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May 16, 1995

Mr. A. A. Linero, P.E.
Administrator
New Source Review Section
FDEP-DARM-BAR

SUBJECT: K&A 187-94-02
Florida Rock Industries, Inc.
Newberry Cement Plant
Permits Nos. AC01-267311 and PSD-FL-228
Response to Request for Additional Information, dated 14-APR-1995

Dear Mr. Linero:

Enclosed please find the requested information for the referenced project. The format of this response is as follows:

1. All questions have been reproduced, preserving original numbering.
2. Responses follow each question.
3. Tables and Attachments are numbered with respect to their corresponding questions; i.e. Table 9-1 is in support of the response to question 9.

Please be aware that the heights of two stacks have changed:

K15, Clinker Cooler ESP: increased from 35 meters to 60 meters
S17, Coal Mill Baghouse: increased from 15 meters to 50 meters

If further information is required, please do not hesitate to call me or Steve Cullen (Project Engineer) at (904) 377-5822.

Sincerely,

John B. Koogler, Ph.D., P.E.
Koogler & Associates

copy to: Fred Cohrs, FRI

ENCLOSURE: (3) 3.5" computer diskettes

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
Florida Rock Industries, Inc. - Newberry Cement Plant
Permits Nos. AC01-267311 and PSD-FL-228

TABLE OF CONTENTS

EMISSION DATA

1. Supply detailed calculations of emissions of criteria and noncriteria pollutants from the burning of the different proposed fuels at this facility. These should be in the same detail as already provided for particulate emissions. Include calculations for each combustion emission unit.

RESPONSE: There are two emissions units (EU 2 &3) that involve combustion of fuels. The air heater detailed in Emission Unit 2 (Raw Mill System) will burn only No. 2 fuel oil. The emissions calculations for the air heater burning No. 2 fuel oil were submitted with the application. The burners associated with Emission Unit 3 (Kiln System) will burn coal, or coal with tires. The burning of tires will be limited to 30% of the kiln's total heat input. The emissions calculations for the kiln burning only coal were submitted with the application.

The emissions from burning coal and tires are assumed to be equal or less than the emissions from burning only coal. Detailed emissions estimates for the combustion of whole tires in cement kilns is not available. However, various references have shown that the emissions of criteria and noncriteria pollutants from cement kilns burning tires or tire-derived fuel (TDF) are not significantly different from emissions from kilns burning only their primary fuel. Portions of these references are presented below.

Reference 1: *Burning Tires for Fuel and Tire Pyrolysis: Air Implications*
USEPA, Document EPA-450/3-91-024, December 1991.

> (Page 4-36) The long residence time and high operating temperatures of cement kilns provide an ideal environment to burn tires as supplemental fuel. Results of several tests conducted on cement kilns while burning tires or TDF indicate the emissions are not adversely affected, but in many cases improve when burning tires.

Reference 2: *Scrap Tire Use/Disposal Study*
A.T. Kearney, Scrap Tire Management Council, September 1990.

> (Page 2) Either whole tires or tire-derived fuel (TDF) can be used as supplemental fuel in cement kilns, depending on kiln size and technology. The technology is proven...Based on testing results, burning scrap tires or TDF in kilns does not adversely affect environmental performance or product quality.

Reference 3: *Air Emissions Associated With The Combustion of Scrap Tires*
Malcolm Pirnie, Inc., May 1991.

> (Page 4-4) Advantages to combusting waste tires as supplemental fuel in cement kilns are as follows:
>
> 1. Nitrogen and sulfur emissions and ash quantities are lower than typical coal values;

2. The steel content provides supplemental iron for the cement; and

3. The ash is incorporated into the product (cement) and thus, is totally consumed.

(Page 6-1) According to Kearney (1990), combustion of scrap tires in cement kilns reduces NOx by approximately 10 percent. In general, the nitrogen (N) content is much lower than in coal (TDF = 0.24 percent N versus coal = 1.76 percent N). SO2 and CO emissions on the average do not show significant changes.

2. Per the 1990 Clean Air Act Amendment (CAAA), EPA is to issue a Maximum Achievable Control Technology (MACT) standard by November 15, 1997, applicable to cement plants. Per Title III (Air Toxics) of the CAAA's 189 Hazardous Air Pollutants (HAPS) are now regulated air pollutants. Please provide the emission rates and ambient maximum 8 hour, 24 hour and average annual concentrations for HAPs emitted from cement manufacturing.

RESPONSE: The emissions of HAPs from cement manufacturing were evaluated using AP-42, Fifth Edition, Table 11.6-9, *Summary of Noncriteria Pollutant Emission Factors for Portland Cement Kilns.* This evaluation identified four (4) HAPs which will be potentially emitted in reportable quantities: Beryllium, lead, hydrogen chloride, and benzene. The potential emissions of these HAPs were described in the application and PSD report. The emission rates and ambient maximum 1 hour, 8 hour, 24 hour and average annual concentrations for these HAPs are:

HAPs	Emission Rate		Ambient Concentration, υg/m^3			
	lb/hr	tpy	1-Hour	8-Hour	24-Hour	Annual
Beryllium, H021	0.0001	0.0002	9.48E-05	6.64E-05	3.79E-05	7.58E-06
Lead, H110	0.07	0.3	2.84E-02	0.019908	0.011376	0.002275
Hydrogen Chloride, H106	4.7	17.5	1.871	1.3097	0.7484	0.14968
Benzene, H017	0.3	1.1	0.1195	0.08365	0.0478	0.00956

3. On February 7, 1995, EPA issued a regulatory determination on Cement Kiln Dust (CKD) which was required by RCRA Subtitle C. Accordingly, EPA will develop CKD regulations. Although the present status of CKD will be maintained until such rules are written, we encourage the applicant to develop a multipathway health risk assessment to address the potential for indirect health and environmental effects from the kiln's emissions. EPA's Region VII Office (Kansas City, KA) is developing a generic workplan for cement kilns burning hazardous waste in their region. The workplan uses a tiering approach to expedite the process. It is suggested that the applicant review the draft document (a copy is available from this office, if requested) developed by the EPA Region VII Office as a possible mechanism for developing a less time and resource intensive protocol for completing a risk assessment.

RESPONSE: The cement plant will not generate cement kiln dust (CKD) as a waste product. All generated and captured dust will be returned to the production process to supplement the raw materials. Therefore, the tailored RCRA standards will likely not apply to this plant. As the risk assessment is specifically a tool for RCRA activities, it is not appropriate for this plant at this time.

The referenced workplan was obtained from the FDEP and reviewed for applicability. The workplan presents a second-tier multipathway risk assessment for cement plants burning hazardous waste. The cement plant did not include the combustion of hazardous wastes as an operating scenario in the Application to Construct, therefore the use of the referenced workplan is not appropriate for this plant at this time.

4. What additional assurance can you provide the Department that the emissions of the various pollutants emitted at this facility are not a threat to human health and welfare (such as by the fuels burned, etc.).

