Rayonier

Specialty Pulp Products

Fernandina Mill

RECEIVED

OCT 26 1998

BUREAU OF
AIR REGULATION

October 23, 1998

A. A. Linero
New Source Review Section
Department of Environmental Protection
2600 Blair Stone Road
Tallahassee, FL 32399-2400

RE: DEP File No. 08900004-006-AC (PSD-FL-256)
Specialty Pulp Products, Temporary Replacement Boiler

Dear Mr. Linero:

In response to your letter of October 19, 1998, Mr. William Shuman, the engineer for the foundation repairs to No. 1 and No. 2 boilers, has sent to you under separate cover a certification that the foundation work will not increase the annual capacity factor of the boilers.

Capacity factor is driven by pulp and energy production. This work will not change either. Some new burner management systems will also be installed, but these will decrease emissions.

In response to your second request, average annual capacity factor for the last two years I am providing the oil and wood fuel usage for the years 1996 and 1997 from the annual operating report, which has been provided to the Department previously.

	Oil(thous. gals)		Wood (tons)	
	1996	1997	1996	1997
No. 1 boiler	6,133	6,255	none	None
No. 2 boiler	1,020	977	96,587	113,233

I appreciate the attention Syed is giving to this permit application. We still plan to begin work on No. 2 boiler during our December shutdown. We must have this temporary boiler functional to be able to start up the mill in January. Fortunately it can sit on a existing foundation. Once we receive the draft permit we will make further arrangements to receive the boiler. If I can assist your review in any way please do not hesitate to call me at 904-277-1452, Email: david.tudor@rayonier.com.

Sincerely,

David E. Tudor
Manager Environmental
Affairs – Air

CC: Syed Arif
Michael Ryan, EMCON
Rita Fenton-Smith
Christopher Kirts

EPA
NPS

Rayonier

Specialty Pulp Products

Fernandina Mill

October 22, 1998

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OCT 26 1998

BUREAU OF
AIR REGULATION

Mr. A. A. Linero, P.E., Administrator
New Source Review Section
Department of Environmental Protection
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Subject: DEP File No. 0890004-006-AC (PSD-FL-256)
Specialty Pulp Products, Temporary Replacement Boiler

Dear Mr. Linero:

Foundation repairs for No's. 1 & 2 Power Boilers at our Fernandina Beach, Florida Mill will have no effect on the capacity of the boilers. The foundation repairs are solely for the purpose of stabilizing the structures to insure continuous, reliable operation of the boilers. David Tudor will be responding to other requests in your letter dated October 19, 1998. This letter is only in response to your question of the effect the foundation repairs will have on the boilers' capacity. If you have any other questions regarding the repairs, please call me at (904) 277-1383.

Sincerely,

John W. Shuman

John W. Shuman, P.E.
Manager – Special Engineering Projects
FL Reg. No. 22141

cc: Mr. Michael Ryan - EMCON

Dave Tudor - FYI
Syed Arif
File

Rayonier

Specialty Pulp Products

Fernandina Mill

October 22, 1998

Mr. A. A. Linero, P.E., Administrator
New Source Review Section
Department of Environmental Protection
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Subject: DEP File No. 0890004-006-AC (PSD-FL-256)
Specialty Pulp Products, Temporary Replacement Boiler

Dear Mr. Linero:

Foundation repairs for No's. 1 & 2 Power Boilers at our Fernandina Beach, Florida Mill will have no effect on the capacity of the boilers. The foundation repairs are solely for the purpose of stabilizing the structures to insure continuous, reliable operation of the boilers. David Tudor will be responding to other requests in your letter dated October 19, 1998. This letter is only in response to your question of the effect the foundation repairs will have on the boilers' capacity. If you have any other questions regarding the repairs, please call me at (904) 277-1383.

Sincerely,

John W. Shuman

John W. Shuman, P.E.
Manager – Special Engineering Projects
FL Reg. No. 22141

cc: Mr. Michael Ryan - EMCON

Department of Environmental Regulation

Routing and Transmittal Slip

To: (Name, Office, Location)

1. Al Liners
2. MS-5505
3.
4.

Patty - Contract Office

Remarks: Patty:

Per Our Phone Conversation I am forward the Check and application to your Office for Al Liners attention.

From: Ollie Henderson

Date 10/7/98

Phone

Rayonier *FERNANDINA DIVISION* *FERNANDINA BEACH, FLORIDA*

052229 ORIGINAL-ACCOUNTS PAYABLE CHECK

MO.	DAY	YR.	INVOICE NUMBER	EXPLANATION	GROSS AMT.	DISCOUNT
9	25	98	9/25/98	PSD PERMIT F/TEMP B/U BLR	7500.00	

VENDOR NO.	CHECK NUMBER	DATE	GROSS AMT.	DISCOUNT	NET AMT.
02437		9/30/98	7500.00		7500.00

ATTACHED CHECK IN PAYMENT OF ITEMS LISTED ABOVE NO RECEIPT REQUIRED DETACH THIS STATEMENT

Trust Company Bank
Atlanta, Georgia or
FNB Rome, Georgia

Rayonier
FERNANDINA MILL
FERNANDINA BEACH, FLORIDA

64-79
611

052229

LOCATION NO.

DATE
9/30/98

DOLLARS	CENTS
7,500 AND	00

NOT GOOD AFTER 90 DAYS

TWO SIGNATURES REQUIRED OVER $24,999.99

PAY

*Seven-Thousand Five-Hundred 00/100 dollars ************************************

TO THE ORDER OF

DEPT. OF ENV. PROTECTION
NORTHEAST DISTRICT
7825 BAYMEADOWS WAY SUITE B200
JACKSONVILLE, FL
322567577

AUTHORIZED SIGNATURE

AUTHORIZED SIGNATURE

⑈052229⑈ ⑆061100790⑆ 8800497052⑈

Rayonier

Specialty Pulp Products

Fernandina Mill

REQUEST FOR CHECK

Date: ________________

Payable to: Florida Department of Environmental Protection

Address: give to Dave Tudor on Fri 10/2/98

RECEIVED

OCT - 2 1998

DEPT. OF ENV. PROTECTION
NORTHEAST DISTRICT - JAX

For: PSD Permit for Temp backup boiler

Charge Account: PAR 6F 97-068 $7500.00

Charge Account: ________________

Charge Account: ________________

Requested By: David E. Tudor

Department Head Approval: ________________

Accounting Office Approval: ________________

FORM1 - 12/6/94

Rayonier

Specialty Pulp Products

Fernandina Mill

October 2, 1998

Christopher L. Kirts, P.E.
Department of Environmental Protection
7825 Baymeadows Way, Suite B200
Jacksonville, FL 32256-7590

0890004-006- AC
PSD-FL-256

RE: Nassau County – AP
Rayonier, Inc.
Temporary Replacement Boiler
File No.: 0890004-006
Request for Additional Information (September 1, 1998 and September 3, 1998)

Dear Mr. Kirts:

On August 7, 1998 Rayonier submitted a construction permit for a temporary boiler to replace either boiler No. 1 or No. 2 while foundations under those boilers are repaired. On September 1 and 3, 1998 you requested additional information regarding those permits. This letter responds to both requests. Responses numbers correspond to the request number in each letter.

