Lhoist North America – Grantsville Facility

BACT Analysis

Title V Operating Permit #4500005003

Grantsville, Utah

Stantec

Prepared for:

Lhoist North America – Grantsville Facility
P.O. Box 357
Grantsville, Utah 84029
Contact: 602.321.6752

Prepared by:

Stantec Consulting Services Inc.
1553 West Elna Rae Street, Suite 101
Tempe, Arizona 85281
Contact: 480.829.0457

Submitted to:

Utah Department of Environmental Quality
Division of Air Quality, Operating Permit Section
P.O. Box 144820
Salt Lake City, Utah 84114-4820

April 5, 2017

Sign-off Sheet

This document entitled **BACT Analysis** was prepared by Stantec Consulting Services Inc. ("Stantec") for the account of **Lhoist North America – Grantsville Facility** (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by: ______________________________
(signature)

Amber Summers

Reviewed by: ______________________________
(signature)

Mannie L. Carpenter, P.E.

Stantec

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

ABBREVIATIONS

BACM	Best Available Control Measure
BACT	Best Available Control Technology
BART VISTAS	Best Available Retrofit Technology – Visibility Improvement State and Tribal Association of the Southeast
CaO	Calcium Oxide
$Ca(OH)_2$	Calcium Hydroxide
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CoST	The Control Strategy Tool
CRF	Capital Recovery Factor
EC	Equipment Costs
EPA	Environmental Protection Agency
gr/dscf	Grains per Dry Standard Cubic Foot
HAP	Hazardous Air Pollutant
hr	Hour
lb/hour	Pounds per Hour
lb/ton	Pounds per Ton
lb/tsf	Pounds per Ton of Stone Feed
LNA	Lhoist North America
MMBtu	Million British Thermal Units
NH_3	Ammonia
NO	Nitrogen Oxide
NO_x	Nitrogen Oxides
PEC	Purchased Equipment Cost
PM	Particulate Matter
PM_{10}	Particulate Matter Less Than or Equal to 10 Microns in Aerodynamic Diameter
$PM_{2.5}$	Particulate Matter Less Than or Equal to 2.5 Microns in Aerodynamic Diameter

ABBREVIATIONS (cont'd)

PSD	Prevention of Significant Deterioration
PTE	Potential to Emit
RBLC	RACT/BACT/LAER Clearinghouse
SIP	State Implementation Plan
SO_2	Sulfur Dioxide
SO_3	Sulfur Trioxide
TCI	Total Capital Investment
TDF	Tire Derived Fuel
tons/hour	Tons per Hour
tons/year	Tons per Year
tsf	Ton of Stone Feed
TSP	Total Suspended Particulate
UDAQ	Utah Division of Air Quality
VOC	Volatile Organic Compounds

1 INTRODUCTION AND BACKGROUND INFORMATION

1.1 INTRODUCTION

Lhoist North America (LNA) currently owns and operates a quarry and lime processing plant located nine miles northwest of Grantsville, Utah in accordance with Title V Operating Permit #4500005003, issued by the Utah Division of Air Quality (UDAQ) on December 30, 2015. As presented in its February 2014 Operating Permit Renewal Application, LNA Grantsville has the following potential to emit (PTE) for particulate matter less than or equal to 2.5 microns in aerodynamic diameter ($PM_{2.5}$) and $PM_{2.5}$ precursors (i.e., sulfur dioxide [SO_2], nitrogen oxides [NO_X], volatile organic compounds [VOC], and ammonia [NH_3]):

- $PM_{2.5}$ = 46.40 tons per year (tpy) (does not include all condensable emissions);
- SO_2 = 8.88 tpy;
- NO_X = 332.74 tpy;
- VOC = 6.29 tpy; and
- NH_3 = 1.52 tpy (NH_3 emissions were not presented in the renewal application).

On January 23, 2017, UDAQ sent a letter to LNA Grantsville explaining that they have begun work on a serious nonattainment control plan for $PM_{2.5}$, as required by 40 Code of Federal Regulations (CFR) 51, Subpart Z. According to the regulation, UDAQ must identify, adopt, and implement best available controls (i.e., Best Available Control Measure [BACM] or Best Available Control Technology [BACT]) on major sources of $PM_{2.5}$ and $PM_{2.5}$ precursors. The major source threshold in an area of serious nonattainment for $PM_{2.5}$ is 70 tpy for both $PM_{2.5}$ and any $PM_{2.5}$ precursors.

Because LNA Grantsville has a PTE greater than 70 tpy for NO_X, it is considered a major source. Therefore, the emission units at the LNA Grantsville facility will need to be addressed in UDAQ's serious nonattainment control plan for $PM_{2.5}$. UDAQ has requested that LNA Grantsville complete a BACT Analysis, which is to include a "detailed, written justification of each available control strategy, taking into account technological and economic feasibility, and including documentation to justify the elimination of any available controls." UDAQ specifies that the BACT Analysis also include a control technology implementation schedule and "propose appropriate limits and monitoring requirements for each emitting unit, along with a justification for the adequacy of [the] suggested measures."

This documents represents LNA Grantsville's BACT Analysis for $PM_{2.5}$ and $PM_{2.5}$ precursors.

1.2 BACKGROUND INFORMATION

1.2.1 Site and Company/Owner Name

The LNA Grantsville facility is owned and operated by Lhoist North America, previously known as Chemical Lime Company. The facility is located nine miles northwest of Grantsville, Utah in a part of Tooele County that has been designated as serious non-attainment for $PM_{2.5}$. The location of the facility is designated as attainment for particulate matter less than or equal to 10 microns in aerodynamic diameter (PM_{10}), ozone, and all other criteria pollutants.

1.2.2 General Description of the Facility

The LNA Grantsville facility consists of the Grantsville Quarry and Grantsville Lime Plant. Activities at the facility include mining, limestone processing, one rotary kiln, post-kiln lime processing, lime hydration equipment, bagging facilities, and load out facilities.

Limestone ore is mined from the Grantsville Quarry with low-grade limestone being stored near the quarry and the remaining limestone being processed through various crushing and screening operations of the Grantsville Lime Plant. During processing, limestone chat is separated out and used for quarry floor and road maintenance, reclamation, and sales. The high quality crushed limestone is sent to the rotary kiln, which heats the crushed limestone and converts it into quicklime (calcium oxide [CaO]). The quicklime can be sold as product or sent on for further processing into hydrated lime (calcium hydroxide [$Ca(OH)_2$]).

The LNA Grantsville facility produces a variety of products including quicklime, hydrate, aggregate kiln-grade limestone, overburden/low-grade limestone, and chat. Emission activities from the facility include drilling/blasting, road dust emissions (hauling), loading/unloading, crushing/screening, storage, kiln firing, hydrating, and transfer point fugitives.

1.2.3 Recent Permitting Action

The LNA Grantsville facility has been in operation since 1960. Title V Operating Permit #4500005003 was last renewed on December 30, 2015. The most recent Approval Order was issued August 14, 2006. There are no more recent permitting actions.

BACT was determined for the Rotary Kiln for total suspended particulate (TSP), PM_{10}, NO_x, and certain hazardous air pollutants (HAPs) in a historical permitting decision (Permit Conditions II.B.3.a, II.B.3.b, II.B.3.c, II.B.3.d, II.B.3.e of Title V Operating Permit #4500005003). BACT was also applied to the Pressure Hydrator for TSP and PM_{10} (Permit Conditions II.B.4.a, II.B.4.b, II.B.4.c, and II.B.4.d of Title V Operating Permit #4500005003) in the same permitting action. Similarly, opacity limits were established as BACT (Permit Conditions II.B.2.a, II.B.2.b, II.B.5.a and II.B.6.a of Title V Operating Permit #4500005003) in addition to limits on sulfur in fuel oil (Permit

Condition II.B.1.d of Title V Operating Permit #4500005003). These BACT limits pre-date the original 1995 Title V permit application.

Because the location of the LNA Grantsville facility has not been designated nonattainment for any pollutant other than $PM_{2.5}$, no previous state implementation plans (SIPs) have included the LNA Grantsville facility. Only the areas of Tooele County above 5,600 feet in elevation have historically been the subject of a SIP (for SO_2).

1.2.4 Current Operational State

Operations at the LNA Grantsville facility were placed in temporary care and maintenance mode on November 14, 2008. This means that the facility is still undergoing basic day-to-day activities such as security, plant clean-up operations, maintenance, etc. to remain in compete "ready mode," but that there is no lime being manufactured and the Rotary Kiln is not being operated (i.e., there is no fuel source being fired to keep the kiln heated). The only other operations currently ongoing at the LNA Grantsville facility is the shipping of previously stockpiled material to offsite locations.

2 IDENTIFICATION OF EMISSION UNITS REQUIRING A BACT ANALYSIS

On February 2, 2017, LNA Grantsville contacted UDAQ to receive clarification on what emission units at the facility require a BACT Analysis. John Black of UDAQ specified that a BACT Analysis is required only for the point sources at the facility. The point sources at the LNA Grantsville facility are identified in Table 2.1. Table 2.1 also identifies if the point sources emit $PM_{2.5}$ or any $PM_{2.5}$ precursors.

The following sections present the BACT Analyses completed for $PM_{2.5}$ and the $PM_{2.5}$ precursors emitted by each point source. Section 3 presents the BACT Analysis for the Rotary Kiln, as currently controlled by Electro Dry Scrubber DS1RK. Section 4 presents the BACT Analysis for the Pressure Hydrator, as currently controlled by Baghouse HBH-1HY. Section 5 presents the BACT Analysis for Baghouse DC-3HB, which currently controls the hydrate system screw conveyors, bucket elevators, separators, and hydrate bagger. As clarified by John Black, only one BACT Analysis is needed for the non-hydrator baghouses, as it can be assumed that the BACT Analysis for the largest baghouse (i.e., in terms of exhaust air flow rate) will also represent the BACT Analysis for the smaller baghouses. Consequently, the BACT Analysis for Baghouse DC-3HB, as presented in Section 5, is assumed to apply to Baghouses DC-1QS, DC-2QP, DC-4LO, DC-5LO, DC-6KD, DC-8KD, and DC-10FF. Finally, Section 6 presents the BACT Analysis for the Kiln Shaft Motor.

LNA Grantsville has limited information about the cost effectiveness and economic impacts of the various control technologies/practices identified in the BACT analyses. Consequently, the EPA Control Strategy Tool (CoST) System was primarily used to compare the cost effectiveness of the different control technologies/practices. Because the EPA CoST System presents average values for all control technologies/practices, it allows comparisons to be made on a level playing field. However, when site-specific information is available, it has been identified in the BACT analyses and should be considered in the determination of BACT.