RESPONSE: Ambient air impact modeling was performed for all pollutants potentially emitted in reportable quantities. Ambient air quality standards are designed to protect human health and welfare from emissions of criteria pollutants. The Federal Boiler and Industrial Furnace (BIF) rules and the State Air Toxics Working Policy are designed to protect human health and welfare from emissions of noncriteria pollutants. The BIF rules establish Reference Air Concentrations (RAC, for non-carcinogens) and Risk Specific Doses (RSD, for carcinogens); and the State Air Toxics Working Policy establishes No Threat Levels for air toxics. The potential facility emissions are evaluated with respect to these various concentrations in the following table. All concentrations are described in $\upsilon g/m^3$. The table shows that all emissions result in ambient air concentrations that are below applicable standards.

TABLE 4-1
Modeled Ambient Air Concentrations
Reportable Pollutants

Florida Rock Industries, Inc.
Newberry Cement Plant
Alachua County, Florida

	AVG PERIOD	FACILITY IMPACT	NAAQS1	NAAQS2	FAAQS	BIF	NTL
PM10	24 hr	29.09	---	---	150	---	---
	Annual	4.98	---	---	50	---	---
SO2	3 hr	196.75	---	1300	1300	---	---
	24 hr	57.06	365	---	260	---	12.48
	Annual	7.11	80	---	60	---	---
NOx	Annual	7.76	100	---	100	---	---
CO	1 hr	141.7	---	---	40,000	---	---
	8 hr	99.19	---	---	10,000	---	---
Lead	8 hr	0.019908	---	---	---	---	0.5
	24 hr	0.011376	---	---	---	---	0.12
	Quarter	0.011376	---	---	1.5	---	---
	Annual	0.002275	---	---	---	0.09	9.00E-02
Beryllium	8 hr	6.64E-05	---	---	---	---	0.02
	24 hr	3.79E-05	---	---	---	---	0.0048
	Annual	7.58E-06	---	---	---	4.20E-03	4.20E-04
HCl	8 hr	1.3097	---	---	---	---	75
	24 hr	0.7484	---	---	---	---	18
	Annual	0.14968	---	---	---	7	7
Benzene	8 hr	0.08365	---	---	---	---	30
	24 hr	0.0478	---	---	---	---	7.2

NOTES:

1. All concentrations are described in $\upsilon g/m^3$
2. NAAQS1 = Primary National Ambient Air Quality Standards
3. NAAQS2 = Secondary National Ambient Air Quality Standards
4. FAAQS = Florida Ambient Air Quality Standards
5. BIF = Boiler and Industrial Furnace Rule
6. NTL = No Threat Level, FDEP air toxics policy

PROCESS EVALUATION

5. Emission Unit 1 (Raw Materials Handling and Storage). Is a baghouse or other air pollution control device used to control PM emissions from any storage building or process equipment?

RESPONSE: No baghouses or other air pollution control devices are associated with Emissions Unit 1 (Raw Materials Handling and Storage). The raw materials are processed with average surface moisture of 8-12%. Negligible emissions are assumed from the handling of wet materials (moisture > 1.5%, per AP-42). Material stockpiles at the plant are covered to limit particulate matter generated by wind erosion.

6. Submit design specifications of each baghouse that will be used. How was the flow (dscfm) calculated for each baghouse. Show any estimates used in these calculations.

RESPONSE: Baghouse design specifications are shown in Appendix A. Flow in dscfm is calculated from acfm, temperature of exhaust gas, and moisture content of exhaust gas. Flow in acfm and air-to-cloth ratio are design specifications, while temperature and moisture content are estimates based on process knowledge. The assumed baghouse exhaust gas loadings of 0.02 grains/dscf are also design specifications. The calculations to convert acfm to dscfm are cell formulas in Table 6-1. An example calculation is:

Given: Baghouse E-28, 15000 acfm, 2-3% moisture, 350° F

Determine: Flow in dscfm

Calculations: Flow in acfm must be adjusted for moisture content in excess of 0%, and temperature different than the standard temperature of 68° F. Temperatures must be converted to an absolute temperature scale (Kelvin or Rankine).

Equations: Moisture: acfm X [(100 - minimum moisture %)/100]

15000 acfm X [(100 - 2)/100] = 14700 dcfm = Q_D

Temperature: °F + 460 = °R

Standard Temperature = 68° F + 460 = 528° R

Exhaust Temperature = 350° F + 460 = 810° R

Dry Standard Flow: $Q_{DS} = Q_D \times (T_S/T_A)$ where:

Q_{DS} = Dry standard flow, dscfm

Q_D = Dry actual flow, dcfm

T_S = Standard temperature, °R

T_A = Actual temperature, °R

Q_{DS} = 14700 dcfm X (528°/810° R) = 9582 dscfm

7. Describe procedures for startup and shutdown of the process equipment to insure minimization of excess emissions.

RESPONSE: Dust collectors will be started-up and shut-down in the sequence suitable for the specific process application. The dust collectors will be in operation prior to the commencement of material and gas flow, and will continue to run for some period of time after the material and gas flow has ceased.

8. Provide a plan to establish good combustion practice to minimize NOx, CO, and VOC emissions from the kiln. Ultimately, such a plan should be reflected in the plant operating procedures.

RESPONSE: Appendix B contains a drawing showing monitoring and control instrumentation. This instrumentation is used to monitor process parameters and maintain good combustion practice. Attachment 8-1 also contains elements of a plant operating plan. Adherence to this plan will minimize plant emissions.

9. Submit an analysis of specifications and quantities of the different fuel combinations to be burned at each combustion source at this facility. Discuss any blending of fuel types.

RESPONSE: A typical analysis for coal is attached in Appendix C. Typical analyses for No. 2 fuel oil are attached as Tables 9-2 and 9-3. A typical analysis for tires is attached as Table 9-4. The proposed quantities to be combusted of each type of fuel at each combustion source follow:

Combustion Source	Fuel	Annual Usage
Raw Mill Air Heater	#2 Fuel oil	2,485,106 Gallons
Kiln: Main Burner (Discharge End)	Coal	49,056 Tons (40% of total heat input)
Kiln: Main Burner (Discharge End)	#2 Fuel oil	125,000 Gallons (Kiln startup only)
Kiln: Calciner Burner (Preheater End)	Coal	73,584 Tons (60% of total heat input)
Kiln: Calciner Burner (Preheater End)	Tires (to replace coal)	36,792 Tons (30% of total heat input)

No blending of fuel types is proposed, except for the partial replacement of coal with tires at the calciner burner; and the use of No. 2 fuel oil in the main burner to allow for kiln preheating during startup. The use of No. 2 fuel oil in the main burner is necessary at startup to create favorable conditions for the combustion of coal.

10. Discuss how captured dust from the ESP will be removed from the system and disposed. What precautions will be used to minimize unconfined emissions while handling the dust?

RESPONSE: The dust captured in the kiln ESP will be returned to the process. There will be no disposal of captured dust. The process equipment utilized to transport the captured dust from the ESP back into the process is all enclosed and vented to baghouses. No unconfined emissions are expected from dust handling and transport activities. The dust handling systems for the ESP is described as follows:

Kiln/Raw Mill ESP: Dust is gravity-fed to a pneumatic screw pump through a conveying pipe. This operation is enclosed and vented to a baghouse. The dust is then pumped either into the homogenizing silo or into the kiln feed airlift. All of these activities are enclosed and vented to baghouses.