Responses to the September 1, 1998 Request for Additional Information

1. A BACT analysis has been prepared and is enclosed as part of a revision to the application. This BACT analysis includes the pollutants particulate matter, sulfur dioxide, and nitrogen oxides. However, our netting analysis indicates that only NO_x emissions increase by an amount greater than the significance levels. Particulate emissions are assumed to be all PM10 emissions and increases of that pollutant are projected at 9 TPY. Sulfur dioxide emissions increases are projected at 34 TPY. A BACT for particulate matter and sulfur dioxide has been submitted for information.

2. The BACT analysis includes feasibility and cost effectiveness for alternate control strategies for sulfur dioxide.

3. The wrong opacity standard rule was indicated as the applicable rule. The applicable opacity rule is FAC 62-296.406(1). A revised page 32 to the application is enclosed with this letter indicating the correct standard and basis.

4. This application has been revised to be a PSD application. A revised page 34 of the application is enclosed to indicate that this unit is undergoing PSD review as part of this application. A technology review (BACT) is enclosed. The other elements of PSD, such as source impact analysis, air quality analysis, additional impact analysis and class I review are not applicable to this application because this is a temporary source.

Responses to the September 3, 1998 Request for Additional Information

1. The response letter indicates the wrong emissions increases. The delta emissions that should be used are those in the far right hand column which reflects the times each existing boiler will be off line and replaced with the temporary boiler. The NO_x emissions in that table were estimated using AP42 emission factors generic to the N content. However, in the process of completing the BACT analysis, actual Nitrogen content of the fuel was determined and the table submitted with the original letter is reproduced here using AP42 emission factors corrected for the N content of the fuel used at Fernandina.

The revised emission factor and NOx emission calculations are:

Quantity of fuel burned in 1997:
#1 boiler 6,255 x 10^3 gals. #6
#2 boiler 977 x 10^3 gals. #6; 113,233 tons bark

NO_x #1 boiler using AP42 emission factor adjusted for #6 oil at 0.5% N content.

(20.54 + 104.39 x N) lb./tgal. x 6,255 tgal./yr. x 1/2000 ton/lb. = 227 TPY

NO_x #2 boiler using AP 42 emissions factors adjusted for #6 oil at 0.5% N content.

(20.54 + 104.39 x N) lb/tgal x 977 tgal./yr x 1/2000 ton/lb. = 36 TPY

Bark portion of NO_x generated as per AOR = 22 TPY

NO_x temporary boiler using BACT emissions

0.425 lb NO_x/MMBtu x 212 MMBtu/hr x 8760 hr/yr x 1/2000 ton/lb = 395 TPY

Pollutant	#1 boiler actual emissions 97 AOR	#2 boiler actual emissions 97 AOR	Temp boiler Potential emissions AP42	Delta emissions With temp on and #1 off	Delta emissions with temp on and #2 off	Delta emissions with repair of 8 mos. to No 2 and 4 mos. No. 1
PM10 & PM	111	159	21[2]	-90	-138	-122
SO2	467	81	244	-223	162	34
CO	16	376	31	15	-345	-225
NOx	227[1]	58[1]	395[2]	167	336	280
VOC	1	10	7	6	-3	0

[1] NO_x emissions have been adjusted from the AOR to reflect N content of fuel.
[1] PM & NOx emission reflects BACT determination.

2. The table submitted with the permit application was calculated for Particulate Matter. It was assumed that all Particulate Matter is emitted as PM10. The revised table above indicates this assumption. Note that the increase in PM and PM10 both are less that the PSD significant levels.

3. The BACT analysis is enclosed and is submitted as an amendment to the permit application.

4. A check for $7500.00 is attached to the submittal.

5. A copy of this letter with enclosures has been sent to Syed Arif in Tallahassee.

Also attached is a copy of the certification by the professional engineer named in the application, Michael Ryan of Emcon.

Sincerely,

David E. Tudor
Manager Environmental
Affairs Air

Enc.

Cc: Syed Arif
Michael Ryan, Emcon

cc: EPA
NPS

I. VISIBLE EMISSIONS INFORMATION
(Regulated Emissions Units Only)

Visible Emissions Limitation: Visible Emissions Limitation __1__ of __1__

1. Visible Emissions Subtype: **VE30**
2. Basis for Allowable Opacity: [X] Rule [ ] Other
3. Requested Allowable Opacity: Normal Conditions: **20** % Exceptional Conditions: **27** % Maximum Period of Excess Opacity Allowed: **6** min/hour
4. Method of Compliance: **EPA Method 9**
5. Visible Emissions Comment (limit to 200 characters): **Wet scrubber on stack.** **Rule basis for allowable opacity is FAC 62-296.406(1)**

Visible Emissions Limitation: Visible Emissions Limitation ______ of ______

1. Visible Emissions Subtype:
2. Basis for Allowable Opacity: [ ] Rule [ ] Other
3. Requested Allowable Opacity: Normal Conditions: % Exceptional Conditions: % Maximum Period of Excess Opacity Allowed: min/hour
4. Method of Compliance:
5. Visible Emissions Comment (limit to 200 characters):

K. PREVENTION OF SIGNIFICANT DETERIORATION (PSD) INCREMENT TRACKING INFORMATION (Regulated and Unregulated Emissions Units)

PSD Increment Consumption Determination

1. Increment Consuming for Particulate Matter or Sulfur Dioxide?

If the emissions unit addressed in this section emits particulate matter or sulfur dioxide, answer the following series of questions to make a preliminary determination as to whether or not the emissions unit consumes PSD increment for particulate matter or sulfur dioxide. Check the first statement, if any, that applies and skip remaining statements.

[X] The emissions unit is undergoing PSD review as part of this application, or has undergone PSD review previously, for particulate matter or sulfur dioxide. If so, emissions unit consumes increment.

[ ] The facility addressed in this application is classified as an EPA major source pursuant to paragraph (c) of the definition of "major source of air pollution" in Chapter 62-213, F.A.C., and the emissions unit addressed in this section commenced (or will commence) construction after January 6, 1975. If so, baseline emissions are zero, and emissions unit consumes increment.

[ ] The facility addressed in this application is classified as an EPA major source, and the emissions unit began initial operation after January 6, 1975, but before December 27, 1977. If so, baseline emissions are zero, and emissions unit consumes increment.

[ ] For any facility, the emissions unit began (or will begin) initial operation after December 27, 1977. If so, baseline emissions are zero, and emissions unit consumes increment.

[ ] None of the above apply. If so, the baseline emissions of the emissions unit are nonzero. In such case, additional analysis, beyond the scope of this application, is needed to determine whether changes in emissions have occurred (or will occur) after the baseline date that may consume or expand increment.

2. Increment Consuming for Nitrogen Dioxide?

If the emissions unit addressed in this section emits nitrogen oxides, answer the following series of questions to make a preliminary determination as to whether or not the emissions unit consumes PSD increment for nitrogen dioxide. Check first statement, if any, that applies and skip remaining statements.

[**X**] The emissions unit addressed in this section is undergoing PSD review as part of this application, or has undergone PSD review previously, for nitrogen dioxide. If so, emissions unit consumes increment.