Table 2.1 Point Sources Located at the LNA Grantsville Facility

Point Source Identification [a]	Manufacturer	Exit Air Flow Rate (acfm)	Emission Units Controlled	Identification of Pollutants Emitted				
				$PM_{2.5}$	SO_2	NO_X	VOC	NH_3
Electro Dry Scrubber DS1RK	Combustion Power Co.	29,100	Rotary Kiln (including associated processes)	Yes	Yes	Yes	Yes	Yes
Baghouse HBH-1HY	Mikropul	2,000	Pressure Hydrator (including the baghouse burner)	Yes	Yes	Yes	Yes	Yes
Baghouse DC-1QS	Mikropul	5,000	Front Lime Handling System Product Bins (FL-1Bin, FL-9Bin, FL-10Bin) and Universal Crusher (FL-Ucrush)	Yes	No	No	No	No
Baghouse DC-2QP	Mikropul	12,500	Front Lime Handling System Bins (FL-2Bin, FL-3Bin, FL-8Bin), Screens, and Belt Conveyors; Back Lime Handling System Product Bins (BL-4Bin, BL-5Bin); and Hydrate System Surge Bin (H-Sbin)	Yes	No	No	No	No
Baghouse DC-3HB	Mikropul	13,900	Hydrate System Screw Conveyors, Bucket Elevators, Separators (H-1Sprtr, H-2Sprtr), and Hydrate Bagger	Yes	No	No	No	No
Baghouse DC-4LO	DLM	550	Back Lime Handling System Loadout Rotary Screen, Rail Loadout and Screw Conveyor, and Hydrate System Bulk Loadout	Yes	No	No	No	No

Table 2.1 Point Sources Located at the LNA Grantsville Facility

Point Source Identification [a]	Manufacturer	Exit Air Flow Rate (acfm)	Emission Units Controlled	Identification of Pollutants Emitted				
				$PM_{2.5}$	SO_2	NO_x	VOC	NH_3
Baghouse DC-5LO	Mikropul	2,200	Back Lime Handling System Transfer Point to Belt Conveyor and Hydrate System Bulk Loadout Screw Conveyor	Yes	No	No	No	No
Baghouse DC-6KD	Fabri-Jet	1,000	Pneumatic Dust Transfer System Located Between Dust Bins (K-DBin1, K-DBin2)	Yes	No	No	No	No
Baghouse DC-8KD	Fuller	875	25 ton Dust Storage Bin (K-DBin2)	Yes	No	No	No	No
Baghouse DC-10FF	Not Available	3,000	Second Bagging Line Bagger (Bagger-2), 120 ton Silo (H-3Silo), Belt Conveyor (H-Belt3), and Screw Conveyor (H-Screw22)	Yes	No	No	No	No
Kiln Shaft Motor (backup power)	100 hp (gasoline)	Not Applicable	Not Applicable	Yes	Yes	Yes	Yes	No

[a] The LNA Grantsville facility includes two additional baghouses (DC-7SC and DC-9HY). Because they do not have the potential to emit air pollutants, they do not need to be addressed in this BACT Analysis.

3 BACT ANALYSIS FOR THE ROTARY KILN SYSTEM

The Rotary Kiln System was installed at the LNA Grantsville facility in 1960 and currently has a production rate limit of 100,000 tons per year on a rolling 12-month basis (i.e., Condition II.B.3.d of Title V Operating Permit #4500005003). The Rotary Kiln System consists of pre-kiln limestone handling, a preheater, a rotary kiln, and a lime cooler. Four fuels can be used in the kiln. Natural gas is available to the kiln through a 5-inch feed line. Fuel oil for the kiln is stored in a storage tank and is used on an as-needed-basis when natural gas delivery is curtailed. Fuel oil can also be used as a primary fuel. On-specification used oil is used to supplement both natural gas and fuel oil on an as-needed-basis. On-specification used oil can also be used as a primary fuel. Tire derived fuel (TDF) is also used to supplement natural gas and fuel oil on an as-needed basis; additionally, TDF is approved as a primary fuel source. Gases from used tires are generated in an external chamber and directed to the kiln firing hood for combustion.

During pre-kiln limestone handling, limestone is conveyed from a kiln-feed stockpile to a bucket elevator via a belt conveyor. Approximately 20 percent of the limestone from the kiln-feed stockpile is processed by a scalping screen prior to being discharged to the bucket elevator. The bucket elevator transfers the limestone to a stone bin, which is located on top of the kiln preheater. Stone is gravity fed from the bin through four discharge chutes which position the rock above and in front of four hydraulic rams in the preheater. The rams are used to push the limestone into the rotary kiln.

In the kiln preheater the limestone is heated by hot gases that flow countercurrent to the flow of the limestone. In the kiln, the limestone is heated to high temperatures whereby it is converted to quicklime. From the kiln the quicklime is passed through an air contact cooler where the quicklime is cooled and where kiln combustion air is preheated. The quicklime produced by the kiln is either sold to customers directly from the kiln as pebble lime, sized to customer specifications in the Front and Back Lime Handling Systems, or processed in the Hydrate System.

Particulate emissions from the Rotary Kiln System consist of fuel burning particulate emissions and dust emissions from the crushed limestone that is entrained in the exhaust stream during the firing process. The particulate emissions from the Rotary Kiln System are currently controlled by an Electro Dry Scrubber. The scrubber consists of a cyclone, which encloses a moving gravel bed, and an electro grid. The electro grid is used to charge the particles resulting in greater retention in the gravel bed. The control efficiency of the Electro Dry Scrubber for $PM_{2.5}$ is 70%. The control efficiency is based on information in AP-42, Table B.2-3 for a low efficiency electrostatic precipitator. The particle size collection efficiencies of a low efficiency electrostatic precipitator are most representative of the Electro Dry Scrubber.

The Rotary Kiln System also has the potential to emit SO_2, NO_x, VOC, and NH_3 emissions (among other pollutants). The potential and actual annual emissions from the Rotary Kiln System as controlled by the Electro Dry Scrubber are presented in Table 3.1.

Table 3.1 Annual Emissions from the Rotary Kiln System (Electro Dry Scrubber DS1RK)

Emission Category	Controlled or Uncontrolled	Annual Emissions (tons/year)				
		$PM_{2.5}$	SO_2	NO_x	VOC	NH_3
Potential Emissions	Controlled	32.56	8.85	328.50	3.00	1.39
	Uncontrolled [a]	108.54	8.85	328.50	3.00	1.39
2013 Actual Emissions	Controlled	0	0	0	0	0
	Uncontrolled [a]	0	0	0	0	0
2011 Actual Emissions	Controlled	0	0	0	0	0
	Uncontrolled [a]	0	0	0	0	0
2008 Actual Emissions [b]	Controlled	12.05	13.08	85.75	9.83	0.48
	Uncontrolled [a]	40.16	13.08	85.75	9.83	0.48
2005 Actual Emissions [c]	Controlled	7.11	2.65	31.31	1.09	Not Determined
	Uncontrolled [a]	23.69	2.65	31.31	1.09	Not Determined

[a] Uncontrolled emissions of $PM_{2.5}$ are back calculated using a control efficiency of 70%. Uncontrolled emissions of the remaining pollutants are assumed equal to controlled emissions because they are controlled only by good combustion practices and inherent sulfur contents (i.e., assumed control efficiency of 0%).

[b] Except for fuel oil combustion, $PM_{2.5}$ emissions were assumed equal to PM_{10} emissions in the submitted 2008 annual emission inventory. For consistency, this table calculates $PM_{2.5}$ emissions assuming they are 30% of the reported PM_{10} emissions in 2008. This is the same $PM_{2.5}$ to PM_{10} ratio used in LNA Grantsville's 2014 renewal application.

[c] $PM_{2.5}$ emissions were not determined in the submitted 2005 annual emission inventory. Consequently, $PM_{2.5}$ emissions have been estimated in this table assuming they are 30% of the reported PM_{10} emissions in 2005. This is the same $PM_{2.5}$ to PM_{10} ratio used in LNA Grantsville's 2014 renewal application.

3.1 $PM_{2.5}$

3.1.1 Top-Down Approach

3.1.1.1 Identification of All Available Control Technologies

The practices/technologies available to control $PM_{2.5}$ from the Rotary Kiln System are presented in Table 3.2. In order to efficiently compare a variety of control practices/technologies, the cost effectiveness values presented in Table 3.2 are average values from EPA's CoST System. However, based on experience at various LNA facilities, the costs of implementing the $PM_{2.5}$ control practices/technologies on a Rotary Kiln System are significantly greater than the average values presented in the EPA CoST System. For example, the site-specific cost effectiveness value for implementing baghouse control was determined in LNA Grantsville's previous RACT Analysis dated August 2013 to be $91,642/ton of $PM_{2.5}$ reduced. Likewise, the site-specific cost effectiveness value for implementing wet scrubber control was determined to be $71,617/ton of $PM_{2.5}$ reduced. Site-specific cost effectiveness values for the remaining $PM_{2.5}$ control practices/technologies are also expected to be significantly greater than the average values in EPA's CoST System.

3.1.1.2 Elimination of Technically Infeasible Control Options

All the control practices/technologies identified in Table 3.2 are technically feasible.

3.1.1.3 Ranking of Remaining Control Technologies

The ranking of the control practices/technologies from top to bottom, taking into account control effectiveness, economic impacts, environmental impacts, and energy impacts, is presented in Table 3.3. The economic impacts presented in Table 3.3 are based on the average cost effectiveness values from EPA's CoST System. However, as previously mentioned, the costs of implementing the $PM_{2.5}$ control practices/technologies on a Rotary Kiln System are significantly greater than the average values presented in the EPA CoST System based on experience at various LNA facilities. For example, the site-specific economic impact of implementing baghouse control was determined in LNA Grantsville's previous RACT Analysis dated August 2013 to be $996,145/year. Likewise, the site-specific economic impact for implementing wet scrubber control was determined to be $534,627/year. Site-specific economic impacts for the remaining $PM_{2.5}$ control practices/technologies are also expected to be significantly greater than the average values in EPA's CoST System.

3.1.1.4 Evaluation of Most Effective Controls

The top three control practices/technologies are all types of fabric filter baghouses with identical control efficiencies and similar economic impacts. Because LNA Grantsville proposes to choose a fabric filter baghouse as BACT, further evaluation of the other controls is not necessary.

3.1.1.5 Selection of BACT

LNA Grantsville proposes BACT to be a type of fabric filter baghouses (pulse jet, mechanical shaker, or reverse air cleaned). Due to the facility currently being in care and maintenance mode, LNA Grantsville would prefer to make a decision on the type of fabric filter baghouse at a later date. However, because of the identical control efficiencies of the different types of fabric filter baghouses, the delayed decision should not affect establishment of emission limitations and monitoring requirements.

3.1.2 Proposed Emission Limits and Monitoring Requirements

3.1.2.1 Emission Limits

Particulate matter (PM) emission limits are established in 40 CFR 63, Subpart AAAAA for lime manufacturing plants that are major sources of HAPs. The PM emission limit for new lime kilns is 0.10 pounds per ton of stone feed (lb/tsf), while the PM emission limit for existing kilns (that did not have a wet scrubber installed and operating prior to January 5, 2004) is 0.12 lb/tsf. These emission limits are for filterable PM emissions only. If LNA Grantsville was a major source of HAPs and subject to 40 CFR 63, Subpart AAAAA, the Rotary Kiln System would be considered an existing kiln.

Although LNA Grantsville is not a major source of HAPs, it is proposed to use the PM emission limit for existing kilns in 40 CFR 63, Subpart AAAAA to assist with establishing the filterable portion of a $PM_{2.5}$ emission limit. This strategy is used because the PM emission limits for lime kilns in 40 CFR 63, Subpart AAAAA are heavily reflected in the Environmental Protection Agency's (EPA's) RACT/BACT/LAER Clearinghouse (RBLC) results.