11. What reasonable precautions will be used to minimize unconfined particulate matter emissions from the plant (quarries, haul roads, CKD handling equipment, dust disposal piles, manufacturing area, etc.).

RESPONSE: The quarrying activities and material storage piles will involve moist or wet raw materials with negligible UPM emissions. Haul roads will be sprinkled by a water truck if this is deemed necessary. All CKD handling equipment is enclosed and vented to baghouses, resulting in negligible UPM emissions. There are no dust disposal piles planned for this facility. The manufacturing area will be paved, and all process equipment will process wet materials (moisture > 1.5%) or be vented to a particulate control device (baghouse or ESP).

BACT EVALUATION

12. Explain the NOx controls proposed for each combustion source. Provide drawings and design details (text) for any low NOx burners, staged combustion or other methods used to lower free O_2 available for NOx formation.

RESPONSE: NOx emissions will be limited through three approaches: Process design, indirect firing system, and staged combustion. These approaches are discussed further below.

PROCESS DESIGN: Preheater and precalciner kilns have lower NOx emission rates than long dry kilns and wet process kilns, due to higher fuel efficiency and lower firing rates in the kiln firing zone (discharge end burner). Secondary combustion of fuel is inherent in precalciner kilns, and combustion characteristics in the kiln firing zone and precalciner firing zones differ substantially. The very high temperature and fuel-lean conditions in the kiln firing zone contribute to higher NOx formation rates than in the precalciner firing zone, which has moderate flame temperature and fuel-rich conditions. In the Florida Rock kiln, approximately 40% of the fuel will be burned in the kiln, and 60% will be burned in the precalciner.

INDIRECT FIRING SYSTEM: An indirect fired system has separate coal pulverizing and firing circuits. This system is often used where there is a single pulverizer unit with multiple firing points (precalciner kilns), or high moistures in the coal to be ground. A process flow diagram of the indirect pulverizer/dryer system with multiple firing points was submitted with the Application to Construct (Appendix B, Process Flow Diagram #14 of 14).The significant features of this system are:

A. All or most of the pulverizer discharge gases are vented to the atmosphere.
B. Pulverized coal is stored in bins for a short period of time before it is delivered to the firing points.
C. Short interruptions in pulverizer operation will not affect kiln operation.
D. This type of system has the lowest overall heat consumption.
E. Since pulverizing and drying gases are separated from coal firing, inert (low oxygen) clinker cooler exhaust gases can be used as pulverizer drying gases.
F. A low volume of air is used to transport the pulverized coal to the firing points, allowing maximum use of high temperature secondary air from the clinker cooler.
G. Primary air supplied to the kiln burner (discharge end) can be optimized with an indirect system (10%-12% primary air), even with high moisture content in the coal. For coals with moisture contents above 12%-15%, indirect coal pulverizing/drying is the best solution for thermal efficiency.

The thermal efficiencies of the indirect firing system result from the utilization of otherwise waste heat from the clinker cooler exhaust gases. This negates the need for an additional hot air source for coal drying, and eliminates any NOx emissions from the combustion of additional fuel. Additionally, an indirect firing system increase overall energy efficiency by allowing a greater proportion of clinker cooler exhaust air as secondary combustion air.

STAGED COMBUSTION: Staging of combustion air allows combustion of fuel to proceed in two distinct zones. The staged combustion is typically achieved by using only a part of the combustion air (primary air) for fuel injection in the flame zone with remaining secondary air being injected in a subsequent cooler zone.

In the first zone, the initial combustion is conducted in a primary, fuel-rich zone. This zone provides the high temperatures necessary for completion of the clinkering reactions. NOx formation in this zone is minimized by limiting excess oxygen available for combustion. The air used for conveying the pulverized coal from the coal mill is called primary air. The indirect firing system as described above can effectively limit the amount of primary air at each burner. A cement kiln using 10 to 12 percent of primary air is described as an indirect fired kiln.

The second combustion zone is characterized by lower temperatures and fuel-lean conditions as a result of excess available oxygen from secondary air. The temperature in this second zone is much lower than the first zone because of mixing with the cooler secondary air. The formation of NOx is thus minimized in spite of the excess available oxygen in the second zone.

The secondary air for both burners is ducted from the clinker cooler which maximizes the overall thermal efficiency of the process. The secondary air for the precalciner burner is ducted via the tertiary air duct.

13. Explore the option of utilizing a baghouse and discuss the benefits/problems of this approach compared to the ESP. Include a discussion of SO_2 control and HAPs and any effects on startup emissions of particulate matter and visible emissions. What is the actual SO_2 removal of the system?

RESPONSE:

BAGHOUSE VERSUS ESP: Either control device is capable of particulate removal efficiencies in excess of 99.9%; and are considered as equivalent technologies for this reason. The ESP was chosen for these applications (kiln and cooler) because it has a lower pressure drop than a baghouse. The lower pressure drop allows the use of lower horsepower fans resulting in lower fan-related power consumption. Further, industry experience has shown that an ESP is easier to maintain than a baghouse.

SO2 Control:
A substantial quantity of data was reviewed by Midwest Research Institute for the preparation of Section 11.6, *Portland Cement* Manufacturing, AP-42 Fifth Edition; and the associated documentation. The documentation contains an analysis of the uncertainty

in kiln emission factors, and states "...there is a slight pattern of lower SO_2 emission factors with fabric filters than with ESP's or no controls but the difference may not be significant...".

It is assumed that significant reduction in SO_2 mass will take place in the kiln and preheater environments; with additional reduction in the raw mill. Absorption of SO_2 into collected particulate matter may take place in the ESP, as the gas stream passes between the collection plates; while in a baghouse this absorption would occur as the gas stream passes through the filter cake.

The projected SO_2 removal efficiency of the total system is calculated from the total SO_2 available for liberation, as compared to the proposed allowable emission limit. Sulfur dioxide is liberated by the combustion of coal and from sulfur compounds in the raw meal; and from the combustion of No. 2 fuel oil in the raw mill air heater.

> Coal: 1.0% sulfur by weight, 14 tph combusted = 28,000 lbs/hr
> Sulfur to sulfur dioxide ratio = 1:2 (2 lbs. SO_2 per 1 lb. S)
>
> SO_2 from coal combustion =
> 28,000 lbs. coal/hr X 0.01 lb. S/lb. coal X 2 lbs. SO_2/1 lb. S = 560 lbs/hr
>
> Raw Meal:
> Sulfite (SO_3) from raw meal (as tested) = 0.08% by weight
> Raw meal is processed at the rate of 150 tph = 300,000 lbs/hr
> Sulfite to sulfur dioxide ratio = 5:4 (4 lbs. SO_2 per 5 lbs. SO_3)
>
> SO_2 from raw meal =
> 300,000 lbs/hr X 0.0008 lbs. SO_3/lb X 4 lbs. SO_2/5 lbs. SO_3 = 192 lbs/hr
>
> Raw Mill Air Heater:
> 0.05% Sulfur in No. 2 fuel oil, 280 gallons/hour burned
> AP-42 factor = 142(%S)/1000 gallons burned = 7.1 lb. SO_2/1000 gallons burned
>
> SO_2 from raw mill air heater =
> 280 gallons/hour X 7.1 lb. SO_2/1000 gallons burned = 1.99 lbs/hr

Total SO_2 from coal, raw meal, and air heater = 560 + 192 + 1.99 = **754 lbs/hr**
Proposed SO_2 emission limit = 51.75 lb/hr (kiln) + 1.99 lb/hr (air heater) = **53.74 lbs/hr**

Estimated SO_2 removal from total system:
100 % - [(53.74 lbs/hr emitted/754 lbs/hr liberated) X 100%] = **92.9%**
HAP Control:

The emissions of HAPs from cement manufacturing were evaluated using AP-42, Fifth Edition, Table 11.6-9, *Summary of Noncriteria Pollutant Emission Factors for Portland*

Cement Kilns. This evaluation identified four (4) HAPs which will be potentially emitted in reportable quantities: Beryllium, lead, hydrogen chloride, and benzene. The potential emissions of these HAPs were described in the application and PSD report. The table lists emission factors based on type of control: ESP's and fabric filters. The factors for the four applicable pollutants are compared as follows:

Beryllium: Factor is only provided for fabric filters. ESP control of beryllium is assumed as equivalent.