[ ] The facility addressed in this application is classified as an EPA major source pursuant to paragraph (c) of the definition of "major source of air pollution" in Chapter 62-213, F.A.C., and the emissions unit addressed in this section commenced (or will commence) construction after February 8, 1988. If so, baseline emissions are zero, and emissions unit consumes increment.

[ ] The facility addressed in this application is classified as an EPA major source, and the emissions unit began initial operation after February 8, 1988, but before March 28, 1988. If so, baseline emissions are zero, and emissions unit consumes increment.

[ ] For any facility, the emissions unit began (or will begin) initial operation after March 28, 1988. If so, baseline emissions are zero, and emissions unit consumes increment.

[ ] None of the above apply. If so, the baseline emissions of the emissions unit are nonzero. In such case, additional analysis, beyond the scope of this application, is needed to determine whether changes in emissions have occurred (or will occur) after the baseline date that may consume or expand increment.

3. Increment Consuming/Expanding Code:			
PM	[ ] C	[ ] E	[**X**] Unknown
SO2	[ ] C	[ ] E	[**X**] Unknown
NO2	[ ] C	[ ] E	[**X**] Unknown
4. Baseline Emissions: **NA**			
PM		lb/hour	tons/year
SO2		lb/hour	tons/year
NO2			tons/year
5. PSD Comment (limit to 200 characters):			

4. Professional Engineer Statement:

I, the undersigned, hereby certify, except as particularly noted herein, that:*

(1) To the best of my knowledge, there is reasonable assurance that the air pollutant emissions unit(s) and the air pollution control equipment described in this Application for Air Permit, when properly operated and maintained, will comply with all applicable standards for control of air pollutant emissions found in the Florida Statutes and rules of the Department of Environmental Protection; and

(2) To the best of my knowledge, any emission estimates reported or relied on in this application are true, accurate, and complete and are either based upon reasonable techniques available for calculating emissions or, for emission estimates of hazardous air pollutants not regulated for an emissions unit addressed in this application, based solely upon the materials, information and calculations submitted with this application.

If the purpose of this application is to obtain a Title V source air operation permit (check here [ ] if so), I further certify that each emissions unit described in this Application for Air Permit, when properly operated and maintained, will comply with the applicable requirements identified in this application to which the unit is subject, except those emissions units for which a compliance schedule is submitted with this application.

If the purpose of this application is to obtain an air construction permit for one or more proposed new or modified emissions units (check here [X] if so), I further certify that the engineering features of each such emissions unit described in this application have been designed or examined by me or individuals under my direct supervision and found to be in conformity with sound engineering principles applicable to the control of emissions of the air pollutants characterized in this application.

If the purpose of this application is to obtain an initial air operation permit or operation permit revision for one or more newly constructed or modified emissions units (check here [ ] if so), I further certify that, with the exception of any changes detailed as part of this application, each such emissions unit has been constructed or modified in substantial accordance with the information given in the corresponding application for air construction permit and with all provisions contained in such permit.

[signature] 10/2/98

Signature Date

(seal)

* Attach any exception to certification statement.

BEST AVAILABLE CONTROL TECHNOLOGY ANALYSIS FOR TEMPORARY BACK-UP BOILER AT

RAYONIER CELLULOSE FACILITY

FERNANDINA BEACH, FLORIDA

Prepared for

Rayonier, Inc.

October 2, 1998

Prepared by

EMCON
3 Riverside Drive
Andover, MA 01810-1121

Project 72780-006.098

CONTENTS

1 INTRODUCTION

On behalf of Rayonier, Inc., EMCON has compiled this best available control technology (BACT) information to supplement the application for a temporary replacement boiler at the Fernandina Beach cellulose manufacturing plant. This supplement to the application is in response to the Florida Department of Environmental Protection (DEP) Request for Additional Information (September 1, 1998) and the amended request (September 3, 1998).

The purpose of the temporary boiler is to enable the Rayonier facility to repair the foundations under two of the boilers in its power house. As the boilers are taken off-line, the facility will still require production steam, and a leased 212 mmBtu/hr temporary unit is proposed as the back-up steam source.

An application for a preconstruction air quality permit under FL 62-300 was initially submitted by Rayonier in August 1998. This supplemental BACT analysis provides information supporting the BACT conclusion for sulfur dioxide (SO_2), nitrogen dioxide (NO_X), and particulate. The analysis includes a Feasibility and Cost Effectiveness analysis for the proposed fuel. The emission standard for SO_2 and particulate emissions from a fuel combustion unit boiler is BACT as specified in 62-296.406 Florida Administrative Code (FAC).

To conduct the BACT analysis, EMCON followed BACT guidelines set forth by the United States Environmental Protection Agency (USEPA) Guidance in the NSR/PSD Handbook (1990). The guideline states that the BACT analysis must be evaluated on a "top-down" basis. That is, the very best option that has been demonstrated or is technically feasible must be considered first, then, only if that option is ruled out for environmental, energy or economic reasons can the next best option be considered. This top-down progression continues until a "Best Available Control Technology" is identified.

In accordance with the above referenced guidance, the BACT analysis is conducted on a pollutant specific basis. In the case of the temporary boiler proposed for Rayonier, the DEP specifically requested analysis of NO_x, SO_2 and particulate matter. Post combustion control technologies, including scrubbers and catalytic reduction technologies, and fuel substitution were examined for reducing all emissions. Combustion controls were considered to reduce NO_x.

This document includes the following:

- Facility and Equipment Description — Section 2
- NO_X Control Systems and BACT — Section 3
- SO_2 Control Systems and BACT — Section 4
- Particulate Control Systems and BACT — Section 5

2 FACILITY AND EQUIPMENT DESCRIPTION

Rayonier, Inc., owns and operates a dissolving sulfite cellulose manufacturing facility located in Fernandina Beach, Florida. Detailed information about the facility is contained in the Title V permit application submitted to the DEP and US EPA on June 15, 1996.

Repairs that must be made to the foundations of power boilers nos. 1 and 2 require the installation of a temporary boiler to compensate for the boilers that will be shut down. The proposed temporary boiler will be operated for a total of 12 months while each permanent boiler is sequentially repaired. It will have a heat input capacity of 212 mmBtu/hr. The temporary installation is designed to connect to the existing fuel supply system and the existing particulate/SO_2 emission control system.

2.1 Existing Boiler Equipment

Boiler no. 1 at the Rayonier facility uses #6 fuel with a 2.5% sulfur content and has a heat input capacity of 185 mmBtu/hr. Boiler no. 2 primarily fires wood waste and also fires #6 oil with 2.5% sulfur content when required. The heat input capacity for boiler no. 2 varies depending on fuel fired, and can fire 218 mmBtu/hr on wood fuels and 184 mmBtu/hr on #6 oil. There is a single #6 oil fuel storage and supply system at the facility that supplies fuel to boiler nos. 1 and 2 and supplies fuel as needed by other combustion units.

2.2 Existing Control Systems

Because of the need to control particulate from its wood and #6 oil fired boilers, Rayonier operates two venturi scrubber systems. Rayonier's venturi scrubber system recycles the caustic waste stream from the bleach plant, a dilute sodium hydroxide solution, as a scrubber solution. As different waste streams from different products are used, the acidity is controlled to maintain a pH of approximately 7.0 to protect the system. This is achieved by adding caustic soda and/or a defoaming chemical as needed. The scrubber system adds humidity to the exhaust stream and cools it significantly.