The $PM_{2.5}$ filterable fraction of emissions from LNA Grantsville's Rotary Kiln System is estimated to be 27% of PM emissions based on information for Rotary Kilns controlled by fabric filters in AP-42, Table 11.17-7. Consequently, using the PM emission limit in 40 CFR 63, Subpart AAAAA for existing lime kilns and a 27% $PM_{2.5}$ particle size distribution results in a $PM_{2.5}$ filterable emission limit of 0.0324 lb/tsf.

A condensable $PM_{2.5}$ emission limit can be estimated using results from testing performed at different LNA facilities. Because of very limited testing, the highest representative value for condensable $PM_{2.5}$ was chosen to account for variability in individual unit operation. The value of condensable $PM_{2.5}$ was prorated to the filterable PM standard in 40 CFR 63, Subpart AAAAA using corresponding filterable PM test results to yield an adjusted condensable $PM_{2.5}$ value of 1.4 lb/tsf. When added to the filterable $PM_{2.5}$ emission limit, the proposed total $PM_{2.5}$ (i.e., filterable plus condensable) emission limit becomes 1.4324 lb $PM_{2.5}$/tsf.

3.1.2.2 Monitoring Requirements

LNA Grantsville proposes monitoring to consist of performance testing requirements. An initial performance test is recommended no later than January 1, 2019 (if startup occurs on or before

January 1, 2019) or within 180 days of source startup (if startup occurs after January 1, 2019). Subsequent performance tests are recommended every three years following the initial performance test, which is based on current Condition II.B.3.b.1.(a)(1) of Title V Operating Permit #4500005003.

Test Methods 201a and 202 from 40 CFR 51, Appendix M (or other EPA approved testing methods acceptable to UDAQ) are recommended for use during performance testing. The back half condensables should be used when demonstrating compliance with the total $PM_{2.5}$ (i.e., filterable plus condensable) emission limit. If a method other than 201a is used, the portion of the front half of the catch considered $PM_{2.5}$ shall be based on information in AP-42, Table 11.17-7 or other data acceptable to UDAQ.

3.1.3 Consideration of Startup and Shutdown Operations

Emissions from the Rotary Kiln System will be exhausted through the fabric filter baghouse during startup and shutdown. Consequently, no unique startup and shutdown provisions are necessary for the fabric filter baghouse technology.

3.1.4 Control Technology Implementation Schedule

As discussed in Section 1.2.4, the LNA Grantsville facility is currently in temporary care and maintenance mode. Resumption of operations of the LNA Grantsville facility depends upon market conditions such that a certain restart date cannot be estimated at this time. Taking into consideration solicitation and selection of an engineering firm to design the fabric filter baghouse system, the design process, and construction of the fabric filter baghouse, the following implementation schedule is suggested:

- If startup occurs on or before January 1, 2019, BACT requirements will become effective on January 1, 2019; or
- If startup occurs after January 1, 2019, BACT requirements will become effective upon startup.

Table 3.2 $PM_{2.5}$ Control Technologies for the Rotary Kiln System

Control Practice/Technology	Control Efficiency [a]		Average Cost Effectiveness	
	Percent Controlled	Reference	$/Ton $PM_{2.5}$ Reduced	Reference
Fabric Filter - Pulse Jet Type	99-99.5%	EPA CoST [b] System	272.55 [d]	EPA CoST System [c]
Fabric Filter - Mechanical Shaker Type	99-99.5%	EPA CoST System	294.24 [d]	EPA CoST System [c]
Fabric Filter - Reverse Air Cleaned Type	99-99.5%	EPA CoST System	345.77 [d]	EPA CoST System [c]
Paper/Nonwoven Filters - Cartridge Collector Type	99%	EPA CoST System	330.85	EPA CoST System [c]
Wet Electrostatic Precipitator - Wire Plate Type	95-99.5%	EPA CoST System	565.00	EPA CoST System [c]
Dry Electrostatic Precipitator - Wire Plate Type	95%	EPA CoST System	279.66	EPA CoST System [c]
Electro Dry Scrubber (current control technology used at LNA Grantsville)	70%	Estimated from AP-42, Table B.2-3 for Low Efficiency Electrostatic Precipitator	Not included in the EPA CoST System	
Wet Scrubber	20-90%	AP-42, Table B.2-3 for Wet Scrubber	Not included in the EPA CoST System [d]	

Table 3.2 $PM_{2.5}$ Control Technologies for the Rotary Kiln System

Control Practice/Technology	Control Efficiency [a]		Average Cost Effectiveness	
	Percent Controlled	Reference	$/Ton $PM_{2.5}$ Reduced	Reference
Cyclone Separator	10-80%	AP-42, Table B.2-3 for Centrifugal Collector	Not included in the EPA CoST System	
Gravel Bed Filter	0%	AP-42, Table B.2-3 for Gravel Bed Filter	Not included in the EPA CoST System	
Good Combustion Practices and Burner/Process Optimization	0%	Assumed	No Additional Costs	Assumed

[a] Control efficiencies are for filterable emissions only.

[b] CoST: The Control Strategy Tool

[c] Average cost effectiveness is for Reference Year 2013.

[d] The cost effectiveness values presented in the EPA CoST system are average values. Site-specific cost effectiveness values for fabric filter baghouses and wet scrubbers are discussed in Section 2.1.3 of LNA Grantsville's previous RACT Analysis dated August 2013. A fabric filter baghouse was determined to have a site-specific cost effectiveness value of $91,642/ton of $PM_{2.5}$ reduced. A wet scrubber was determined to have a site-specific cost effectiveness value of $71,617/ton of $PM_{2.5}$ reduced. Site-specific cost effectiveness values for the remaining $PM_{2.5}$ control practices/technologies are also expected to be similarly greater than the average values in EPA's CoST System.

Table 3.3 Ranking of Remaining $PM_{2.5}$ Control Efficiencies

Control Practice/Technology	Control Efficiency [a]	Expected Controlled $PM_{2.5}$ Emission Rate (tons/year) [b]	Expected $PM_{2.5}$ Emission Reduction (tons/year) [c]	Economic Impacts ($/year) [d]	Environmental Impacts	Energy Impacts
Fabric Filter - Pulse Jet Type	99-99.5%	0.81	107.72	29,359.73 [e]	Not Applicable (top option is chosen)	Not Applicable (top option is chosen)
Fabric Filter - Mechanical Shaker Type	99-99.5%	0.81	107.72	31,696.23 [e]		
Fabric Filter - Reverse Air Cleaned Type	99-99.5%	0.81	107.72	37,247.17 [e]		
Paper/Nonwoven Filters - Cartridge Collector Type	99%	1.09	107.45	35,550.18		
Wet Electrostatic Precipitator - Wire Plate Type	95-99.5%	2.98	105.55	59,636.68		
Dry Electrostatic Precipitator - Wire Plate Type	95%	5.43	103.11	28,835.63		
Electro Dry Scrubber (current control technology used at LNA Grantsville)	70%	32.56	75.98	Not Determined		
Wet Scrubber	20-90%	48.84	59.70	Not Determined [e]		

Table 3.3 Ranking of Remaining $PM_{2.5}$ Control Efficiencies

Control Practice/Technology	Control Efficiency [a]	Expected Controlled $PM_{2.5}$ Emission Rate (tons/year) [b]	Expected $PM_{2.5}$ Emission Reduction (tons/year) [c]	Economic Impacts ($/year) [d]	Environmental Impacts	Energy Impacts
Cyclone Separator	10-80%	59.70	48.84	Not Determined	Not Applicable (top option is chosen)	Not Applicable (top option is chosen)
Gravel Bed Filter	0%	108.54	0	Not Determined		
Good Combustion Practices and Burner/Process Optimization	0%	108.54	0	No Additional Costs		

[a] Control efficiencies are for filterable emissions only.

[b] Calculated using the uncontrolled potential $PM_{2.5}$ emission rate in Table 3.1 and the expected control efficiencies. When there is a range of control efficiencies, emissions are calculated using the median of the control efficiencies. The uncontrolled potential $PM_{2.5}$ emission rate in Table 3.1 includes only filterable emissions.

[c] Calculated by subtracting the expected controlled $PM_{2.5}$ emission rates from the uncontrolled potential $PM_{2.5}$ emission rate in Table 3.1.

[d] Calculated by multiplying the average cost effectiveness presented in Table 3.2 by the amount of $PM_{2.5}$ reduced per year.

[e] The economic impacts are based on cost effectiveness values presented in the EPA CoST system, which are average values. Site-specific economic impacts for fabric filter baghouses and wet scrubbers are discussed in Section 2.1.3 of LNA Grantsville's previous RACT Analysis dated August 2013. A fabric filter baghouse was determined to have a site-specific economic impact of $996,145/year. A wet scrubber was determined to have a site-specific economic impact of $534,627/year. Site-specific economic impacts for the remaining $PM_{2.5}$ control practices/technologies are also expected to be similarly greater than the average values in EPA's CoST System.

3.2 SO_2

3.2.1 Top-Down Approach

3.2.1.1 Identification of All Available Control Technologies

The practices/technologies available to control SO_2 from the Rotary Kiln System are presented in Table 3.4. For reference purposes, the cost effectiveness range for flue gas desulfurization presented in Table 3.4 is from an EPA Air Pollution Control Fact Sheet. However, based on experience at other LNA facilities, the costs of implementing flue gas desulfurization on the LNA Grantsville Rotary Kiln System would be greater than the high end of the range presented in the EPA Air Pollution Control Fact Sheet for Flue Gas Desulfurization. For example, the site-specific cost effectiveness value for implementing dry sorbent injection (i.e., a low cost type of flue gas desulfurization) on the LNA Grantsville Rotary Kiln System was determined to be approximately $80,000/ton of SO_2 reduced. Determination of the cost effectiveness value is presented in Appendix A. Because dry sorbent injection systems are known to have significantly lower capital and annual costs compared to wet systems, the cost effectiveness values for wet systems installed on the LNA Grantsville Rotary Kiln System are expected to be greater than the $80,000/ton of SO_2 determined for dry sorbent injection.

3.2.1.2 Elimination of Technically Infeasible Control Options

All the control practices/technologies identified in Table 3.4 are technically feasible.

3.2.1.3 Ranking of Remaining Control Technologies

The ranking of the control practices/technologies from top to bottom, taking into account control effectiveness, economic impacts, environmental impacts, and energy impacts, is presented in Table 3.5. The economic impact presented in Table 3.5 for flue gas desulfurization is based on the median of the cost effectiveness values presented in an EPA Air Pollution Control Fact Sheet. However, as previously mentioned, the costs of implementing dry sorbent injection (i.e., a low cost type of flue gas desulfurization) on the LNA Grantsville Rotary Kiln System would be greater than the values presented in the EPA Air Pollution Control Fact Sheet for Flue Gas Desulfurization. For example, the site-specific economic impact of implementing dry sorbent injection was determined to be approximately $495,000/year. Determination of the economic impact is presented in Appendix A. Because dry sorbent injection systems are known to have significantly lower capital and annual costs compared to wet systems, the economic impacts of wet systems installed on the LNA Grantsville Rotary Kiln System are expected to be greater than the $495,000/year determined for dry sorbent injection.

