2.3.3-2(b)(i) in the original permit, which would have prohibited any visible emissions from this operation. The limits for stack emissions from barge loadout are now in Condition 2.2.3-2(c)(iii) rather than Condition 2.2.3-2(b)(ii). The mass limit for stack emissions would now be set as 0.005 gr/scf as PM, rather than 0.0002 gr/scf, as was erroneously specified by the original permit.

2. Emission Limitations – Revised Condition 2.3.6(a):

Corrections are made to various limits for the particulate emissions of the subject emission units other than units for loadout of quick lime, which are now addressed in new Condition 2.3.6(b). The new limits for three units (handling of kiln dust, the hydrator and the storage bins for quick lime) are higher because the errors acted to understate the potential emissions of these units (e.g., applying the factor for control efficiency twice). For other units with new limits, the new limits are lower because the errors acted to overstate the potential emissions of those units (e.g., counting units twice). Overall, the corrections result in a reduction in the permitted emissions of the subject units compared to the original permit.

3. Emission Limitations – New Condition 2.3.6(b):

This new condition now contains the limits for the particulate emissions from units that load out quick lime. Separate limits are set for the stack emissions and uncaptured emissions of these units. The hourly limits for loading of rail cars and barges would apply as 24-hour averages, consistent with the form of the short-term NAAQS for $PM_{2.5}$. This is because a barge or string of rail cars would be able to be loaded in substantially less than 24-hours and these units would not operate continuously might occur with for loading of trucks. This new condition is a consequence of the new limits for visible emissions and opacity from these units that would be set as part of the revisions to Condition 2.3.3-2, which will accommodate uncaptured emissions.

4. Testing Requirements – New Condition 2.3.7(b):

This new condition requires the source to conduct for observations of visible emissions or opacity from the emission units that loadout quick lime from the plant. These new requirements are a consequence of the new limits for visible emissions and opacity from these units that would be set as part of the revisions to Condition 2.3.3-2. The source must conduct observations to verify compliance with these new limits.

Section 2.4: Permit Conditions for Storage Piles and Roadways

1. Recordkeeping Requirements – Revised Condition 2.4.9(d)(i):

The revised condition does not require detailed records for treatment of subject units to control dust that are automated, such as spray systems located next to certain roadway segments. This change addresses methods of applying dust suppressants to roadways that were not contemplated by the original permit. The original permit assumed that all dust control measures would be implemented by vehicles or other equipment that would be driven by plant personnel.

Section 3: General Permit Conditions

1. Emission Testing Requirements – Revised Condition 3.1(b)(i):

Changes are made to this listing of the applicable methods for emission testing to reflect changes to the requirements for emission testing earlier in the permit. For example, test methods for NO_x emissions are no longer present because the permit would not provide for operational monitoring of the NO_x emissions of the kilns to ever replace continuous monitoring of emissions. Test methods for methane and nitrous oxide are now specified as emission testing for these pollutants is now required. Changes are also made to update and clarify the applicable method for testing emissions of condensable particulate. Only the current USEPA method for such testing is now specified, USEPA Method 202. Testing for condensable particulate is also only addressed once since the applicable test method is the same for testing of both PM_{10} and $PM_{2.5}$ emissions.

Attachment 1 – Summary of Annual Emissions of the Lime Plant

Changes are made to this summary of the permitted annual emissions of the proposed plant so that the permitted emissions of the kilns reflect changes to the emissions limits for the kilns made in Condition 2.1.6. In particular, for the kilns, this summary reflects lower permitted SO_2 emissions, 219 tons/per year, which were the result of the reduction of the SO_2 BACT limit in Condition 2.1.3-3(b)(i)(D). This summary now also addresses GHG emissions from the kilns, indicating permitted GHG emissions, as CO_2e, of 1,201,842 tons/year.

Changes are also made to this summary to reflect the changes in permitted emissions of lime processing and handling due to the changes to the emission limitations in Condition 2.3.6(a).

The emergency engine generators are now addressed in this summary. The permitted emissions of GHG, NO_x and CO, which would be emitted in more than minimal amounts when the engines are operated to verify availability in the event of a power outage, are now specified. This accounts for the contribution of the operational testing of these units to the emissions of the plant. The emissions during actual power outages are not addressed. The kilns would not be operating during such periods and the overall emissions of the plant during such periods will be far less than when the kilns are in operation.