The particulate emission rate (all particulate is assumed to be PM10 for the purpose of this application) is under 0.2 grains/dry standard cubic foot, as demonstrated by testing.

A secondary benefit of the venturi scrubber systems is the reduction of SO_2 emissions. A recent test shows the SO_2 reduction efficiency is approximately 90 percent.

The exhaust from both boiler nos. 1 and 2 is vented through the Scrubber A system, as described in the permit application. The proposed temporary boiler will be hooked in to Scrubber A. Because the temporary boiler will fire #6 fuel oil while the wood boiler (no. 2) foundation is repaired, this will eliminate the wood combustion particulate for that time period.

Emission rates are also a function of the fuels used. Rayonier's first choice of fuel is its wood waste, which is fired in boiler no. 2 and others not included in this project. Because the facility requires more process steam than its wood waste fuels can produce, it also stores and uses #6 residual oil with a sulfur content of 2.5%. The use of 2.5% fuel oil is permitted for these units, and the particulate and SO_2 emission rates are reduced by the wet scrubber system.

Table 2-1
Equipment Summary for Boiler Project

Equipment	Size or Capacity	Fuel(s)
Boiler no.1	185 mmBtu/hr	2.5% Sulfur, #6 Fuel Oil
Boiler no.2	218 / (184) mmBtu/hr	Wood Waste / (2.5% Sulfur, #6 Fuel Oil)
Proposed Temporary Boiler	212 mmBtu/hr	2.5% Sulfur, #6 Fuel Oil
Venturi Scrubbers	N/A	N/A

2.3 Operations and Emissions

The power requirement at Rayonier varies as different products are made, which typically changes twice a week. The process liquids also change with production, so the scrubber systems use different amounts of chemicals during different production scenarios to avoid acid conditions.

Boiler no.2 is a preferred steam source because it uses fuel that would otherwise be waste. The annual capacity factor for boiler no.1 was about 50 percent in 1997.

The temporary boiler will replace the steam generating capacity of whichever of the two boilers is being repaired. To fulfill the steam demand for the boiler under repair, the proposed temporary unit will have a heat input capacity of 212 mmBtu/hr. Because the boiler is a temporary unit designed for ease of transport, it is designed for minimal boiler size and maximum boiler output. Therefore, the boiler will be a high heat release boiler with a smaller combustion camber volume under high load. By nature of the temporary boiler design, the thermal NO_x generation will be higher.

The temporary boiler is expected to be under high load while boiler no. 2 is off-line for about 8 months in the first part of 1999. At the end of eight months, it will then replace boiler no. 1 and be in use at an average 50 percent capacity for the next four months while the wood waste unit is back in operation. As a result, actual emissions are expected to be less than 85 percent of potential emissions. For purposes of BACT and permitting, Rayonier has assumed potential uncontrolled emissions based on maximum heat output and 8760 hours of operation although actual emissions are expected to be lower than calculated potentials.

3 NO_X CONTROL SYSTEMS AND BACT

The following provides a discussion of available NO_x control techniques with analysis of control scenarios for Rayonier which leads to the BACT selection. Supporting calculations are found in Appendix A.

NO_x is formed in combustion processes through the thermal fixation of atmospheric nitrogen in the combustion air and the oxidation of fuel bound nitrogen. The thermal reaction is dependent on peak temperature, oxygen concentration, and time of exposure at peak temperature. The conversion of fuel nitrogen to NO_x can be as high as 90 percent, but as low as 20 percent. The nitrogen content of oils vary from values in the range of 0.1 to 0.2% for distillate oil (#2 oil) while residual #6 oils may have nitrogen contents in the range of 0.3 to 0.6%. There are no refining specifications or regulatory requirements targeted toward the nitrogen content of fuels.

EMCON developed a list of NO_x control techniques through review of EPA's Compilation of Emission Factors (AP-42), investigation of the EPA RACT/BACT/LAER Clearinghouse (RBLC or "BACT/LAER database"), and discussions with vendors. The principle types of control techniques for NO_x can be described as: (1) control techniques that affect the boiler combustion and (2) control techniques that are applied to the flue gas from the boiler after combustion. Post combustion techniques are add-on controls that are additional processes to the boiler itself. For Rayonier both types of control techniques were examined.

The RBLC contained NO_X emission rate information on six permits for fuel oil boilers over 100 mmBtu/hr, with three BACT determinations reported in lb/mmBtu. No NO_x BACT determinations were based on post-combustion add-on controls. None of the BACT determinations provided in the RBLC were for temporary boiler installations. A summary chart of the RBLC determinations is contained in Appendix B.

The combustion controls equipped on the temporary boiler proposed by Rayonier include flue gas recirculation (FGR) and low NO_x burners. A discussion with the vendor indicated that no boilers were available without these controls, hence, EMCON assumed that level of control to be part of the baseline equipment, and therefore, it was not costed separately.

Because the boiler is temporary (12 months), the economic impact analysis of add-on type controls were based on a one year equipment life amortization versus a typical 10 year life. The one year timeframe results in a very high economic impact as calculated following BACT guidelines. Combustion controls can be incorporated into the boiler design and, therefore, have a lower economic impact.

Table 3-1 provides options presented in descending order of control efficiency:

Table 3-1
NO_x Control Techniques

Control Technology	Control Efficiency
Flue Gas Controls	
Conventional Selective Catalytic Reduction	90 - 80%
Selective Noncatalytic Reduction	70-40%
Combustion Controls	
Low NO_X Burners with Flue Gas Recirculation	50-20%
Staged Combustion	50-20%
Low NO_X Burners	50-20%
Fuel Substitution	35-7%
Load Reduction	33-25%
Flue Gas Recirculation	30-15%
Low Excess Air	28-0%

The following provides a discussion of control alternatives which could potentially be employed for the reduction in NO_X emissions from the proposed temporary boiler

3.1 Selective Catalytic Reduction

Selective Catalytic Reduction (SCR) involves injecting ammonia or urea into the emission stream where it selectively reacts with NO_x and a catalyst in the presence of oxygen to form nitrogen gas and steam. The combustion temperature and the amount of ammonia injection must be closely monitored to achieve the desired pollutant reductions. An SCR is effective in removing NO_X, with reductions as great as 80 to 90 percent under ideal temperature conditions (steady load and 600 to 800 °F). However, the SCR process may actually increase the amount of NO_x if operated outside of the prescribed temperature range and/or wide load variations.

The demand on the temporary boiler proposed for the Fernandina Beach facility will vary considerably during the course of the repairs of the permanent boilers. The load changes and frequent startup and shutdowns are detrimental to the operation of the SCR process, particularly the catalyst. Ideal reductions of 80 to 90 percent control efficiency would not be achieved under these conditions. Reductions of 80 percent have been anticipated for the purpose of calculating NO_x emissions for the SCR options analysis.