3.2.1.4 Evaluation of Most Effective Controls

SO_2 emissions from the Rotary Kiln System are mainly due to the presence of sulfur contained in the fuel used in the kiln. The sulfur combines with oxygen in the combustion air to form SO_2. A search of comparable facilities in EPA's RBLC indicates a wide variety of limitations for the sulfur content of fuel as well as sulfur emission rates. However, the most prevalent control method listed in EPA's RBLC for SO_2 emissions are fuel sulfur limitations and "inherent" sulfur control. It is well known that the alkaline properties of limestone tend to neutralize acid gases and that limestone has a scrubbing effect that reduces SO_2 emissions. Lime kilns with preheat create conditions for this scrubbing effect to occur thereby serving as an inherent control mechanism. Add-on SO_2 controls, such as flue gas desulfurization (which actually employ lime to control SO_2 emissions) have been effectively employed at sources such as coal-fired power plants which have relatively high SO_2 concentrations in the flue gas. The Rotary Kiln System at the LNA Grantsville facility does not utilize coal.

The sulfur content of the fuel used in LNA Grantsville's Rotary Kiln System varies from nearly zero for natural gas (pipeline quality) to 1.2% (by weight) for TDF. Additionally, the sulfur content of fuel oil (diesel) and on-specification used oil is limited to 0.85 lb per million British Thermal Units (MMBtu) and 0.5% (by weight), respectively, by Conditions II.B.1.d and II.B.3.e of Title V Operating Permit #4500005003. Source testing performed during pilot testing of the TDF burning system indicates that emissions of SO_2 are greatest when burning natural gas and SO_2 was not present within detection limits during any tests performed while burning TDF. It is assumed that the conditions under which tires are combusted produces highly reactive sulfur compounds that are absorbed by the lime as it comes in contact with the combustion gases.

Consequently, because it is known that the fuel burned in in LNA Grantsville's Rotary Kiln System produces SO_2 emission rates much lower than coal-fired lime kilns, the use of an add-on control device such as flue gas desulfurization would result in little added benefit due to relatively low SO_2 concentration in the flue gas stream.

3.2.1.5 Selection of BACT

Due to the economic, environmental, and energy impacts of flue gas desulfurization with only minimal reductions in SO_2 emissions, LNA Grantsville proposes good combustion practices, burner/process optimization, and inherent control as BACT.

3.2.2 Proposed Emission Limits and Monitoring Requirements

3.2.2.1 Emission Limits

Because the proposed BACT is the practice/technology currently used at the LNA Grantsville facility, it is not necessary to establish new limitations. As previously mentioned, SO_2 emissions from the Rotary Kiln System are mainly due to the presence of sulfur contained in the fuel used in the kiln. The sulfur content of diesel fuel oil and on-specification used oil is already limited by Title V Operating Permit #4500005003. Furthermore, the sulfur content of pipeline quality natural gas is limited by tariffs set forth to maintain pipeline integrity. Finally, the sulfur content of TDF is approximately 1.2% (by weight), but source testing showed SO_2 emissions are not within detection limits while burning TDF. Therefore, the existing sulfur limits in Title V Operating Permit #4500005003 along with the inherent sulfur contents of pipeline quality natural gas and TDF is sufficient to enforce the proposed BACT.

3.2.2.2 Monitoring Requirements

Monitoring requirements for the sulfur content of diesel fuel oil and on-specification used oil are already established in Conditions II.B.1.d.1 and II.B.3.e.1 of Title V Operating Permit #4500005003. Monitoring requirements for the sulfur content of pipeline quality natural gas is unnecessary since it is limited by tariffs. Because source testing showed SO_2 emissions are not within detection limits while burning TDF, it is also unnecessary to establish monitoring requirements for the sulfur content of TDF.

3.2.3 Consideration of Startup and Shutdown Operations

No unique startup and shutdown provisions are necessary for use of good combustion practices, burner/process optimization, and inherent control.

3.2.4 Control Technology Implementation Schedule

Continued use of good combustion practices, burner/process optimization, and inherent control can begin immediately upon start-up of the LNA Grantsville facility.

Table 3.4 SO_2 Control Technologies for the Rotary Kiln System

Control Practice/Technology	Control Efficiency		Average Cost Effectiveness	
	Percent Controlled	Reference	$/Ton SO_2 Reduced	Reference
Flue Gas Desulfurization [a]	50-90%	EPA CoST System	500-5,000	EPA Air Pollution Control Fact Sheet for Flue Gas Desulfurization [b]
Good Combustion Practices, Burner/Process Optimization, Inherent Control (current control practice used at LNA Grantsville)	0%	Assumed	No Additional Costs	Assumed

[a] LNA conducted a cost effectiveness analysis for dry sorbent injection (i.e., a type of flue gas desulfurization) for kilns located at one of their other facilities that are fired by coal and petroleum coke. The cost effectiveness of dry sorbent injection on the coal/coke kilns was determined to be approximately $5,000-$5,500/tons of SO_2 reduced. Assuming the same equipment, installation, and operational costs (adjusted for sorbent usage), a dry sorbent injection system installed on the LNA Grantsville Rotary Kiln System would have a cost effectiveness of approximately $80,000/tons of SO_2 reduced (see Appendix A). The higher cost effectiveness value is due to the minimal amount of SO_2 emitted by the LNA Grantsville Rotary Kiln System and therefore, the limited available reduction in SO_2 emissions. Furthermore, because dry sorbent injection systems are known to have significantly lower capital and annual costs compared to wet systems, the cost effectiveness values for wet systems installed on the LNA Grantsville Rotary Kiln System are expected to be greater than the $80,000/ton of SO_2 determined for dry sorbent injection.

[b] Average cost effectiveness is for Reference Year 2001. Because the EPA Air Pollution Control Fact Sheet for Flue Gas Desulfurization is primarily applicable to stationary coal and oil-fired combustion units, the average cost effectiveness values are lower than what would be expected for LNA Grantsville's Rotary Kiln System, which has an uncontrolled potential to emit of only 8.85 tons/year.

Table 3.5 Ranking of Remaining SO_2 Control Efficiencies

Control Practice/Technology	Control Efficiency	Expected Controlled SO_2 Emission Rate (tons/year) [a]	Expected SO_2 Emission Reduction (tons/year) [b]	Economic Impacts ($/year) [c]	Environmental Impacts	Energy Impacts
Flue Gas Desulfurization [d]	50-90%	2.65	6.19	17,031.63	Waste disposal would be necessary	Additional electricity demand
Good Combustion Practices, Burner/Process Optimization, Inherent Control (current control practice used at LNA Grantsville)	0%	8.85	0	No Additional Costs	None	No additional energy use

[a] Calculated using the uncontrolled potential SO_2 emission rate in Table 3.1 and the expected SO_2 control efficiencies. When there is a range of control efficiencies, emissions are calculated using the median of the control efficiencies.

[b] Calculated by subtracting the expected controlled SO_2 emission rates from the uncontrolled potential SO_2 emission rate in Table 3.1.

[c] Calculated by multiplying the average cost effectiveness presented in Table 3.4 by the amount of SO_2 reduced per year. When there is a range of cost effectiveness, economic impacts are calculated using the median of the cost effectiveness.

[d] As previously described, LNA conducted a cost effectiveness analysis for dry sorbent injection (i.e., a type of flue gas desulfurization) for coal/coke kilns located at one of their other facilities. The corresponding economic impacts of dry sorbent injection on the coal/coke kilns was determined to be approximately $3,350,000-$5,076,000/year. Assuming the same equipment, installation, and operational costs (adjusted for sorbent usage), a dry sorbent injection system installed on the LNA Grantsville Rotary Kiln System would have an economic impact of approximately $495,000/year (see Appendix A). The lower economic impact is due to the lower amount of sorbent needed to reduce the minimal amount of SO_2 emitted by the LNA Grantsville Rotary Kiln System. Because dry sorbent injection systems are known to have significantly lower capital and annual costs compared to wet systems, the economic impacts of wet systems installed on the LNA Grantsville Rotary Kiln System are expected to be greater than the $495,000/year determined for dry sorbent injection.

3.3 NO_X

3.3.1 Top-Down Approach

3.3.1.1 Identification of All Available Control Technologies

The technologies available to control NO_X from the Rotary Kiln System are presented in Table 3.6. In order to efficiently compare a variety of control practices/technologies, the cost effectiveness values presented in Table 3.6 are average values from EPA's CoST System. However, based on experience at various LNA facilities, the costs of implementing the NO_X control practices/technologies on a Rotary Kiln System are significantly greater than the average values presented in the EPA CoST System. For example, the site-specific cost effectiveness value for implementing selective non-catalytic reduction control was determined in LNA Grantsville's previous RACT Analysis dated August 2013 to be $3,977/ton of NO_X reduced. Site-specific cost effectiveness values for low NO_X burner systems and selective catalytic reduction (although determined to be infeasible for the LNA Grantsville facility) are also expected to be significantly greater than the average values in EPA's CoST System.

3.3.1.2 Elimination of Technically Infeasible Control Options

Low NO_X burner systems and selective catalytic reduction are considered technically infeasible and are discussed in more detail below. Selective non-catalytic reduction and good combustion practices/optimization are considered technically feasible.

Low NO_X Burner Systems

Low NO_X burner systems control NO_X emissions by lowering the peak burner flame temperature and staging the mixing of the fuel and combustion air. By design, low NO_X burner systems operate at lower flame temperature than conventional burners. The lower flame temperature may cause carry-over of unburned carbon into the limestone which could have adverse effects on product quality. Additionally, lowering the flame temperature can result in an increase in carbon monoxide (CO) emissions. Low NO_X burner systems require precise control of fuel/air mixture to lower the flame temperature while maintaining efficient burner operation.

UDAQ has indicated that "the EPA and UDAQ view low-NO_X burners as a control option for this activity," however, current technical documentation does not support the use of low NO_X burner systems for the type of kiln at the LNA Grantsville facility. NO_X emission reductions of up to 30% have been claimed, but these reductions cannot be universally achieved. The LNA Grantsville Rotary Kiln System is over 40 years old; is small in size; and is equipped to burn natural gas, fuel oil, used oil, and tires as fuel. The few kilns that have successfully employed low NO_X burner systems are substantially larger, newer, and typically use only one type of fuel.

The main principle of the low NO_X burner systems is stepwise or staged combustion and localized exhaust gas recirculation (i.e., at the flame). Low NO_X burner systems are designed to reduce flame turbulence, delay fuel/air mixing, and establish fuel-rich zones for initial combustion. The longer, less intense flames resulting from the staged combustion lower the flame temperatures and reduce thermal NO_x formation. However, the use of low NO_x burner systems in lime kilns is not a widely used control technology, and past use of bluff body low NO_x burner systems at other LNA facilities was not successful. The burners wore out in approximately six months, impacted production, caused brick damage, and resulted in unscheduled shutdowns of the kilns. Consequently, LNA Grantsville discounts the use of bluff body low NO_x burner systems, does not have reason to believe changing the burners will reduce NO_x emissions by any specific percentage, and does not see low NO_x burner systems as proven technology for shorter, preheater rotary kilns like the LNA Grantsville Rotary Kiln System.

Installation of low NO_x burners on the LNA Grantsville Rotary Kiln System would also require extensive conversion of the fuel handling system, duct work, and burner system to accommodate the precise control required for maintaining viable burner performance and NO_x control. Additionally, the BART VISTAS program (Best Available Retrofit Technology – Visibility Improvement State and Tribal Association of the Southeast) no longer lists low NO_x burner systems as a NO_x control option for lime kilns. Furthermore, one of the energy sources for the LNA Grantsville Rotary Kiln System is from the combustion of whole tires and this process is not amenable to low NO_x burners.