Lead: ESP = 7.1×10^{-4} lb/ton clinker
Fabric filter = 7.5×10^{-5} lb/ton clinker

Hydrogen Chloride: ESP = 0.025 lb/ton clinker
Fabric filter = 0.073 lb/ton clinker

Benzene: ESP = 0.0016 lb/ton clinker
Fabric filter = 0.008 lb/ton clinker

This analysis shows that emissions of hydrogen chloride and benzene may be lower with the ESP, while lead emissions may be higher.

STARTUP EMISSIONS/VISIBLE EMISSIONS: Under ideal operating conditions, the ESP is more likely to exhibit visible emissions at startup as the temperature and O_2 characteristics of the exhaust gas reach steady-state operating parameters; whereas the baghouse can filter the gas regardless of temperature and O_2 characteristics. However, industry experience shows that baghouses require extensive maintenance and bag failure is not uncommon.

14. Discuss feasibility of using cleaner fuels, such as natural gas or No. 2 fuel oil at 0.05% sulfur, to minimize SO_2 and NOx emissions. For reference permitted NOx emissions are 3.14 lbs/ton of clinker at Florida Mining and Materials (2/93) and permitted SO_2 emissions are 0.31 lb/ton of clinker at Ash Grove Cement (6/90). Investigate any emerging technology for the control of NOx.

RESPONSE:

Cleaner Fuels: "Types of fuels used vary across the industry. Historically, some combination of coal, oil, and natural gas was used, but over the last 15 years, most plants switched to coal, which generates less NOx than does oil or gas...The sulfur content of both raw materials and fuels varies from plant to plant and with geographic location. However, the alkaline nature of the cement provides for direct absorption of SO2 into the product, thereby mitigating the quantity of SO2 emissions in the exhaust stream." (*Emission Factor Documentation for AP-42 Section 11.6: Portland Cement Manufacturing*, USEPA 68-D2-0159, May 1994.)

The use of other fuels, such as natural gas or No. 2 fuel oil, is economically infeasible and would provide questionable environmental benefits. Natural gas is currently unavailable in the Newberry area, and its unit cost (where available) is approximately one and one-half times (1.5X) the unit cost of coal. Similarly, the unit cost of No. 2 fuel oil is approximately twice (2.0X) the unit cost of coal.

Referenced Emission Limits: It is inappropriate to compare the proposed SO2 emission rate (0.54 lb/ton clinker) to the Ash Grove emission level (0.31 lb/ton clinker) as the proposed emission level represents a maximum emission level while the Ash Grove emission level represents an average emission level.

It is inappropriate to compare the proposed NOx emission rate (4.6 lb/ton clinker) to the Florida Mining & Materials emission level (3.14 lb/ton clinker) as the proposed emission level represents a maximum emission level while the Florida Mining & Materials emission level represents an average emission level.

Emerging technologies for NOx control are discussed in the expanded BACT analysis (Attachment 15-1).

15. The BACT analysis must be expanded. BACT is done on a case-by-case basis and, at a minimum should include a technical, economic, and environmental analysis of any applicable control technology. Please refer to EPA's New Source Review Workshop Manual.

RESPONSE: See attached BACT analysis for NOx in Appendix D.

AIR QUALITY ANALYSIS

16. Although some preliminary air quality modeling results have been provided to the Department within the period of review of this letter, these results have shown that more extensive modeling is necessary to complete the required PSD air quality analysis. Therefore, further air quality analysis review can not be performed without the submittal of this more extensive modeling. Please provide a copy of all modeling input and output in both diskette and paper formats.

RESPONSE: See attached Air Quality Analysis in Appendix E.

APPLICATION FORM

17. Complete applicable questions on pages 104-106-108-112-113-115 of application form DER Form No. 62-210.900(1). There are also a few other blank fields throughout the application that need to be completed.

RESPONSE: Please see attached updated pages 104-106-108-112-113-115 of application form DER Form No. 62-210.900(1). These pages are in Appendix F.

GENERAL

18. Will the proposed project comply with all of the Alachua County air pollution control regulations?

RESPONSE: The Alachua County Office of Environmental Protection [(904) 955-2442] was contacted on April 20, 1995. Staff said that no air pollution control regulations have been issued by the Alachua County Office of Environmental Protection.

19. Please be advised that we are still awaiting comments from EPA and the National Park Service. As soon as we have received these comments, we will forward them to you.

RESPONSE: No response required.

SOLID WASTE REVIEW

20. Please locate and label on the drawings the areas to be used for storage of solid waste. These areas include, but are not necessarily limited to, the used tire, fly ash, sandblast grit, gypsum, and coal ash storage areas. Please provide information to ensure that the storage areas are not in violation of the prohibitions given in Florida Administrative Code (F.A.C.) Rule 62-701.300.

RESPONSE: The storage areas for coal ash and gypsum are labeled on Figure 2-3 (facility plot plan) as submitted with the Application to Construct. Used tires will be located near the rotary kiln as labeled in Figure 2-3. Sandblast grit, if used, will be stored in the area labeled sand. Any fly ash will be coal ash. The prohibitions given in Rule 62-701.300 (FAC) are addressed as follows:

(1)(b). No person shall store or dispose of solid waste in a manner or location that causes air quality standards to be violated or water quality standards or criteria of receiving waters to be violated.

RESPONSE: The handling of materials at this facility will not cause or contribute to the violation of any air or water quality standards.

(2)(a). No solid waste shall be stored or disposed of by being placed in an area where geological formations or other subsurface features will not provide support for the solid waste.

RESPONSE: All materials for use in cement production will be stored under cover on compacted clay to prevent the generation of runoff or leachate.

(2)(b). No solid waste shall be stored or disposed of by being placed in any area where the absence of geological formations or subsurface features would allow for the unimpeded discharge of waste or leachate to ground or surface water.

RESPONSE: All materials for use in cement production will be stored under cover on compacted clay to prevent the generation of runoff or leachate.

(2)(c). No solid waste shall be stored or disposed of by being placed within 500 feet of an existing or approved potable water well.

RESPONSE: A 500 foot minimum separation will be maintained between the material storage areas and any potable water well.

(2)(d). No solid waste shall be stored or disposed of by being placed in a dewatered pit.