Other environmental concerns of using a SCR unit are the handling and storage of ammonia, unreacted ammonia emissions, and disposal of spent catalysts. Ammonia is a hazardous compound. For the quantities of ammonia that Rayonier would be required to store, they would have to undergo additional environmental and safety permitting. Unreacted ammonia ("Ammonia Slip") emissions can occur if ammonia is fed to the process at greater than stiochiometric concentrations. Ammonia slip may occur during startup or shut down, sudden load changes, injection at other than the optional temperature range, insufficient carrier gas, or greater than stoichiometric concentrations of ammonia

The annualized capital and operating cost of the SCR unit is approximately $2.2 million. Using a 80% reduction of NO_x, the economic impact in terms of cost per ton of NO_x removed would be approximately $6,970. Detailed cost calculations are provided in Appendix A. Based on the cost of an SCR system for the proposed temporary boiler, this option is considered to be economically unfeasible.

3.2 Selective Non-Catalytic Reduction

Selective non-catalytic reduction (SNCR) is similar in principal to SCR but is practiced at a much higher temperature and without a catalyst. The process utilizes injection of ammonia or urea at high temperatures to reduce NO_x. This process is highly dependent on injection of the reagent at the appropriate temperature. Required temperatures usually run between 1600 and 1800 °F with control efficiencies ranging from 30 - 60 percent for SNCR units.

In applying SNCR, a temperature profile of the boiler is developed to identify the most appropriate location for the ammonia or urea injection ports. As mentioned in the discussion on SCR, the facility's boilers will be undergoing load changes, startup and shutdown. These conditions will change the temperature profile of the boiler. Because the injection point cannot be relocated during operation, changing the temperature profile may change the temperature at the injection point beyond the 1600 to 1800°F range necessary for optional NO_x reduction. When this occurs, emissions of both NO_x and ammonia will increase. A control efficiency of 30% was assumed, because efficiencies at the higher end of the range are rarely achieved in practice and the temperature profile will change with load swings,reducing efficiency.

The annualized capital and operating cost of the SNCR unit is approximately $1.03 million. Using 30% reduction of NO_x, the economic impact in terms of cost per ton of NO_x removed would be approximately $8,750. Detailed cost calculations can be found in Appendix A. Based on the cost of an SNCR system for the proposed temporary boiler, this option is considered to be economically unfeasible.

3.3 Low NO_X Burners with Flue Gas Recirculation

Low NO_x burners reduce NO_x by conducting the combustion process in stages. Staging partially delays the combustion process, resulting in a cooler flame which suppresses thermal NO_x formation. Nitrogen oxide emission reductions of 40 to 85 percent (relative to uncontrolled emission levels) have been observed with low NO_x burners when combined with flue gas recirculation.

Low NO_x burners are frequently used on the type and size of the temporary boiler proposed by Rayonier. The low relative cost and NO_x reduction capability make it the most widely used NO_x control option identified in the BACT/LAER database. Low NO_x burners are an available and applicable NO_x reduction technology.

In a flue gas recirculation (FGR) system, a portion of the flue gas is recycled from the stack to the burner windbox. Upon entering the windbox, the cooler gas is mixed with combustion air prior to being fed to the burner. The FGR system reduces NO_x emissions by two mechanisms. In the first mechanism, the recycled flue gas is made up of combustion products which act as inserts during combustion of the fuel/air mixture. This additional mass is heated in the combustion zone, thereby lowering the peak flame temperature and reducing the amount of NO_x formed. Second, to a lesser extent, FGR also reduces NO_x formation by lowering the oxygen concentration in the primary flame zone. The temperature and amount of the flue gas recirculated are a key operating parameters influencing NO_x emission rates for these systems. FGR is normally used in combination with low NO_x burners.

The installed cost of a low NO_x burner and FGR have not been detailed as they were part of the base temporary boiler package in the lease agreement that Rayonier is seeking. Operating costs for a low NO_x burner are essentially the same as those for other burners, as such, no economic impact has been assumed for the low NO_x burner/FGR control option. Based on vendor guarantees, based on the high nitrogen content of fuel typically supplied to Rayonier and the maximum heat output for the high heat release temporary boiler, the NO_X emission rate with low NO_x and FGR will be 0.425 lb/mmBtu.

The other techniques, low excess air and load reduction, are not as effective as the low NO_X burner and FGD, and no further BACT review was conducted for these techniques.

3.4 Fuel Substitution

NO_x emissions decrease as the nitrogen content of the fuel decreases. Fuel nitrogen contents vary by oil type, ranging from 0.3 to 0.6% in high sulfur residual #6 oil, to 0.1 to 0.2% for distillate fuels. Unlike the sulfur content of fuels, nitrogen levels are not specified or controlled as part of the refining process, hence, are not the subject of purchase specifications. As such, it is not practical to quantify any reductions in NO_x

emissions. However, using representative values for nitrogen concentrations from empirical data, the economic impact was determined for fuel substitution at Rayonier.

A recent test of the fuel composition at Rayonier shows the typical nitrogen content to be 0.5 percent in their 2.5% sulfur residual oil. If the fuel was switched to 1.0-1.5% sulfur fuel the nitrogen content would be expected to average 0.4 percent nitrogen the NO_x emission rate approximately 7% percent less. The lowest nitrogen content fuels are approximately 0.14 percent nitrogen which would reduce the rate 35% percent.

The boiler vendor has provided different guaranteed NO_x emission rates for different fuel nitrogen content levels. Although the nitrogen content is not a specified variable, empirical data shows that the nitrogen content is lower in the lower sulfur fuels.

Several inherent chemical properties make handling and combustion of different fuel types or quality more complex to implement. Fuel storage and delivery systems are different for #6 and #2 fuel oils, due to the differences in gravity and viscosity. Both the fuel delivery system and the boiler burner would need be altered to accommodate a lighter fuel oil, such as #2. It is unfeasible to deliver two grades of fuel in a single system so a new one would have to be constructed. Different fuel systems must be also installed if different nitrogen content fuels are required for individual combustion units at a facility.

A residual fuel oil system is not sensitive to nitrogen content, which means substituting a lower nitrogen oil is a technically feasible alternative at an existing facility. The viscosity and specific gravity variations among #6 fuels with different characteristics might require some operational adjustments in the delivery system, such as changing the fuel temperature.

The cost differential for Rayonier to purchase lower sulfur fuels is based on information from Bob Bosman of Steuart Petroleum. The cost of 1.5% sulfur fuel would be $0.10 more per gallon than the current 2.5% sulfur fuel and #2 distillate with 0.5% sulfur (per DEP requirements) would be $0.20 more per gallon. Based on the projected potential gallons of fuel, the costs of fuel substitution to control NO_x in the proposed temporary boiler is approximately $48,900 per ton of NO_x controlled using 0.4 percent nitrogen fuel, and $21,800 per ton NO_x controlled using 0.14 percent nitrogen fuel. Based on the cost analysis, fuel substitution is not considered economically feasible. Detailed cost calculations are provided in Appendix A.

3.5 BACT Conclusion for NO_x

Post combustion techniques of SCR and SNCR were not considered economically feasible for the one year operating period and raised additional environmental concerns of ammonia handling. Fuel substitution was not deemed economically feasible. As such, FGR and low NO_x burners with a vendor guaranteed maximum emission rate of 0.425 lb/mmBtu are considered to be BACT for this high heat release, temporary boiler.