LNA Grantsville reviewed recent permitting activity to achieve a better understanding of whether low NO_x burner systems had been permitted as BACT in the lime industry. LNA Grantsville conducted a search of the EPA's RBLC for lime kiln permits issued since 2003 to understand whether there were permits issued for lime kilns that required low NO_x burner systems. None of the recent permitting actions have determined low NO_x burner systems to be BACT, except the permitting action shown for the Western Lime Corporation. While the RBLC database indicates low NO_x burner systems were determined to be BACT for a Western Lime kiln, the low NO_x burner systems used by Western Lime in practice consist of a straight pipe with a bluff body. As stated above, LNA has experimented with bluff body low NO_x burner systems and was not successful.

LNA Grantsville has no data to suggest that NO_x reductions are achievable from changing to burners classified as low-NO_x burners for a kiln with the same design features as the LNA Grantsville Rotary Kiln System. EPA has indicated that a 14 percent reduction in NO_x emissions may be anticipated in switching from a direct-fired standard burner to an indirect-fired Low NO_x burner system in a Portland cement kiln (NO_x Control Technologies for the Cement Industry, EC/R Incorporated, Chapel Hill, NC, USA, U.S. EPA Contract No. 68-D98-025, U.S. EPA RTP, September 19, 2000). EPA has determined, however, that "the [emission reduction] contribution of the low-NO_x burner itself and of the firing system conversion [from direct to indirect] cannot be isolated from the limited data available." Further, Portland cement kilns are different than lime kilns and it would not be appropriate to make the generalization that an anticipated reduction in a Portland cement kiln is directly transferable to a lime kiln due to the different temperatures and operating conditions, which would be expected to impact NO_x generation rates.

Overall, because there is significant uncertainly with respect to the ability of a burner retrofit to reduce NO_x emissions, LNA Grantsville considers low NO_x burner systems to be technically infeasible.

Selective Catalytic Reduction

Selective catalytic reduction is an add-on control device utilizing an ammonia injection system in conjunction with a catalyst impregnated grid to convert NO_x into nitrogen and water via a reduction reaction on the catalyst surface. Selective catalytic reduction systems have been effectively used to control NO_x emissions on power plants and other sources and can achieve very high removal efficiencies, particularly on steady-state systems.

However, selective catalytic reduction systems must operate in a specific temperature range (typically 600°F to 750°F) to effectively remove NO_x. If the temperature is too low, the reduction reaction will not proceed to completion resulting in higher NO_x emissions and the escape of NH_3 (i.e., ammonia slip). If the temperature is too high, ammonia can be oxidized to nitrogen oxide (NO) resulting in higher NO_x emissions. The stack temperature of the lime kiln is in the range of 345°F which is too low for effective selective catalytic reduction operation. This would necessitate the installation of a heat exchanger system to raise the exhaust stream temperature to the required range of operation for a selective catalytic reduction system. Such a heat exchanger system would greatly increase the cost of installing a selective catalytic reduction system.

Additionally, there is the potential that particulate emissions would be generated from SO_2 in the exhaust stream reacting with ammonia, causing an increase in fine particulate emissions (i.e., $PM_{2.5}$) and increasing the potential for ammonium salt deposits on the catalyst, reducing efficiency. There is also the potential for SO_2 in the gas stream to react on the catalyst forming sulfur trioxide (SO_3) emissions. An EPA RBLC search for lime kilns indicates that no selective catalytic reduction systems have been installed to control NO_x emissions. In addition, Prevention of Significant Deterioration (PSD) permitting decisions have determined that selective catalytic reduction is technically infeasible for a lime kiln[1]. For these reasons, LNA Grantsville considers the installation of a selective catalytic reduction system for NO_x controls to be technically infeasible.

---

[1] PSD Review of Weyerhauser - Flint River Operations Located in Macon County, Georgia. Preliminary Determination, State of Georgia DNR. March 2003. Project Summary for an Application for a Construction Permit/PSD Approval from Mississippi Lime Company for a Lime Manufacturing Plant in Prairie Du Rocher, Illinois. Illinois EPA. 2010.

3.3.1.3 Ranking of Remaining Control Technologies

The ranking of the remaining control practices/technologies from top to bottom, taking into account control effectiveness, economic impacts, environmental impacts, and energy impacts, is presented in Table 3.7. The economic impact presented in Table 3.7 for selective non-catalytic reduction is based on the average cost effectiveness value from EPA's CoST System. However, as previously mentioned, the costs of implementing the NO_X control practices/technologies on a Rotary Kiln System are significantly greater than the average values presented in the EPA CoST System based on experience at various LNA facilities. For example, the site-specific economic impact of implementing selective non-catalytic reduction was determined in LNA Grantsville's previous RACT Analysis dated August 2013 to be $163,324/year. Site-specific economic impacts for low NO_X burner systems and selective catalytic reduction (although determined to be infeasible for the LNA Grantsville facility) are also expected to be significantly greater than the average values in EPA's CoST System.

3.3.1.4 Evaluation of Most Effective Controls

The top remaining control technology is selective non-catalytic reduction. Because LNA Grantsville proposes to choose selective non-catalytic reduction as BACT, further evaluation of the final control is not necessary.

3.3.1.5 Selection of BACT

LNA Grantsville proposes BACT to be selective non-catalytic reduction.

3.3.2 Proposed Emission Limits and Monitoring Requirements

3.3.2.1 Emission Limits

NO_X emissions from the Rotary Kiln System is currently limited to 75.00 pounds per hour (lb/hour) and 650.00 parts per million (ppm) per Condition II.B.3.c of Title V Operating Permit #4500005003. As presented in Table 3.6, LNA Grantsville estimates the NO_X control efficiency for selective non-catalytic reduction to be between 25-50% based on data obtained from a urea injection system operated at another LNA facility and EPA's CoST system. The lower end of the control range would be expected for the LNA Grantsville Rotary Kiln System due to the variety of fuels combusted.

Consequently, using the current NO_X emission limit of 75.00 lb/hour and a control efficiency of 25%, LNA Grantsville proposes a BACT limit of 56.25 lb/hour. Using a maximum kiln capacity of 16.5 ton/hr, the proposed BACT limit converts to 3.41 lb/ton, which is similar to other recently established BACT limits on EPA's RBLC.

3.3.2.2 Monitoring Requirements

LNA Grantsville proposes monitoring to consist of performance testing requirements. An initial performance test is recommended no later than January 1, 2019 (if startup occurs on or before January 1, 2019) or within 180 days of source startup (if startup occurs after January 1, 2019).

Subsequent performance tests are recommended every three years following the initial performance test, which is based on current Condition II.B.3.c.1.(a) of Title V Operating Permit #4500005003.

Test Method 7E from 40 CFR 60, Appendix A (or other EPA approved testing methods acceptable to UDAQ) are recommended for use during performance testing.

3.3.3 Consideration of Startup and Shutdown Operations

Selective non-catalytic reduction technology is based on a gas-phase homogeneous reaction between NO_x in the exhaust gas and either injected ammonia or urea. The reaction must occur within a specified temperature range in order to properly convert the NO_x gases into gaseous nitrogen and water vapor. The approximate temperature range where selective non-catalytic reduction is effective is 1,600 - 2,100 degrees Fahrenheit, with ammonia injection being more effective at the lower portion of this range and urea injection being more effective in the upper portion of this range.

Operation at lower temperatures results in unreacted ammonia slip, and at higher temperatures, NO_x emissions can actually be increased. The limited temperature range in which selective non-catalytic reduction is effective prohibits its use during startup until the flue gas temperatures reaches the appropriate range in which it becomes effective. Shutdown procedures include either a controlled reduction or a cessation of fuel combustion which reduces or ceases NO_x generation due to fuel combustion. Shutdown also reduces the temperature at which selective non-catalytic reduction is effective.

Consequently, startup/shutdown provisions for selective non-catalytic reduction technology is proposed to correspond to:

- No ammonia or urea injection during startup until the combustion gases exiting the kiln reach the temperature when NO_x reduction is effective; and
- No ammonia or urea injection during shutdown.

Recordkeeping requirements are proposed to be used to ensure that these provisions are enforceable. Requirements may include keeping records of ammonia or urea injection in an operations log. The operations log would need to include all periods of startup/shutdown and subsequent beginning and ending times of ammonia or urea injection.

3.3.4 Control Technology Implementation Schedule

As discussed in Section 1.2.4, the LNA Grantsville facility is currently in temporary care and maintenance mode. Resumption of operations of the LNA Grantsville facility depends upon market conditions such that a certain restart date cannot be estimated at this time. Taking into consideration solicitation and selection of an engineering firm to design the selective non-catalytic reduction system, the design process, and the construction of the selective non-catalytic reduction system, the following implementation schedule is suggested:

- If startup occurs on or before January 1, 2019, BACT requirements will become effective on January 1, 2019; or
- If startup occurs after January 1, 2019, BACT requirements will become effective upon startup.

Table 3.6 NO_x Control Technologies for the Rotary Kiln System

Control Practice/Technology	Control Efficiency		Average Cost Effectiveness	
	Percent Controlled	Reference	\$/Ton NO_x Reduced	Reference
Low NO_x Burner Systems	30%	EPA CoST System	896.77	EPA CoST System [a]
Selective Catalytic Reduction	90%	EPA CoST System	2,829.98	EPA CoST System [a]
Selective Non-Catalytic Reduction	25-50%	EPA CoST System and Data from a Different LNA Facility	1,233.06 [b]	EPA CoST System [a]
Good Combustion Practices and Burner/Process Optimization (current control practice used at LNA Grantsville)	0%	Assumed	No Additional Costs	Assumed

[a] Average cost effectiveness is for Reference Year 2013.

[b] The cost effectiveness value presented in the EPA CoST system is an average value. A site-specific cost effectiveness value for selective non-catalytic reduction is discussed in Section 3.1.3 of LNA Grantsville's previous RACT Analysis dated August 2013. Selective non-catalytic reduction was determined to have a site-specific cost effectiveness value of \$3,977/ton of NO_x reduced. Site-specific cost effectiveness values for low NO_x burner systems and selective catalytic reduction (although determined to be infeasible for the LNA Grantsville facility) are also expected to be similarly greater than the average values in EPA's CoST System.

Table 3.7 Ranking of Remaining NO_x Control Efficiencies

Control Practice/Technology	Control Efficiency	Expected Controlled NO_x Emission Rate (tons/year) [a]	Expected NO_x Emission Reduction (tons/year) [b]	Economic Impacts ($/year) [c]	Environmental Impacts	Energy Impacts
Selective Non-Catalytic Reduction	25-50%	205.31	123.19	151,897.58 [d]	Not Applicable (top option is chosen)	Not Applicable (top option is chosen)
Good Combustion Practices and Burner/Process Optimization (current control practice used at LNA Grantsville)	0%	328.50	0	No Additional Costs		

[a] Calculated using the uncontrolled potential NO_x emission rate in Table 3.1 and the expected control efficiencies. When there is a range of control efficiencies, emissions are calculated using the median of the control efficiencies.

[b] Calculated by subtracting the expected controlled NO_x emission rates from the uncontrolled potential NO_x emission rate in Table 3.1.