RESPONSE: No materials will be stored or disposed of by being placed in any dewatered pits.

(2)(e). No solid waste shall be stored or disposed of by being placed in an area subject to frequent and periodic flooding unless flood protection measures are in place.

RESPONSE: The area where the cement plant will be located is not subject to frequent and periodic flooding.

(2)(f). No solid waste shall be stored or disposed of by being placed in any natural or artificial body of water including ground water.

RESPONSE: All materials for use in cement production will be stored under cover on compacted clay above the seasonal high water table.

(2)(g). No solid waste shall be stored or disposed of by being placed within 200 feet of any natural or artificial body of water, including wetlands within the jurisdiction of the Department, except bodies of water contained completely within the boundaries of the disposal site, which do not discharge from the site to surface waters.

RESPONSE: All bodies of water at the site (stormwater retention/detention ponds and mining pits) are contained completely within the boundaries of the site and do not discharge from the site to surface waters.

(2)(h). No solid waste shall be stored or disposed of by being placed on the right of way of any public highway, road, or alley.

RESPONSE: No material storage is located on the right of way of any public highway, road, or alley.

(2)(i). No solid waste shall be stored or disposed of by being placed within 1000 feet of an existing or approved potable water well serving a community water system as defined in Rule 62-550.200(9), FAC.

RESPONSE: No existing or approved potable water well serving a community water system exists within 1000 feet of any material storage area.

21. Please provide additional information concerning the handling of waste tires at the site. According to page 3 of the report portion of the application, the tires will be whole tires stored for use in burning only.

RESPONSE: Tires will be received in closed vans and unloaded in the tire feeding hopper. There will be a minimum inventory of tires on the ground in the immediate vicinity of the tire feed hopper, if any.

The tires on-hand will be limited to an amount which will result in inventory turnover within one week to protect against tire fires and mosquitoes.

22. Please provide a list of the sources of the materials to be used as additives, i.e. gypsum, coal ash, etc. In addition, please provide and /or propose a mix composition for the additives. This feed/product mix composition should also include that material generated on site such as material from the baghouse. Please note that it is unclear exactly what the 1.7 feed to clinker ratio mentioned in the application represents; therefore, clarification of what constitutes the feed and the clinker is required. Figure 2-5 indicates that gypsum is added after the clinker storage area. Is this the proposed addition point for all proposed additives except the fly ash which is to be added at the crusher? If not, is the crusher the addition point for all additives except gypsum?

RESPONSE:

SOURCES OF RAW MATERIALS AND ADDITIVES/ADDITION POINTS:

-Limestone, clay, sand: Mined on site, added at primary crusher

-Coal ash: From Seminole Electric (Palatka) and Gainesville Regional Utilities. The coal ash is stored under cover and added at the raw mill.

-Gypsum: From Spain or from Tampa Electric's flue gas scrubber product. The gypsum is added at the finish mill.

-Iron Oxide: Source as yet undetermined. Required only for Type II cement in quantities less than 1%. The iron oxide is added at the raw mill.

-Baghouse/ESP catch: This material is returned to the processes from which it is generated.

MIX COMPOSITION:

The mix composition will vary based on the target chemical composition of the cement. The anticipated mix proportions for raw mill feed are:

-Limestone, clay, sand, and recycle dust = 90-92%
-Coal ash = 8-10%
-Iron oxide = < 1%

The gypsum is interground with the clinker in the finish mill to produce cement. The gypsum is used at approximately 5% by weight of cement produced.

FEED TO CLINKER RATIO:

The *Raw Materials* (limestone, clay, sand, recycle dust, iron oxide, coal ash) are dried and ground in the raw mill, becoming *Raw Meal*. The *Raw Meal* is proportioned, blended, and fired in the kiln system, becoming *Clinker* [Calcium carbonate ($CaCO_3$) is thermally decomposed to calcium oxide and carbon dioxide (CaO, CO_2)]. The *Clinker* is interground with the gypsum in the finish mill, becoming *Cement*. The 1.7:1.0 feed-to-clinker ratio is determined as follows:

> Raw material: **1.7 units** with 8% moisture (92% net)
> Raw meal: 1.7 units X 0.92 = 1.4 units
> Clinker: (approximately 29% lost as CO_2, 71% net); 1.4 units X 0.71 = **1.0 units**

23. Please provide a description of the handling (and transporting) of the residual material, such as the baghouse material, to ensure that it remains in the closed loop of the process and does not make contact with the soil at the facility at any time.

RESPONSE: All baghouse and ESP catches are returned to the processes from which they are generated. The return systems are close-circuited, whereby the materials do not make contact with the soil at any time. The catches are handled/transported by enclosed screw conveyors, air slides, bucket elevators, and gravity feeds. The conveying equipment is all vented to baghouses.

24. Please provide a contingency plan addressing timeframes and activities relating to the disposal of kiln dust, gypsum, fly ash, tires, coal ash and other solid waste materials should the facility cease operation or discontinue operation for some period of time that you propose. Please include a statement concerning how and where the solid waste items above will be disposed. Please note that the Department will make a determination concerning the proposed length of time requested prior to beginning disposal of stored solid waste at the facility.

RESPONSE: There will not be an inventory of kiln dust. All other raw materials will be stored under cover in moderate quantities and will be totally consumed in the event of a planned shut-down exceeding two months in duration. In the event of a permanent shut-down, all residual materials will be transported to an approved landfill or other cement production facilities within 6 months after such shutdown.