4 SO_2 CONTROL SYSTEMS AND BACT

The following provides a discussion of each SO_2 control option examined for Rayonier and the BACT selection. Supporting calculations are found in Appendix A.

Because SO_2 is generated from the oxidation of sulfur contained in fuel, uncontrolled emissions are almost entirely dependent on the sulfur content of the fuel and are not affected by boiler size, burner design or grade of fuel being fired.

EMCON developed the following list of SO_2 control techniques through review of EPA's Compilation of Emission Factors (AP-42) and the RBLC for fuel oil combustion. The RBLC database contained information on several BACT determinations for oil-fired boilers in Florida, Virginia and others. It contained SO_2 emission rate information on six permits for fuel oil boilers over 100 mmBtu/hr, all based on fuel specifications. None were based on post-combustion controls. None of the BACT determinations were specific to temporary boilers.

A summary chart is provided in Appendix B.

The SO_2 control options are presented in descending order of control efficiency.

Table 4-1
SO_2 Control Options

Control Technique	Control Efficiency
Wet scrubbers	98-80%
Fuel Substitution	98-20%
Venturi Scrubber (caustic solution)	97-80%
Spray Drying	90-70%
Furnace/Duct Injection	50-25%

4.1 Wet Scrubbers

Control of the SO_2 emissions through the use of wet scrubbing techniques involves passing the boiler exhaust through a liquid medium. This either captures the sulfur oxide gas (or the particulate created as it oxidizes), or it reacts and neutralizes the pollutants.

Venturi scrubbers or packed bed scrubbers can be used. A venturi throttles the exhaust gas stream to create a low pressure zone which pulls scrubber liquid into the exhaust stream. An additional environmental benefit of the venturi scrubber system is that the waste water from production processes is used in the scrubber rather than going directly to the facility's wastewater treatment system. This saves water while treating the boilers' exhaust to reduce both particulate and SO_2.

Rayonier currently employs this technology to achieve both SO_2 and particulate control, for their permanent boiler and recent tests show it is 92-97 percent effective in reducing SO_2. A recent test of the existing scrubber control system at Rayonier shows the maximum SO_2 emission rate to be 0.2 lb/mmBtu.

The project to utilize a temporary boiler while boiler nos. 1 and 2 are sequentially taken off-line for repair creates no new wastewaters, although the scrubber liquid sulfur content will increase while Boiler no. 2 is not operating. Because this is the existing control system at the facility, there is no incremental cost considered for its use for the temporary boiler exhaust. The venturi scrubber is a feasible control option for Rayonier and will be used for SO_2 control.

A packed bed type scrubber using dual alkali or sodium carbonate scrubbing solution can achieve 96% or 98% removal, respectively, of acid gas. The recent scrubber test at Rayonier indicates that the existing Venturi system achieves 92 to 97 percent removal efficiency when the scrubber solution is maintained at a pH of 7.0 or higher. Packed bed scrubbers using scrubber solutions would not achieve reductions significantly better than the existing system. Installation of a new packed bed type scrubber would not improve the emission rate and is, therefore, not a practical alternative.

4.2 Fuel Substitution

SO_2 emissions decrease as the sulfur content of the fuel decreases. Fuel sulfur contents vary by oil type, ranging from heavy residual #6 oil, which can contain between 2.5-3 % sulfur, and lighter #2 distillate oils, which are normally a maximum of 0.5% sulfur in Florida but can be as clean as 0.05% sulfur for high grade transportation fuels. The lowest sulfur fuel available is natural gas, but it is not a feasible option for Rayonier because the gas distribution system ends 20 miles away.

Fuel storage and delivery systems are different for #6 and #2 fuel oils, due to the differences in gravity and viscosity. Both the fuel storage and delivery system and the boiler burner would need to be altered to accommodate a lighter fuel oil, such as #2. It is unfeasible to deliver two grades of fuel in a single system so a new one would have to be constructed. Different fuel systems must be also installed if different sulfur content fuels are required for individual combustion units at a facility.

A residual fuel oil system is not particularly sensitive to the sulfur content, as such, substituting a lower sulfur #6 oil is a technically feasible alternative at an existing facility. The viscosity and gravity variations among #6 fuels with different characteristics might require some operational adjustments in the delivery system, such as changing the fuel temperature.

Rayonier has a single #6 oil fuel system that supplies its power boilers, which are permitted for 2.5% sulfur oil. Any fuel switching control would be in addition to the control by the venturi scrubber, pushing the reduction efficiency from 97 percent (with the current 2.5% oil) to a little more than 99 percent (with distillate oil). In order to use a different sulfur content fuel for the proposed temporary boiler, an additional fuel system would need to be installed for the fuel or all boilers would have to use a lower sulfur fuel during the year.

A cost impact analysis was conducted to determine the economic feasibility of using lower sulfur oil. The first cost review was based on the SO_2 reduction possible by using 1.5% sulfur #6 oil or #2 fuel oil, for 8760 hours per year and it does not include any cost except the fuel prices. Based on information from Bob Bosman of Steuart Petroleum, the cost of 1.5% sulfur fuel would be $0.10 more per gallon than the current 2.5% sulfur fuel and #2 distillate with 0.5% sulfur would be $0.20 more per gallon. Therefore fuel switching to 1.5% or 0.5% sulfur oil would not be economically feasible at a cost of approximately $11,150 to $14,900 per ton of SO_2 controlled. Detailed cost calculations are provided in Appendix A.

The other techniques, spray drying and furnace and duct injection, have lower control effectiveness (25-50%) compared to the existing scrubber, and no further BACT review was conducted for these techniques.

4.3 BACT Conclusion for SO_2

EMCON has concluded that using the current fuel with the existing wet scrubber system represents BACT. The cost of fuel for the other existing steam generation units at the facility is not increased. The post combustion control technology of a venturi scrubber is economically feasible and will achieve an emission rate of 0.26 lb/mmBtu, which is considered to be BACT for this temporary boiler project.

5 PARTICULATE CONTROL

The following provides a discussion of each particulate control option examined for the proposed Rayonier temporary boiler and the BACT selection. For the purposes of this application, all particulate is assumed to be PM10. Supporting calculations are found in Appendix A.

EMCON has developed a list of particulate control techniques through discussions with vendors and a search of the EPA's RBLC database for fuel oil combustion by boilers over 100 mmBtu/hr. Six determinations referenced particulate rates. However, the fuels ranged from #6 fuel oil to natural gas and most were described as being controlled by boiler or combustion controls, with only two records referencing conventional particulate controls - fuel specifications and a multiclone. None of the BACT determinations were specific to temporary boilers.

The following provides a discussion of control alternatives which could potentially be employed for reducing particulate emissions (assuming all particulate is PM10 for this application) from the temporary boiler. The options are presented in descending order of control efficiency.