[c] Calculated by multiplying the average cost effectiveness presented in Table 3.6 by the amount of NO_x reduced per year.

[d] The economic impact is based on a cost effectiveness value presented in the EPA CoST system, which is an average value. A site-specific economic impact for selective non-catalytic reduction is discussed in Section 3.1.3 of LNA Grantsville's previous RACT Analysis dated August 2013. Selective non-catalytic reduction was determined to have a site-specific economic impact of $163,324/year. Site-specific economic impacts for low NO_x burner systems and selective catalytic reduction (although determined to be infeasible for the LNA Grantsville facility) are also expected to be similarly greater than the average values in EPA's CoST System.

3.4 VOC

3.4.1 Top-Down Approach

3.4.1.1 Identification of All Available Control Technologies

The practices/technologies available to control VOC from the Rotary Kiln System are presented in Table 3.8. A search of EPA's RBLC and other references indicate no add-on controls are available.

3.4.1.2 Elimination of Technically Infeasible Control Options

All the control practices/technologies identified in Table 3.8 are technically feasible.

3.4.1.3 Ranking of Remaining Control Technologies

The ranking of the control practices/technologies from top to bottom, taking into account control effectiveness, economic impacts, environmental impacts, and energy impacts, is presented in Table 3.9.

3.4.1.4 Evaluation of Most Effective Controls

The top (and only) control practice/technology is good combustion practices and burner/process optimization. Because LNA Grantsville proposes to choose this option as BACT, further evaluation is not necessary.

3.4.1.5 Selection of BACT

LNA Grantsville proposes BACT to be good combustion practices and burner/process optimization.

3.4.2 Proposed Emission Limits and Monitoring Requirements

3.4.2.1 Emission Limits

Because the proposed BACT of good combustion practices and burner/process optimization is currently used at the LNA Grantsville facility, emission limits are not necessary. Instead, emissions will be controlled by Condition II.B.3.d of Title V Operating Permit #4500005003, which limits the production of quicklime in the Rotary Kiln System to 12.5 tons per hour (tons/hour) (annual average) and 100,000 tons/year (rolling 12-month total).

3.4.2.2 Monitoring Requirements

Monitoring requirements for the production of quicklime are already established in Condition II.B.3.d.1 of Title V Operating Permit #4500005003. No other monitoring requirements are necessary.

3.4.3 Consideration of Startup and Shutdown Operations

No unique startup and shutdown provisions are necessary for use of good combustion practices and burner/process optimization.

3.4.4 Control Technology Implementation Schedule

Continued use of good combustion practices and burner/process optimization can begin immediately upon start-up of the LNA Grantsville facility.

Table 3.8 VOC Control Technologies for the Rotary Kiln System

Control Practice/Technology	Control Efficiency		Average Cost Effectiveness	
	Percent Controlled	Reference	$/Ton VOC Reduced	Reference
Good Combustion Practices and Burner/Process Optimization (current control practice used at LNA Grantsville)	0%	Assumed	No Additional Costs	Assumed

Table 3.9 Ranking of Remaining VOC Control Efficiencies

Control Practice/Technology	Control Efficiency	Expected Controlled VOC Emission Rate (tons/year) [a]	Expected VOC Emission Reduction (tons/year) [b]	Economic Impacts ($/year)	Environmental Impacts	Energy Impacts
Good Combustion Practices and Burner/Process Optimization (current control practice used at LNA Grantsville)	0%	3.00	0	No Additional Costs	Not Applicable (top option is chosen)	Not Applicable (top option is chosen)

[a] Calculated using the uncontrolled potential VOC emission rate in Table 3.1 and the expected control efficiency.

[b] Calculated by subtracting the expected controlled VOC emission rate from the uncontrolled potential VOC emission rate in Table 3.1.

3.5 NH_3

3.5.1 Top-Down Approach

3.5.1.1 Identification of All Available Control Technologies

The practices/technologies available to control NH_3 from the Rotary Kiln System are presented in Table 3.10. A search of EPA's RBLC and other references indicate no add-on controls are available.

The control practices/technologies presented in Table 3.10 are reflective of NH_3 emissions resulting from the combustion of fuel (i.e., not the NH_3 emissions that may result from the use of NO_X control technology such as selective catalytic reduction or selective non-catalytic reduction). Control of NH_3 emissions due to the use of selective catalytic reduction or selective non-catalytic reduction would be achieved by temperature control and the cessation of ammonia/urea injection during startup and shutdown.

3.5.1.2 Elimination of Technically Infeasible Control Options

All the control practices/technologies identified in Table 3.10 are technically feasible.

3.5.1.3 Ranking of Remaining Control Technologies

The ranking of the control practices/technologies from top to bottom, taking into account control effectiveness, economic impacts, environmental impacts, and energy impacts, is presented in Table 3.11.

3.5.1.4 Evaluation of Most Effective Controls

The top (and only) control practice/technology is good combustion practices and burner/process optimization. Because LNA Grantsville proposes to choose this option as BACT, further evaluation is not necessary.

3.5.1.5 Selection of BACT

LNA Grantsville proposes BACT to be good combustion practices and burner/process optimization.

3.5.2 Proposed Emission Limits and Monitoring Requirements

3.5.2.1 Emission Limits

Because the proposed BACT of good combustion practices and burner/process optimization is currently used at the LNA Grantsville facility, emission limits are not necessary. Instead, emissions will be controlled by Condition II.B.3.d of Title V Operating Permit #4500005003, which limits the production of quicklime in the Rotary Kiln System to 12.5 tons/hour (annual average) and 100,000 tons/year (rolling 12-month total).

3.5.2.2 Monitoring Requirements

Monitoring requirements for the production of quicklime is already established in Condition II.B.3.d.1 of Title V Operating Permit #4500005003. No other monitoring requirements are necessary.

3.5.3 Consideration of Startup and Shutdown Operations

No unique startup and shutdown provisions are necessary for use of good combustion practices and burner/process optimization.

3.5.4 Control Technology Implementation Schedule

Continued use of good combustion practices and burner/process optimization can begin immediately upon start-up of the LNA Grantsville facility.

Table 3.10 NH_3 Control Technologies for the Rotary Kiln System

Control Practice/Technology	Control Efficiency		Average Cost Effectiveness	
	Percent Controlled	Reference	$/Ton NH_3 Reduced	Reference
Good Combustion Practices and Burner/Process Optimization (current control practice used at LNA Grantsville)	0%	Assumed	No Additional Costs	Assumed

Table 3.11 Ranking of Remaining NH_3 Control Efficiencies

Control Practice/Technology	Control Efficiency	Expected Controlled V Emission Rate (tons/year) [a]	Expected NH_3 Emission Reduction (tons/year) [b]	Economic Impacts ($/year)	Environmental Impacts	Energy Impacts
Good Combustion Practices and Burner/Process Optimization (current control practice used at LNA Grantsville)	0%	1.39	0	No Additional Costs	Not Applicable (top option is chosen)	Not Applicable (top option is chosen)

[a] Calculated using the uncontrolled potential NH_3 emission rate in Table 3.1 and the expected control efficiency.

[b] Calculated by subtracting the expected controlled NH_3 emission rate from the uncontrolled potential NH_3 emission rates in Table 3.1.

4 BACT ANALYSIS FOR THE PRESSURE HYDRATOR

The Pressure Hydrator is used at the LNA Grantsville facility to convert quicklime into hydrated lime (i.e., calcium hydroxide). It currently has a production rate limit of 126,000 tons/year on a rolling 12-month basis (i.e., Condition II.B.4.c of Title V Operating Permit #4500005003). To begin operations, quicklime is mixed with water and pumped as a slurry into the Pressure Hydrator. Within the Pressure Hydrator, the calcium oxide component of the quicklime and water react exothermically to produce calcium hydroxide. The heat that is released converts excess water to steam which in turn raises the pressure within the Pressure Hydrator. As the pressure increases, magnesium oxide reacts with the superheated steam to form magnesium hydroxide.

Once the pressure reaches the operating range, the outlet valve of the Pressure Hydrator opens to allow the hydrated quicklime to blow out into a collector where the hydrated lime is separated from the superheated steam. The steam is vented from the top of the collector into a natural gas fired burner hot baghouse (Baghouse HBY-1HY). The natural gas burner is used on an as-needed-basis to maintain the temperature of the flue gas above the dew point to keep the steam from condensing on the bags. Any dust that is pulled into the baghouse collects on the outside of the bags where it is purged and fed back into the hydrated lime stream. The cleaned steam is pulled from Baghouse HBY-1HY by an induced draft fan and blown up a stack that is vented to the atmosphere.

Particulate emissions from the Pressure Hydrator consist of fuel burning particulate emissions and dust emissions from the hydration process. Baghouse HBY-1HY is estimated to have a control efficiency of 99.25% for $PM_{2.5}$ based on the median value for the range of control efficiencies presented in EPA's CoST System for fabric filter baghouses. The Pressure Hydrator also has the potential to emit SO_2, NO_x, VOC, and NH_3 emissions (among other pollutants) due to the associated natural gas fired, baghouse burner. The potential and actual annual emissions from the Pressure Hydrator as controlled by Baghouse HBY-1HY are presented in Table 4.1.

Table 4.1 Annual Emissions from the Pressure Hydrator (Baghouse HBH-1HY)

Emission Category	Controlled or Uncontrolled	Annual Emissions (tons/year)				
		$PM_{2.5}$	SO_2	NO_X	VOC	NH_3
Potential Emissions	Controlled	1.74	0.02	3.01	0.17	0.10
	Uncontrolled [a]	231.57	0.02	3.01	0.17	0.10
2013 Actual Emissions	Controlled	0	0	0	0	0
	Uncontrolled [a]	0	0	0	0	0
2011 Actual Emissions	Controlled	0	0	0	0	0
	Uncontrolled [a]	0	0	0	0	0
2008 Actual Emissions [b]	Controlled	0.39	0	15.15	0.83	0.48
	Uncontrolled [a]	52.19	0	15.15	0.83	0.48
2005 Actual Emissions [c]	Controlled	0.02	0.0002	0.04	0.002	Not Determined
	Uncontrolled [a]	2.85	0.0002	0.04	0.002	Not Determined

[a] Uncontrolled emissions of $PM_{2.5}$ are back calculated using a control efficiency of 99.25% (median value of the range 99-99.5%). Uncontrolled emissions of the remaining pollutants are assumed equal to controlled emissions because they are controlled only by good combustion practices and inherent sulfur contents (i.e., assumed control efficiency of 0%).

[b] $PM_{2.5}$ emissions were assumed equal to PM_{10} emissions in the submitted 2008 annual emission inventory. For consistency, this table calculates $PM_{2.5}$ emissions assuming they are 30% of the reported PM_{10} emissions in 2008. This is the same $PM_{2.5}$ to PM_{10} ratio used in LNA Grantsville's 2014 renewal application.

[c] $PM_{2.5}$ emissions were not determined in the submitted 2005 annual emission inventory. Consequently, $PM_{2.5}$ emissions have been estimated in this table assuming they are 30% of the reported PM_{10} emissions in 2005. This is the same $PM_{2.5}$ to PM_{10} ratio used in LNA Grantsville's 2014 renewal application.

4.1 $PM_{2.5}$

4.1.1 Top-Down Approach

4.1.1.1 Identification of All Available Control Technologies

The practices/technologies available to control $PM_{2.5}$ from the Pressure Hydrator are presented in Table 4.2.