APPENDIX A

TABLE 6-1: BAGHOUSE DESIGN SPECIFICATIONS

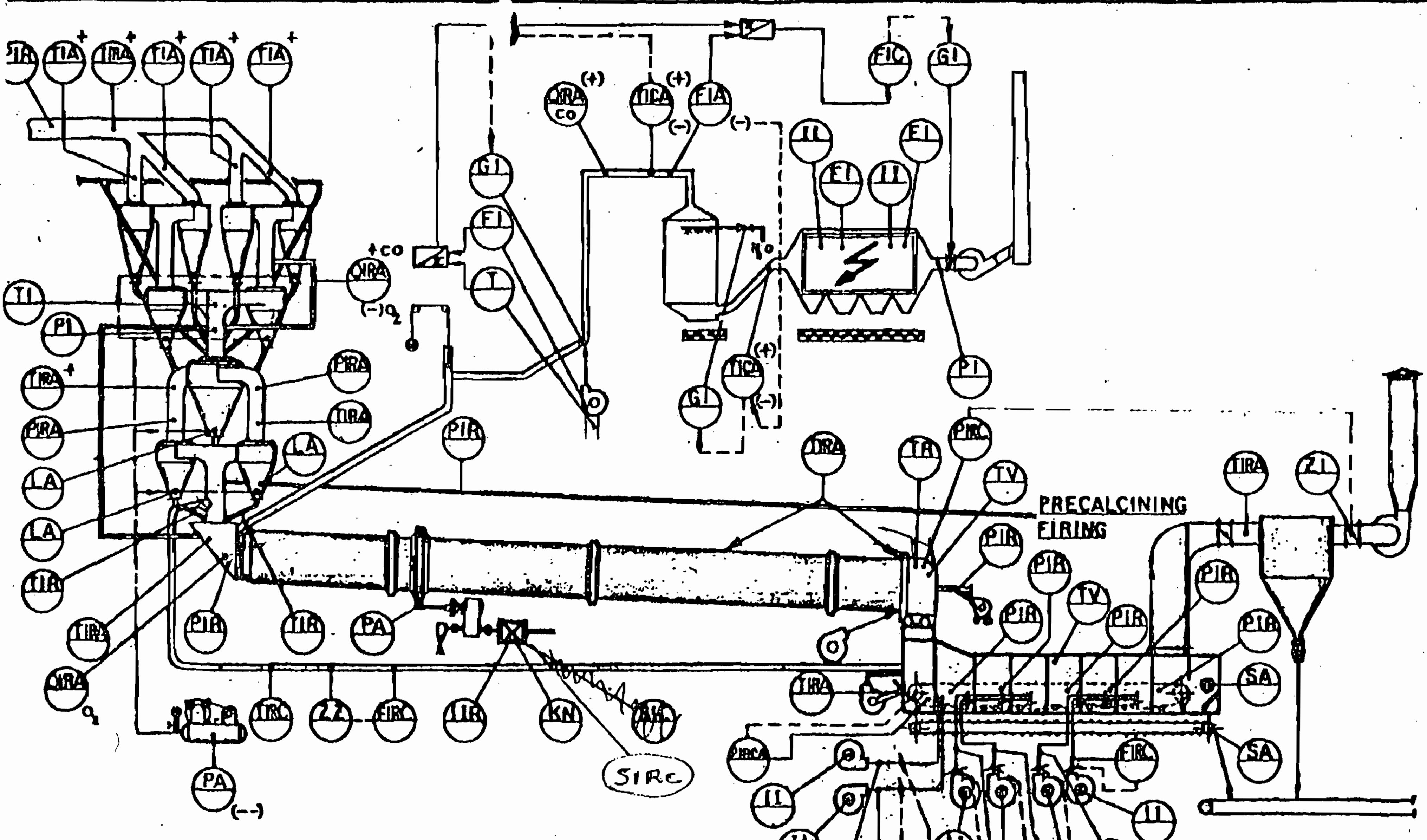
TABLE 6-1
Baghouse Design Specifications

Florida Rock Industries, Inc.
Newberry Cement Plant
Alachua County, Florida

	#	Description	acfm	°F	°R	H_2O	dscfm	Bag Area	Air:Cloth		Hours	Height	Stack	Type of	Type of
								ft^2	Ratio		per Year	ft.	Dia., in.	Bags	Cleaning
1	E-28	Recycle dust + raw meal to homogenization silo	15000	350	810	2%	9582	2604	5.8	:1	8760	40	26.2	Nomex	Pulse Jet
2	E-29	Recycle dust to airlift	1000	356	816	2%	634	188	5.3	:1	8760	10	6.8	Nomex	Pulse Jet
3	G-07	Recycle dust + raw meal into homogenization silo	15000	200	660	2%	11760	2604	5.8	:1	8760	225	26.2	Polyester	Pulse Jet
4	H-08	Raw meal + recycle dust to preheater	6000	200	660	2%	4704	1178	5.1	:1	8760	60	16.6	Polyester	Pulse Jet
5	L-03	Clinker cooler discharge and breaker	3000	300	760	2%	2043	577	5.2	:1	8760	10	11.7	Nomex	Pulse Jet
6	L-06	Clinker into clinker silos	4000	300	760	2%	2723	754	5.3	:1	8760	190	13.5	Nomex	Pulse Jet
7	M-07	Clinker to finish mill	4000	212	672	2%	3080	754	5.3	:1	8760	10	13.5	Polyester	Pulse Jet
8	M-08	Clinker to finish mill	4000	212	672	2%	3080	754	5.3	:1	8760	10	13.5	Polyester	Pulse Jet
9	N-09	Finish mill air separator	10000	210	670	2%	7723	1696	5.9	:1	8760	60	21.4	Polyester	Pulse Jet
10	N-13	Finish mill	30000	210	670	2%	23169	6834	4.4	:1	8760	123	37.1	Polyester	Pulse Jet
11	N-14	Cement handling in finish mill	6000	200	660	2%	4704	1178	5.1	:1	8760	60	16.6	Polyester	Pulse Jet
12	Q-25	Cement storage silos	12000	150	610	2%	10179	2121	5.7	:1	8760	260	23.5	Polyester	Pulse Jet
13	Q-26	Cement storage silos	12000	150	610	2%	10179	2121	5.7	:1	8760	260	23.5	Polyester	Pulse Jet
14	Q-27	Cement storage silos	12000	150	610	2%	10179	2121	5.7	:1	8760	260	23.5	Polyester	Pulse Jet
15	Q-14	Cement silo loadout	3000	150	610	2%	2545	484	6.2	:1	8760	30	11.7	Polyester	Pulse Jet
16	Q-17	Cement silo loadout	3000	150	610	2%	2545	484	6.2	:1	8760	30	11.7	Polyester	Pulse Jet
17	Q-21	Cement silo loadout	3000	150	610	2%	2545	484	6.2	:1	8760	30	11.7	Polyester	Pulse Jet
18	R-12	Cement bagging operation	12000	150	610	2%	10179	2121	5.7	:1	8760	100	23.5	Polyester	Pulse Jet
19	S-17	Coal mill	18000	150	610	6.50%	14568	4005	4.5	:1	8760	164	28.7	Polyester	Pulse Jet
20	S-21	Pulverized coal storage bin	3000	150	610	2%	2545	577	5.2	:1	8760	60	11.7	Polyester	Pulse Jet

APPENDIX B

ATTACHMENT 8-1: CONTROL INSTRUMENTATION AND OPERATING PLAN



STANDARD INSTRUMENTATION
PREPOL KILN WITH TERTIARY
DUCT & COOLER

G.P.H.8-2-78

END LEGEND
FOR CONTROL FLOW SHEET
ELECTROSTATIC PRECIPITATOR

A				A	(Alarm)
B				B	(State Display)
C				C	(Controlling)
D	(Density)	D	(Difference)		
E	(All Electrical Variables)			E	(Sensing Element)
F	(Flow Rate)	F	(Ratio)		
G	(Gauging, Position or Length)				
H	(Hand, Manually Initiated)				
I	(Ampere)			I	(Indicating)
J		J	(Scan)		
K	(Time or Time Program)				
L	(Level)				
M	(Moisture or Humidity)				
N	(Piece)			N	(User's Choice)
O	(User's Choice)			O	(Visual Indicator)
P	(Pressure or Vacuum)			P	(Test Point Connection)
Q	(Quality)	Q	Integral, (Integrate or totalize)	Q	(Integrating, or Summating)
R	(Nuclear Radiation			R	Recording
S	(Speed or Frequency)			S	(Switching)
T	Temperature			T	(Transmitting)
U	(Multi-Variable)			U	(Multi-Function Unit)
V	(Viscosity)			V	(Valve, Damper, Louvre, Actuating Element, Unspecified Correcting Unit)
W	(Weight or Force)				
X	(Unclassified Variables)			X	(Unclassified Functions, e.g., tv camera, cathode ray tube, radioactive source)
Y				Y	(Computing Relay, Relay)
Z				Z	(Emergency or Safety Rating)
+				+	(High)
/				/	(Intermediate)
					(Low)

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2. Interlock requirements and protective measures for firing systems and electrostatic precipitators.