Table 5-1
Particulate Control Techniques

Control Technology	Control Efficiency
Fabric Filters/Electrostatic Precipitators	99%
Wet Scrubber	99-95%
Venturi Scrubber	92-87%
Fuel Substitution	91-35%
Cyclone/Multiclone	90-75%

5.1 Fabric Filters/Electrostatic Precipitators

Fabric filters can be applied to various size particles as well as a range of particulate loads. Typically fabric filters are used when high collection efficiencies are required, material is to be collected dry, volumetric flow is reasonably low, and temperatures are low. Typical control efficiencies for fabric filters are 99% or greater. Particulate emissions from wood fired boilers can be controlled with a fabric filter, but the fabric will clog up quickly when used to extract wood fuel particulate. At Rayonier, the economic impact of fabric filters was calculated to be $14,320 per ton particulate controlled.

Electrostatic precipitation is based on the mutual attraction between particles of one electrical charge and a collecting point of opposite polarity. Electrostatic precipitators (ESPs) are typically used when high efficiencies are required for one or more of the following conditions; removing fine dust, valuable material needs to be recovered, or very large volumes are to be handled. Typical control efficiencies for ESPs are 99% or greater. Since electrostatic precipitators are generally more expensive or equally as expensive as fabric filters, both fabric filters and electrostatic precipitators were eliminated from BACT due to high economic impact per ton controlled.

5.2 Fuel Substitution

Particulate emissions decrease as the sulfur content of the fuel decreases. Fuel sulfur content is a good indicator of combustion particulate produced from combustion. It varies by oil type, ranging from heavy residual #6 oil, which can contain between 2.5-3% sulfur, and lighter #2 distillate oils. As described for SO_2 and NO_x reduction, fuel storage and delivery systems are different for #6 and #2 fuel oils, due to the differences in gravity and viscosity. Both the fuel delivery system and the boiler burner would need be altered to some degree to accommodate a lighter fuel oil, such as #2.

However, a residual fuel oil system is not particularly sensitive to the sulfur content, which means substituting a lower sulfur #6 oil is a technically feasible alternative at an existing facility. Without considering the particulate reduction by the scrubber system, substituting 1.5% sulfur #6 oil would reduce the emission rate approximately 35 percent at a cost of $21,760 per ton particulate controlled, and #2 oil (at 0.5% sulfur) would reduce the particulate emission rate 91 percent, at a cost of $19,600 per ton controlled. Fuel substitution is not considered economically feasible for particulate control in Rayonier's temporary boiler.

5.3 Wet Scrubbers

In a wet scrubber a liquid is used to capture particulate dust and handle it in the liquid stream. Wet scrubbers are typically used when exhaust streams are too hot or corrosive for fabric filtration. Additionally for process operations like Rayonier, scrubbers can utilize process liquid streams as scrubber solution. The Rayonier venturi scrubber system is at least 87% efficient at controlling particulate and will be employed to control particulate from the temporary boiler.

The cost impact of a venturi scrubber for control of particulate emissions from the proposed temporary boiler is negligible with regard to capital and operating costs at Rayonier, given that the system is in place at the facility to control particulate emission from the existing boilers. The ductwork and flue handling equipment would be the only cost to control particulate, therefore 87% of the particulate would be controlled at virtually no cost.

5.4 BACT Conclusion for Particulate

EMCON has concluded that using the current fuel with the existing venturi scrubber system as a post-combustion control represents BACT, with an emission rate of 0.03 lb/mmBtu.

APPENDIX A

BACT ANALYSIS CALCULATIONS

RAYONIER - FERNANDINA BEACH
Temporary Boiler

BACT Analysis for Selective Catalytic Reduction

Estimating Total Capital Investment

Direct Costs

Purchased equipment costs		
Catalyst equipment + auxilliary equipment	Vendor quote, A_1	$950,000.00
Instrumentation	(0.10)*A	$95,000.00
Sales taxes	(0.03)*A	$28,500.00
Freight	(0.05)*A	$47,500.00
Purchased Equipment Cost, PEC	B = (1.18)*A	$1,121,000.00
Direct installation costs		
Foundations & supports	(0.08)*B	$89,680.00
Handling & erection	(0.14)*B	$156,940.00
Electrical	(0.04)*B	$44,840.00
Piping	(0.02)*B	$22,420.00
Insulation for ductwork	(0.01)*B	$11,210.00
Painting	(0.01)*B	$11,210.00
Direct Installation Costs	(0.30)*B	$336,300.00
Building (assume no additional work)		$0.00
Site Preparation (assume no cost)		$0.00
Total Direct Costs, DC	(1.30)*B + SP + Bldg.	$1,457,300.00

Indirect Costs (installation)

Engineering	(0.10)*B	$112,100.00
Construction and field expenses	(0.05)*B	$56,050.00
Contractor fees	(0.10)*B	$112,100.00
Start-up	(0.02)*B	$22,420.00
Performance test	(0.01)*B	$11,210.00
Contingencies	(0.03)*B	$33,630.00
Total Indirect Costs, IC	(0.31)*B	$347,510.00
Total Capital Investment = DC + IC	(1.61)*B + SP + Bldg.	$1,804,810.00

A_1 Sample vendor cost for 150 MMBtu boiler increased by approximately 25%

RAYONIER - FERNANDINA BEACH
Temporary Boiler

BACT Analysis for Selective Catalytic Reduction

Estimating Annual Costs

Direct Costs

Operating labor		
Operator	(1.5 hr/day)*(365 day/yr)*($25/hr)	$13,687.50
Supervisor	15% of Operator	$2,053.13
Operating materials	Ammonia $250 per ton	$98,659.50
Maintenance		
Labor	(1.5 hr/day)*(365 day/yr)*($25/hr)	$13,687.50
Material	100% of maintenance labor	$13,687.50
Catalyst Replacement	100% of Catalyst for year only 75 Ft^3 of catalyst @ $650.00 per Ft^3	$48,750.00
Utilities		
Electricity - fan	fan power requirement(kWh/yr)*0.08/kWh	$91,632.68
Auxiliary Fuel	$0.65/ccf	$15,288.83
	Total Direct Annual Costs	$297,446.63

Indirect Costs

Overhead	60%*($labor_{(oper.+supv.+maint.)}$+(maint mat.))	$25,869.38
Administrative charges	2% of Total Capital Investment	$36,096.20
Property taxes	1% of Total Capital Investment	$18,048.10
Insurance	1% of Total Capital Investment	$18,048.10
Capital recovery	CRF*(Total Capital Investment) assume a 1 year life	$1,804,810.00
	Total Indirect Annual Costs	$1,902,871.78
	Total Annual Costs	$2,200,318.41
	Amount of NOx Controlled (TPY) 395 TPY * 80% efficiency	315.71
	Total Annual Cost per Ton of NOx Controlled	$6,969.42

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RAYONIER - FERNANDINA BEACH
Temporary Boiler

BACT Analysis for Selective Non Catalytic Reduction

Estimating Total Capital Investment

Direct Costs

Purchased equipment costs		
Catalyst equipment + auxilliary equipment	Vendor quote, A_1	$400,000.00
Instrumentation	(0.10)*A	$40,000.00
Sales taxes	(0.03)*A	$12,000.00
Freight	(0.05)*A	$20,000.00
Purchased Equipment Cost, PEC	B = (1.18)*A	$472,000.00
Direct installation costs		
Foundations & supports	(0.08)*B	$37,760.00
Handling & erection	(0.14)*B	$66,080.00
Electrical	(0.04)*B	$18,880.00
Piping	(0.02)*B	$9,440.00
Insulation for ductwork	(0.01)*B	$4,720.00
Painting	(0.01)*B	$4,720.00
Direct Installation Costs	(0.30)*B	$141,600.00
Total Direct Costs, DC	(1.30)*B + SP + Bldg.	$613,600.00