4.1.1.2 Elimination of Technically Infeasible Control Options

All the control practices/technologies identified in Table 4.2 are technically feasible.

4.1.1.3 Ranking of Remaining Control Technologies

The ranking of the control practices/technologies from top to bottom, taking into account control effectiveness, economic impacts, environmental impacts, and energy impacts, is presented in Table 4.3.

4.1.1.4 Evaluation of Most Effective Controls

The top three control practices/technologies are all types of fabric filter baghouses with identical control efficiencies and similar economic impacts. Because LNA Grantsville proposes to choose a fabric filter baghouse as BACT, further evaluation of the other controls is not necessary.

4.1.1.5 Selection of BACT

LNA Grantsville proposes BACT to be a fabric filter baghouse. A pulse jet type fabric filter baghouse (i.e., Baghouse HBH-1HY) is currently used to control $PM_{2.5}$ emissions from the Pressure Hydrator. Because the different types of fabric filter baghouses have identical control efficiencies, continued operation of Baghouse HBH-1HY meets the proposed BACT.

4.1.2 Proposed Emission Limits and Monitoring Requirements

4.1.2.1 Emission Limits

Because the proposed BACT is the practice/technology currently used at the LNA Grantsville facility, it is not necessary to establish a new limitation. Additionally, PM_{10} emissions are currently limited to 1.32 pounds per hour (lb/hour) and 0.060 grains per dry standard cubic foot (gr/dscf) by Condition II.B.4.b of Title V Operating Permit #4500005003. Because $PM_{2.5}$ is a subset of PM_{10}, the existing limit in Condition II.B.4.b of Title V Operating Permit #4500005003 is sufficient to enforce the proposed BACT.

4.1.2.2 Monitoring Requirements

Monitoring requirements for the PM_{10} emission limit are already established in Condition II.B.4.b.1 of Title V Operating Permit #4500005003 and consist of performance testing every three years. No other monitoring requirements are necessary.

4.1.3 Consideration of Startup and Shutdown Operations

Emissions from the Pressure Hydrator will be exhausted through the fabric filter baghouse (i.e., Baghouse HBH-1HY) during startup and shutdown. Consequently, no unique startup and shutdown provisions are necessary for Baghouse HBH-1HY.

4.1.4 Control Technology Implementation Schedule

Continued use of Baghouse HBH-1HY can begin immediately upon start-up of the LNA Grantsville facility.

Table 4.2 $PM_{2.5}$ Control Technologies for the Pressure Hydrator

Control Practice/Technology	Control Efficiency [a]		Average Cost Effectiveness	
	Percent Controlled	Reference	\$/Ton $PM_{2.5}$ Reduced	Reference
Fabric Filter - Pulse Jet Type (current control technology used at LNA Grantsville)	99-99.5%	EPA CoST System	272.55	EPA CoST System [b]
Fabric Filter - Mechanical Shaker Type	99-99.5%	EPA CoST System	294.24	EPA CoST System [b]
Fabric Filter - Reverse Air Cleaned Type	99-99.5%	EPA CoST System	345.77	EPA CoST System [b]
Paper/Nonwoven Filters - Cartridge Collector Type	99%	EPA CoST System	330.85	EPA CoST System [b]
Wet Electrostatic Precipitator - Wire Plate Type	95-99.5%	EPA CoST System	565.00	EPA CoST System [b]
Dry Electrostatic Precipitator - Wire Plate Type	95%	EPA CoST System	279.66	EPA CoST System [b]
Best Combustion/ Management Practices	0%	Assumed	No Additional Costs	Assumed

[a] Control efficiencies are for filterable emissions only.

[b] Average cost effectiveness is for Reference Year 2013.

Table 4.3 Ranking of Remaining $PM_{2.5}$ Control Efficiencies

Control Practice/Technology	Control Efficiency [a]	Expected Controlled $PM_{2.5}$ Emission Rate (tons/year) [b]	Expected $PM_{2.5}$ Emission Reduction (tons/year) [c]	Economic Impacts ($/year) [d]	Environmental Impacts	Energy Impacts
Fabric Filter - Pulse Jet Type (current control technology used at LNA Grantsville)	99-99.5%	1.74	229.83	62,640.67	Not Applicable (top option is chosen)	Not Applicable (top option is chosen)
Fabric Filter - Mechanical Shaker Type	99-99.5%	1.74	229.83	67,625.72		
Fabric Filter - Reverse Air Cleaned Type	99-99.5%	1.74	229.83	79,468.95		
Paper/Nonwoven Filters - Cartridge Collector Type	99%	2.32	229.25	75,848.33		
Wet Electrostatic Precipitator - Wire Plate Type	95-99.5%	6.37	225.20	127,238.26		
Dry Electrostatic Precipitator - Wire Plate Type	95%	11.58	219.99	61,522.45		
Best Combustion/ Management Practices	0%	231.57	0	No Additional Costs		

[a] Control efficiencies are for filterable emissions only.

[b] Calculated using the uncontrolled potential $PM_{2.5}$ emission rate in Table 4.1 and the expected control efficiencies. When there is a range of control efficiencies, emissions are calculated using the median of the control efficiencies. The uncontrolled potential $PM_{2.5}$ emission rate in Table 4.1 includes only filterable emissions.

[c] Calculated by subtracting the expected controlled $PM_{2.5}$ emission rates from the uncontrolled potential $PM_{2.5}$ emission rate in Table 4.1.

[d] Calculated by multiplying the average cost effectiveness presented in Table 4.2 by the amount of $PM_{2.5}$ reduced per year.

4.2 SO_2, NO_X, VOC, AND NH_3

As demonstrated in Section 1.1 and Table 4.1, SO_2, NO_X, VOC, and NH_3 emissions from the Pressure Hydrator represent a very small portion of the total gaseous emissions from the LNA Grantsville facility. Consequently, additional analyses will not be performed for these pollutants. NO_X, VOC, and NH_3 emissions will continue to be primarily controlled by good combustion practices to maintain a proper air to fuel ratio. SO_2 emissions are dependent on the sulfur content of the fuel. Pipeline quality natural gas will continue to be used in the baghouse burner, as it has a very low sulfur content due to sulfur limitations set forth in tariffs to maintain pipeline integrity.

Additionally, SO_2, NO_X, VOC, and NH_3 emissions will be naturally limited by: (a) the baghouse burner only being used when necessary to maintain the temperature of the flue gas above the dew point; and (b) Condition II.B.4.c of Title V Operating Permit #4500005003, which limits the production of hydrate in the Pressure Hydrator to 126,000 tons/year (rolling 12-month total).

5 BACT ANALYSIS FOR BAGHOUSE DC-3HB

Baghouse DC-3HB controls a variety of emission points within LNA Grantsville's Hydrate System, including screw conveyors, bucket elevators, separators, and a bagger. The particulate emissions controlled by Baghouse DC-3HB are generated from the material transfer and size classification of hydrated lime. Baghouse DC-3HB is estimated to have a control efficiency of 99.25% for $PM_{2.5}$ based on the median value for the range of control efficiencies presented in EPA's CoST System for fabric filter baghouses. The potential and actual annual emissions from Baghouse DC-3HB are presented in Table 5.1.

Table 5.1 Annual Emissions from Baghouse DC-3HB

Emission Category	Controlled or Uncontrolled	Annual Emissions (tons/year)				
		$PM_{2.5}$	SO_2	NO_X	VOC	NH_3
Potential Emissions	Controlled	1.10	--	--	--	--
	Uncontrolled [a]	146.38	--	--	--	--
2013 Actual Emissions	Controlled	0	--	--	--	--
	Uncontrolled [a]	0	--	--	--	--
2011 Actual Emissions	Controlled	0	--	--	--	--
	Uncontrolled [a]	0	--	--	--	--
2008 Actual Emissions	Controlled	0.33	--	--	--	--
	Uncontrolled [a]	43.61	--	--	--	--
2005 Actual Emissions [b]	Controlled	0.04	--	--	--	--
	Uncontrolled [a]	5.45	--	--	--	--

[a] Uncontrolled emissions of $PM_{2.5}$ are back calculated using a control efficiency of 99.25% (median value of the range 99-99.5%).

[b] $PM_{2.5}$ emissions were not determined in the submitted 2005 annual emission inventory. Consequently, $PM_{2.5}$ emissions have been estimated in this table assuming they are 30% of the reported PM_{10} emissions in 2005. This is the same $PM_{2.5}$ to PM_{10} ratio used in LNA Grantsville's 2014 renewal application.

5.1 $PM_{2.5}$

5.1.1 Top-Down Approach

5.1.1.1 Identification of All Available Control Technologies

The practices/technologies available to control $PM_{2.5}$ from the emission points within LNA Grantsville's Hydrate System are presented in Table 5.2.

5.1.1.2 Elimination of Technically Infeasible Control Options

All the control practices/technologies identified in Table 5.2 are technically feasible.

5.1.1.3 Ranking of Remaining Control Technologies

The ranking of the control practices/technologies from top to bottom, taking into account control effectiveness, economic impacts, environmental impacts, and energy impacts, is presented in Table 5.3.

5.1.1.4 Evaluation of Most Effective Controls

The top three control practices/technologies are all types of fabric filter baghouses with identical control efficiencies and similar economic impacts. Because LNA Grantsville proposes to choose a fabric filter baghouse as BACT, further evaluation of the other controls is not necessary.

5.1.1.5 Selection of BACT

LNA Grantsville proposes BACT to be a fabric filter baghouse. A pulse jet type fabric filter baghouse (i.e., Baghouse DC-3HB) is currently used to control $PM_{2.5}$ emissions from the emission points within LNA Grantsville's Hydrate System. Because the different types of fabric filter baghouses have identical control efficiencies, continued operation of Baghouse DC-3HB meets the proposed BACT.

5.1.2 Proposed Emission Limits and Monitoring Requirements

5.1.2.1 Emission Limits

Because the proposed BACT is the practice/technology currently used at the LNA Grantsville facility, it is not necessary to establish a new limitation. Additionally, opacity from Baghouse DC-3HB is currently limited by Title V Operating Permit #4500005003. Because opacity is a surrogate for $PM_{2.5}$, the existing opacity limitation in Title V Operating Permit #4500005003 is sufficient to enforce the proposed BACT.

5.1.2.2 Monitoring Requirements

Monitoring requirements for the opacity limitation are already established in Title V Operating Permit #4500005003 and consist of visual observations every month. No other monitoring requirements are necessary.

5.1.3 Consideration of Startup and Shutdown Operations

Emission points within LNA Grantsville's Hydrate System will be exhausted through the fabric filter baghouse (i.e., Baghouse DC-3HB) during startup and shutdown. Consequently, no unique startup and shutdown provisions are necessary for Baghouse DC-3HB.

5.1.4 Control Technology Implementation Schedule

Continued use of Baghouse DC-3HB can begin immediately upon start-up of the LNA Grantsville facility.