2.1 Explanations of the Interlock Requirements

Below is a list, Serial Nos. 1 through 11 of the individual interlocks. The list is broken down according to the following categories:

<u>Area:</u> Under area we mean those units of equipment to which the corresponding measures refer.

<u>Type:</u> The type corresponds to the possible operating malfunction.

<u>Measures:</u> The measures are broken down so that the interlock, protective measure and monitoring can be individually recognized.

Note that existing internal equipment interlocks are not obviated by this list but rather retain their validity.

2.2 List of Interlocks

1. Sinter Zone Burner
2. Sinter Zone Burner with Calcining Operation - AT Process
3. Sinter Zone Burner with Calcining Operation - AS Process

5. Calcining Burner - AS Process
6. Electrostatic Precipitator
7. Auxiliary Firing
8. Switchover Simple/Compound Operation

10. Fuel Increase
11. Emergency Operation Due to Power Failure

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Area	Type	Measures		
		Interlock	Protective Measures	Monitoring
1. Sintering Zone Burner				
1.1 Switch-On Requirements	1.1.1	Permissive	Electrostatic precipitator has to be grounded, high voltage has to be switched off.	
	1.1.2		Minimal gas analysis volume has to be supplied to the analyzer.	Gas flow from analysis device.
	1.1.3		Assure adequate purging of the plant following the CO-max. 2 switchoff	Purge cycle 5 minutes.
	1.1.4		Signal point CO-max. 1 not attained.	All CO analysis devices.
	1.1.5		Only with gas and oil firing. Quick shutoff valve closed.	*)
	1.1.6		Only with gas and oil firing. Fuel regulator valve closed and set value controller zeroed out.	*)
			Only in coal firing, fuel supplier switched off and set value controller zeroed out.	
	1.1.7		Exhaust gas fan and electrostatic precipitator fan have to be in operation.	Motor monitoring.

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Area	Type	Measures		
		Interlock	Protective Measures	Monitoring
	1.1.8		Primary air fan must be in operation.	Motor Monitoring.
	1.1.9		Cool air fans of Compartments 1-3 must be in operation.	Motor Monitoring.
	1.1.10		Only in oil firing. Burner (lance) must be in operating position.	Limit Switch
	1.1.11		Throttle valves to the mill must be closed.	Limit Switch
	1.1.12		Damper for simple operation has to be at least 30% open. -fasten mechanically-	
	1.1.13		Only in oil firing. Oil temperature has to be above minimum.	Temperature measurement with adjustable limit value.
	1.1.14		Only for oil firing. Oil pressure must be greater than minimum.	Pressure measurement with adjustable limit values.

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Area	Type	Measures		
		Interlock	Protective Measures	Monitoring
1. Sintering Zone Burner				
1.2 Constant Operating Conditions	1.2.1 Only with Oil Firing			
	In case of failure of the primary air.	Quick shut-off of fuel supply.		Motor Monitoring
	Only with Coal Firing			
	In case of failure of primary air.	Stop of fuel supply. Explanation: If the primary air fan is used also as a conveying fan, the conveying air and fuel feed have to be stopped immediately. In other cases the fuel feed is immediately stopped and the conveying air delayed in accordance with the purging time of the line.		Motor monitoring.

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Area	Type	Measures		
		Interlock	Protective Measures	Monitoring
	Only for Gas Firing			
	In case of failure of primary air.	Quick shutoff with fan sizing of >5% primary air.	Warning signal with sizing of <5% primary air.	Motor monitoring.
	1.2.2 In case of failure of the exhaust gas fan following the preheater or following the electrostatic precipitator	Quick shutoff of fuel supply		Motor monitoring.
	1.2.3 Upon attaining a max. temperature after the preheater	Quick shutoff of fuel supply	Before attaining of the max. temperature a warning signal has to issue at a lower temperature.	Temperature measurement with adjustable limit values.
	1.2.4 Upon attaining a max. temperature after the kiln exhaust fan.	Quick shutoff of fuel supply	Before attaining the max. temperature a warning signal has to be issued at a lower temperature.	Temperature measurement with adjustable limit values.
	1.2.5 Upon attaining a max. temperature following the electrostatic precipitator.		Warning signal.	Temperature measurement with adjustable limit values.

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Area	Type	Measures		
		Interlock	Protective Measures	Monitoring
	1.2.6 In case of positive as well as negative pressure following the exhaust gas fan.	Quick shutoff of fuel supply		Pressure measurement directly after kiln exhaust gas fan with adjustable limit values
	1.2.7 Upon attaining the max, max. CO content after preheater.	In compound operation with auxiliary firing on, the auxiliary firing system also has to be discontinued during quick shutoff of the kiln firing.	Before attaining the max, max value, a warning signal has to sound at a lower level.	Gas analyzer

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Area	Type	Measures		
		Interlock	Protective Measures	Monitoring
5. Calcining Burner - AS Process				
5.1 Switch-on Requirements	5.1.1 Requirements as under Item 4.1			
5.2 Constant Operating Requirements	5.2.1 Requirements as under Item 4.2			
5.3 Switch-off Requirements	5.3.1 Requirements as under Item 4.3			
6. Electrostatic Precipitator	6.1.1		The precipitator ground should only be released when starting up cold if there is no CO measured.	Gas analyzer
6.1 Requirements for Switch-On	6.1.2		Following short-term interruption of the fuel feed due to plant interlocks, the high voltage can only be switched on again if, after a certain timespan (corresponding to the purging time of the system and the instructions of the precipitator supplier) no CO content is measured in the exhaust gas.	If there are no special instructions the purging cycle with running fans and opened throttle valves is 5 minutes. The purge cycle of the system starts after completion of the automatic purge cycle on the kiln burner Gas Analyzer

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Area	Type	Measures		
		Interlock	Protective Measures	Monitoring
7. Auxiliary Firing				
7.1 Switch-on	7.1.1		After CO max failure (kiln) one has to make certain that the purging of the system is completed and the indicated CO value falls beneath max 1.	Purging cycle: 5 minutes with running system fans and opened throttle valves.
	7.1.2		Fuel regulator valve has to be closed and set value controller zeroed out.	
	7.1.3		Quick shutoff valve has to be closed.	
	7.1.4		Primary air fan must be in operation.	Motor monitoring
	7.1.5		Mixed air fan in operation.	Motor monitoring
	7.1.6		Burner must be in operating position.	Limit switch
	7.1.7		Flame monitor must be ready for operation.	