Indirect Costs (installation)

Engineering	(0.10)*B	$47,200.00
Construction and field expenses	(0.05)*B	$23,600.00
Contractor fees	(0.10)*B	$47,200.00
Start-up	(0.02)*B	$9,440.00
Performance test	(0.01)*B	$4,720.00
Contingencies	(0.03)*B	$14,160.00
Total Indirect Costs, IC	(0.31)*B	$146,320.00
Total Capital Investment = DC + IC	(1.61)*B + SP + Bldg.	$759,920.00

RAYONIER - FERNANDINA BEACH
Temporary Boiler

BACT Analysis for Selective Non Catalytic Reduction

Estimating Annual Costs

Direct Costs

Operating labor		
Operator	(1.5 hr/day)*(365 day/yr)*($25/hr)	$13,687.50
Supervisor	15% of Operator	$2,053.13
Operating materials	Ammonia/Urea Injection	$20,000.00
Maintenance		
Labor	(1.5 hr/day)*(365 day/yr)*($25/hr)	$13,687.50
Material	100% of maintenance labor	$13,687.50
Catalyst Replacement	100% of Catalyst for year only 75 Ft^3 of catalyst @ $650.00 per Ft^3	$48,750.00
Utilities		
Electricity - fan	fan power requirement(kWh/yr)*0.08/kWh	$91,632.68
Auxiliary Fuel	$0.65/ccf	$15,288.83
	Total Direct Annual Costs	$218,787.13

Indirect Costs

Overhead	60%*(labor$_{(oper.+supv.+maint.)}$+(maint mat.))	$25,869.38
Administrative charges	2% of Total Capital Investment	$15,198.40
Property taxes	1% of Total Capital Investment	$7,599.20
Insurance	1% of Total Capital Investment	$7,599.20
Capital recovery	CRF*(Total Capital Investment) assume a 1 year life	$759,920.00
	Total Indirect Annual Costs	$816,186.18
	Total Annual Costs	$1,034,973.31
	Amount of NOx Controlled (TPY) 395 TPY * 30% efficiency	118.39
	Total Annual Cost per Ton of NOx Controlled	$8,741.96

RAYONIER - FERNANDINA BEACH
Temporary Boiler

NOX Emission Rates

Uncontrolled Emission Rates

73.778 lb NOx[1] / 1000 gal	12,408 1000 gal / yr	ton / 2000 lb	=	458 ton / yr

Low NOx Burner Emission Rates

0.425 lb NOx[2] / mmbtu	212 mmbtu / hr	8760 hr	=	789276 lb / yr
	789276 lb / yr	ton / 2000 lb	=	395 ton / yr

[1] Based on EPA AP-42 Emission Factors
[2] Vendor provided NOx Emission Rate

Assumptions for NOx Cost Calculations

Variables used in calculation of Annual Costs

specific gravity s.g. =	1
fan-motor efficiency =	0.65
system flowrate (acfm), Q =	120,000
System Pressure Drop DP =	8
fan power requirement (kWh/yr) =	1,522,138
FP = .000181Q*DP*f assuming s.g.=1, & fan-motor eff.=65%	
annual operating hours for fan, f	8,760

Desired outlet temperature °F 800

RAYONIER - FERNANDINA BEACH
Temporary Boiler

Fuel Costs - NOx

		#6 Oil @ 2.5% S @ 0.5% N	#6 Oil @ 1.5% S @ 0.4% N	#2 Oil @ 0.5% S @ 0.14% N
Fuel Unit Cost		$ 0.29	$ 0.40	$ 0.50
Gal/8760 hrs		12408000	12408000	13294286
Annual Fuel Cost		$ 3,598,320	$ 4,963,200	$ 6,647,143
Incremental Fuel Cost		-	$ 1,364,880	$ 3,048,823
Uncontrolled NOx	(tons/yr)	395.5	368	228.0
	(lb/MMBtu) [A]	*0.425*	*0.395*	*0.245*
NOx reduction (tons/yr)		-	28	139.6
Removal %			7%	35%
Cost/ton NOx removed		-	$ 48,888	$ 21,841

Conversion Factors & Assumptions:

212.47 MMBtu/hr Boiler
150,000 Btu/gallon #6 Residual Fuel Oil (2.5% Sulfur)
140,000 #2 Fuel Oil, 0.5% sulfur
2,000 lb/ton

A - NOx emission rates (lb/MMBtu) for #6 and #2 oil from boiler vendor

Fuel Price Quotes

conversation with Bob Bosman (Steuart Oil, Jacksonville, FL) 9/23/98.

$12.60	/bbl of 2.5% Sulfur, #6 Fuel Oil	$ 0.30	per gallon
$16.80	/bbl of 1.5% Sulfur, #6 Fuel Oil	$ 0.40	
$21.00	/bbl of 0.5% Sulfur, #2 Fuel Oil	$ 0.50	per gallon
42	gal/bbl		

RAYONIER - FERNANDINA BEACH
Temporary Boiler

Fuel Costs - SO2

		#6 Oil @2.5%	#6 Oil @1.5%	#2 Oil @ 0.5%
Fuel Unit Cost		$ 0.30	$ 0.40	$ 0.50
Gal/8760 hrs		12408000	12408000	13294286
Annual Fuel Cost		$ 3,722,400	$ 4,963,200	$ 6,647,143
Incremental Fuel Cost		-	$ 1,240,800	$ 2,924,743
Uncontrolled SO_2	(tons/yr)	2435	1321	473.6
	(lb/mmBtu) [A]	*2.62*	*1.42*	*0.51*
Scrubber reduction	90%			
controlled	(tons/yr)	243.5	132	47.4
	(lb/mmBtu)	*0.26*	*0.14*	*0.05*
SO_2 reduction (tons/yr)		-	111	196.1
Cost/ton SO_2 removed		-	$ 11,143	$ 14,911

Conversion Factors & Assumptions:

212.47 MMbtu/hr Boiler
150,000 Btu/gallon #6 Residual Fuel Oil (2.5% Sulfur)
140,000 #2 Fuel Oil, 0.5% sulfur
2,000 lb/ton

Emission Factors

0.51 lb(SO_2)/gal of #2 Fuel Oil (0.5% Sulfur). (AP-42; Table 1.3-2)
[142(S)] lb/1000gal where S is the sulfur content of the fuel.

A - emissions from application divided by boiler heat input capacity

Fuel Price Quotes

conversation with Bob Bosman (Steuart Oil, Jacksonville, FL) 9/23/98.

$12.60	/bbl of 2.5% Sulfur, #6 Fuel Oil	$ 0.30	per gallon
$16.80	/bbl of 1.5% Sulfur, #6 Fuel Oil	$ 0.40	
$21.00	/bbl of 0.5% Sulfur, #2 Fuel Oil	$ 0.50	per gallon
42	gal/bbl		