Table 5.2 $PM_{2.5}$ Control Technologies for Baghouse DC-3HB

Control Practice/Technology	Control Efficiency [a]		Average Cost Effectiveness	
	Percent Controlled	Reference	$/Ton $PM_{2.5}$ Reduced	Reference
Fabric Filter - Pulse Jet Type (current control technology used at LNA Grantsville)	99-99.5%	EPA CoST System	272.55	EPA CoST System [b]
Fabric Filter - Mechanical Shaker Type	99-99.5%	EPA CoST System	294.24	EPA CoST System [b]
Fabric Filter - Reverse Air Cleaned Type	99-99.5%	EPA CoST System	345.77	EPA CoST System [b]
Paper/Nonwoven Filters - Cartridge Collector Type	99%	EPA CoST System	330.85	EPA CoST System [b]
Wet Electrostatic Precipitator - Wire Plate Type	95-99.5%	EPA CoST System	565.00	EPA CoST System [b]
Dry Electrostatic Precipitator - Wire Plate Type	95%	EPA CoST System	279.66	EPA CoST System [b]
Best Combustion/ Management Practices	0%	Assumed	No Additional Costs	Assumed

[a] Control efficiencies are for filterable emissions only.

[b] Average cost effectiveness is for Reference Year 2013.

Table 5.3 Ranking of Remaining $PM_{2.5}$ Control Efficiencies

Control Practice/Technology	Control Efficiency [a]	Expected Controlled $PM_{2.5}$ Emission Rate (tons/year) [b]	Expected $PM_{2.5}$ Emission Reduction (tons/year) [c]	Economic Impacts ($/year) [d]	Environmental Impacts	Energy Impacts
Fabric Filter - Pulse Jet Type (current control technology used at LNA Grantsville)	99-99.5%	1.10	145.28	39,596.03	Not Applicable (top option is chosen)	Not Applicable (top option is chosen)
Fabric Filter - Mechanical Shaker Type	99-99.5%	1.10	145.28	42,747.15		
Fabric Filter - Reverse Air Cleaned Type	99-99.5%	1.10	145.28	50,233.43		
Paper/Nonwoven Filters - Cartridge Collector Type	99%	1.46	144.91	47,944.78		
Wet Electrostatic Precipitator - Wire Plate Type	95-99.5%	4.03	142.35	80,429.07		
Dry Electrostatic Precipitator - Wire Plate Type	95%	7.32	139.06	38,889.19		
Best Combustion/ Management Practices	0%	146.38	0	No Additional Costs		

[a] Control efficiencies are for filterable emissions only.

[b] Calculated using the uncontrolled potential $PM_{2.5}$ emission rate in Table 5.1 and the expected control efficiencies. When there is a range of control efficiencies, emissions are calculated using the median of the control efficiencies. The uncontrolled potential $PM_{2.5}$ emission rate in Table 5.1 includes only filterable emissions.

[c] Calculated by subtracting the expected controlled $PM_{2.5}$ emission rates from the uncontrolled potential $PM_{2.5}$ emission rates in Table 5.1.

[d] Calculated by multiplying the average cost effectiveness presented in Table 5.2 by the amount of $PM_{2.5}$ reduced per year.

5.2 SO_2, NO_X, VOC, AND NH_3

Baghouse DC-3HB does not have the potential to emit SO_2, NO_X, VOC, or NH_3. Consequently, a BACT analysis for these pollutants is not required.

5.3 EXTENSION TO REMAINING BAGHOUSES

As described in Section 2, only one BACT Analysis is needed for the baghouses controlling non-hydrator emission points at the LNA Grantsville facility. It is assumed that the BACT Analysis for Baghouse DC-3HB (i.e., the largest baghouse in terms of exhaust air flow rate) will also represent the BACT Analysis for the smaller baghouses (i.e., Baghouses DC-1QS, DC-2QP, DC-4LO, DC-5LO, DC-6KD, DC-8KD, and DC-10FF).

This is confirmed by reviewing the practices/technologies available to control $PM_{2.5}$ from the emission points within LNA Grantsville's Front Lime Handling System, Back Lime Handling System, Hydrate System, Bagging System, and Dust Handling System. The most effective practices/technologies are fabric filter baghouses. This is the same result produced during the full BACT Analysis for Baghouse DC-3HB presented in Section 5.1.

Consequently, the BACT Analysis for Baghouse DC-3HB, as presented in Section 5.1, also applies to Baghouses DC-1QS, DC-2QP, DC-4LO, DC-5LO, DC-6KD, DC-8KD, and DC-10FF. The continued operation of these baghouses meets the proposed BACT.

6 BACT ANALYSIS FOR THE KILN SHAFT MOTOR

The Kiln Shaft Motor is gasoline fired and rated at 100 horsepower. It is an auxiliary unit used for backup powering of the Rotary Kiln System during outages. It does not typically run for more than 100 hours per year. The Kiln Shaft Motor has the potential to emit $PM_{2.5}$, SO_2, NO_x, and VOC emissions (among other pollutants). The potential emissions from the Kiln Shaft Motor are presented in Table 6.1 using a worst case estimate of 500 hours of operation per year. Emissions from the Kiln Shaft Motor have not been included in recent annual emission inventories.

As demonstrated in Section 1.1 and Table 6.1, $PM_{2.5}$, SO_2, NO_x, and VOC emissions from the Kiln Shaft Motor represent a very small portion of the total emissions from the LNA Grantsville facility. Because of the low emission rates, limited operation, and lack of add-on controls for an engine of this size that could be retrofitted to the unit, additional analyses will not be performed.

$PM_{2.5}$, NO_x, and VOC emissions will continue to be primarily controlled by good combustion practices to maintain a proper air to fuel ratio. SO_2 emissions are dependent on the sulfur content of the fuel. Gasoline will continue to be used in the Kiln Shaft Motor and it has a very low sulfur content.

Table 6.1 Annual Emissions from the Kiln Shaft Motor

Emission Category	Controlled or Uncontrolled	Annual Emissions (tons/year)				
		$PM_{2.5}$	SO_2	NO_x	VOC	NH_3
Potential Emissions	Controlled	0.02	0.01	0.29	0.53	--
	Uncontrolled [a]	0.02	0.01	0.29	0.53	--

[a] Uncontrolled emissions are assumed equal to controlled emissions because the Kiln Shaft Motor utilizes only good combustion practices and inherent sulfur contents to control emissions (i.e., assumed control efficiency of 0%).

APPENDIX A SITE-SPECIFIC COST EFFECTIVENESS AND ECONOMIC IMPACT CALCULATIONS FOR DRY SORBENT INJECTION

Parameter Number	Cost Parameter	Unit	Analysis for Sorbent Type A	Analysis for Sorbent Type B	Reference
Capital Costs					
1	Equipment Costs (EC)	$	1,022,500.00	1,022,500.00	Noltech Quote - May 22, 2013
2	Instrumentation	$	102,250.00	102,250.00	10% of EC - EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.3
3	Sales Taxes	$	30,675.00	30,675.00	3% of EC - EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.3
4	Freight	$	51,125.00	51,125.00	5% of EC - EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.3
5	**Purchased Equipment Cost (PEC)**	**$**	**1,206,550.00**	**1,206,550.00**	**1 + 2 + 3 + 4**
6	Foundation and Supports	$	144,786.00	144,786.00	12% of PEC - EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.3
7	Handling and Erection	$	482,620.00	482,620.00	40% of PEC - EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.3
8	Electrical	$	--	--	Included in EC
9	Piping	$	361,965.00	361,965.00	30% of PEC - EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.3

Parameter Number	Cost Parameter	Unit	Analysis for Sorbent Type A	Analysis for Sorbent Type B	Reference
10	Insulation for Ductwork	$	12,065.50	12,065.50	1% of PEC - EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.3
11	Painting	$	--	--	Included in EC
12	**Direct Installation Costs**	**$**	**1,001,436.50**	**1,001,436.50**	**6 + 7 + 8 + 9 + 10 + 11**
13	Engineering	$	--	--	Included in EC
14	Construction and Field Expenses	$	120,655.00	120,655.00	10% of PEC - EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.3
15	Contractor Fees	$	120,655.00	120,655.00	10% of PEC - EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.3
16	Performance Test	$	12,065.50	12,065.50	1% of PEC - EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.3
17	Contingencies	$	36,196.50	36,196.50	3% of PEC - EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.3
18	**Indirect Installation Costs**	**$**	**289,572.00**	**289,572.00**	**13 + 14 + 15 + 16 + 17**
19	**Total Capital Investment (TCI)**	**$**	**2,497,558.50**	**2,497,558.50**	**5 + 12 + 18**

Parameter Number	Cost Parameter	Unit	Analysis for Sorbent Type A	Analysis for Sorbent Type B	Reference
20	Capital Recovery Factor (CRF)	--	0.09	0.09	CRF = [i x (1 + i)^a]/[(1 + i)^a - 1], where i = interest rate (7%), a = equipment life (20 years)
Annual Costs					
21	Tons of Sorbent Needed Per Ton of SO_2 Reduced	tons/ton	9	6.5	Based on testing conducted in June 2013 at LNA's Nelson Facility (9 tons/ton), Based on email from Dustex to Gideon Siringi of LNA dated 04.03.13: "We usually assume 5 pounds per pound of SO_2...", plus a 30% safety factor (6.5 tons/ton)
22	Sorbent Cost	$/ton	250	600	Estimated Price Point
23	Sorbent Transportation Cost	$/ton	260	139	Estimated Trucking Costs
24	Annual Sorbent Cost	$/year	28,427.34	29,749.61	21 * 37 * (22 + 23)
25	Annual Cost for Increased Bag Replacement (3 years vs 5 years)	$/year	60,000	60,000	LNA Estimate of $450,000/Kiln for Bags, Cages, and Labor Over a 20 Year Life
26	General O&M Labor	$/year	8,462.50	8,462.50	LNA Estimate of 0.5 hours/day for Operation and 3 hours/week for Maintenance at $25/hour

Parameter Number	Cost Parameter	Unit	Analysis for Sorbent Type A	Analysis for Sorbent Type B	Reference
27	General O&M Materials	$/year	12,693.75	12,693.75	LNA Estimate of 1.5 times Operating Labor Costs
28	Annual Power Cost	$/year	35,215.20	35,215.20	586,920 kWh/year Based on NolTech Quotation (90 hp blowers = 67 kW) at $0.06/kWh
29	**Total Direct Annual Costs**	**$/year**	**144,798.79**	**146,121.06**	**24 + 25 + 26 + 27 + 28**
30	Overhead	$/year	12,693.75	12,693.75	60% of Labor and Material Costs - EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4
31	Administrative Charges	$/year	49,951.17	49,951.17	2% of TCI - EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4
32	Property Tax	$/year	24,975.59	24,975.59	1% of TCI - EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4
33	Insurance	$/year	24,975.59	24,975.59	1% of TCI - EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4
34	Capital Recovery	$/year	235,751.85	235,751.85	TCI * CRF - EPA Air Pollution Control Cost Manual, Section 5.2, Chapter 1, Table 1.4
35	**Total Indirect Annual Costs**	**$/year**	**348,347.94**	**348,347.94**	**30 + 31 + 32 + 33 + 34**
36	**Total Annual Costs**	**$/year**	**493,146.73**	**494,469.01**	**29 + 35**

Parameter Number	Cost Parameter	Unit	Analysis for Sorbent Type A	Analysis for Sorbent Type B	Reference
37	Tons of SO_2 Reduced	tons/year	6.19	6.19	Table 3.5
38	**Control Cost in Dollars per Ton of SO_2 Reduced**	**$/ton**	**79,625.59**	**79,839.09**	**36 / 37**