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Area	Type	Measures		
		Interlock	Protective Measures	Monitoring
7.2 Constant Operating Conditions	7.2.1 In case of failure of the primary air	Quick shutoff of fuel feed		Motor monitoring
			Upon attaining minimal pressure value warning signal has to issue.	Pressure measurement with adjustable limit value following damper and fan.
	7.2.2 In case of failure of mix air	Quick shutoff of fuel feed	A warning signal has to sound upon attaining minimal pressure value	
	7.2.3 In case of failure of a downstream exhaust gas fan	Quick shutoff of fuel feed		Motor monitoring
	7.2.4 In case of failure of the sintering zone burner due to plant interlock by CO max.	Quick shutoff of fuel feed		
	7.2.5 Burner not in operating position	Quick shutoff of fuel feed		Limit Switch, if Present
	7.2.6 Upon attaining the max. temperature after burning compartment	Quick shutoff of fuel feed	Before attaining the max. value a warning signal has to sound.	Temperature measurement with adjustable limit values

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Area	Type	Measures		
		Interlock	Protective Measures	Monitoring
	7.2.7 If max. or min. pressure following kiln exhaust gas fan	Quick shutoff of fuel feed		Measurement of static pressure directly following kiln exhaust gas fan with adjustable limit values.
	7.2.8 In case of flame extinction	Quick shutoff of fuel feed		Flame monitor
	7.2.9 Upon attaining a minimal pressure following the burning chamber	Quick shutoff of fuel feed	Before attaining the minimum value a warning signal has to sound	Pressure measurement with adjustable limit values.
	7.2.10 <u>Only with Oil Firing</u> Upon attaining a minimal temperature of the fuel		Warning signal	Temperature measurement with adjustable limit values.

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Area	Type	Measures		
		Interlock	Protective Measures	Monitoring
8. Switchover	Simple/Compound Operation			
8.1 Switchover Requirements	8.1.1 When switching from simple to compound and vice-versa		Static pressure after kiln exhaust gas fan has to be held constant	Pressure measurement
9. Bypass				
9.1 Constant Operation	9.1.1 In case of failure of the bypass fan	Only with Bypass Values > or = 5%		
		Quick shutoff of fuel feed for the sintering zone burner		Differential between the volumetric flow measurement: fresh air and bypass volume
			Only for Bypass Volumes < = 5% Warning signal	For bypass systems designed for > or = 5%
				Motor monitoring
				For bypass systems designed for > or = 5%

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Area	Type	Measures		
		Interlock	Protective Measures	Monitoring
				Difference from the volumetric flow: fresh air and bypass volume.
10. Fuel Increment				
10.1 Requirements	10.1.1 Adjustment of the fuel increment to the time cycle of the gas analyzer		Additional fuel feed can only be possible after it has been ascertained that the gas analysis has already computed the preceeding fuel increment. Increase in the fuel volume has to take place in steps of max. 10% fuel increment each with a subsequent wait of 100 seconds.	
	10.1.2 When exceeding the control deviation (e.g., possible case of a cable breakdown of the actual value con-troller)	Quick shutoff of fuel feed (sintering zone burner and calciner burner)		

APPENDIX C

TABLES 9-1, 9-2, 9-3, 9-4: FUEL SPECIFICATIONS

AMPLE ANALYSIS REPORT

BEST AVAILABLE COPY

TEAM COAL

TABLE 9-1
COAL ANALYSIS

RCH OF KENTUCKY - UPPER LICK MINE

OXIMATE ANALYSIS	As Rec'd	Dry Basis
oisture	5.00	0.00
1	9.14	9.62
atile Matter	34.45	36.26
xed Carbon	51.41	54.12
U/lb.	12,571	13,233
lfur	0.75	0.79

ULTIMATE ANALYSIS	As Rec'd	Dry Basis
Moisture	5.00	0.00
Ash	9.14	9.62
Hydrogen	4.85	5.11
Carbon	69.80	73.47
Nitrogen	1.35	1.42
Sulfur	0.75	0.79
Chlorine	0.14	0.15
Oxygen	8.97	9.44

ULFUR FORMS	As Rec'd	Dry Basis
itic	0.28	0.30
lphate	0.04	0.04
anic	0.43	0.45
al	0.75	0.79

MINERAL ANALYSIS	As Rec'd	Dry Basis
Moisture	5.00	0.00
Silicon Dioxide, SiO2	53.43	56.25
Aluminum Oxide, Al2O3	28.02	29.49
Titanium Dioxide, TiO2	1.14	1.20
Calcium Oxide, CaO	1.05	1.11
Iron Oxide, Fe2O3	7.01	7.38
Magnesium Oxide, MgO	1.05	1.10
Potassium Oxide, K2O	2.54	2.67
Sodium Oxide, Na2O	0.44	0.46
Sulfur Trioxide, SO3	[illegible]	[illegible]
Phos. Pentoxide, P2O5	0.17	0.18
Strontium Oxide, SrO	—	
Barium Oxide, BaO		
Manganese Dioxide, MnO2	—	—
Undetermined	0.01	0.01

ATER SOLUBLE ALKALIES	As Rec'd	Dry Basis
assium Oxide, K2O	0.008	0.008
lium Oxide, Na2O	0.005	0.005
lorine	—	—

SION TEMPERATURE	Reducing	Oxidizing
tial	2700 F	2700 F
ftening (H=W)	2700 F	2700 F
misphericaI (H=1/2W)	2700 F	2700 F
uid	2700 F	2700 F

ISCELLANEOUS	
alies as Na2O (dry)	—
AF BTU/lb.	14,642
quilibrium Moisture	3.02
rdgrove Grindability Index	49
e Swelling Index	3
uling Index	0.07
gging Index	0.12
ulfur/MM BTU	0.60
O2/MM BTU	1.19

% Acidic	86.94
% Basic	12.72
Base:Acid Ratio	0.15
Silica/Alumina Ratio	1.91
Silica Ratio	85.43
Bitum. or Lignite	"B"
Dolomite	17.37
T250 Temperature	+2700 F

TABLE 9-2

No. 2 Fuel Oil Typical Specifications

rade	No. 1 Fuel Oil	No. 2 Fuel Oil	No. 4 Fuel Oil	No. 5 Fuel Oil	No. 6 Fuel Oil
ype	Distillate (Kerosene)	Distillate	Very Light Residual	Light Residual	Residual
olor	Light	Amber	Black	Black	Black
PI gravity, 60 F	40	32	21	17	13
pecific gravity, 60/60 F	0.8251	0.8654	0.9279	0.9529	0.9861
b per U.S. gallon, 60 F	6.870	7.206	7.727	7.935	8.212
iscos., Centistokes, 100 F	1.6	2.68	15.0	50.0	360.0
iscos., Saybolt Univ., 100 F	31	35	77	232	—
iscos., Saybolt Furol, 122 F	—	—	—	—	170
our point, F	Below zero	Below zero	10	30	65
emp. for pumping, F	Atmospheric	Atmospheric	15 min.	35 min.	100
emp. for atomizing, F	Atmospheric	Atmospheric	25 min.	130	200
arbon residue, per cent	Trace	Trace	2.5	5.0	12.0
Sulfur, per cent	0.1	0.4–0.7	0.4–1.5	2.0 max.	2.8 max.
Oxygen and nitrogen, per cent	0.2	0.2	0.48	0.70	0.92
Hydrogen, per cent	13.2	12.7	11.9	11.7	10.5
Carbon, per cent	86.5	86.4	86.10	85.55	85.70
Sediment and water, per cent	Trace	Trace	0.5 max.	1.0 max.	2.0 max.
Ash, per cent	Trace	Trace	0.02	0.05	0.08
Btu per gallon	137,000	141,000	146,000	148,000	150,000

* Technical information from Humble Oil & Refining Company.

Ref: EPA 450/2-80-063