ECT
Environmental Consulting & Technology, Inc.

Environmental Consulting & Technology, Inc. - **ECT**

3701 Northwest 98th Street
Gainesville, Florida 32606
352/332-0444

TELECOPY COVERSHEET

TO: Joe Kahn

TELECOPY NUMBER: (850) 922-6979

FROM: Tom Davis

DATE: 06/08/99 CHARGE NO.: 990294-0100

WE ARE TRANSMITTING 5 PAGES, INCLUDING COVERSHEET. IF THE TRANSMISSION WAS NOT COMPLETE OR IF THE MESSAGE WAS NOT LEGIBLE, PLEASE CALL US IMMEDIATELY.

352/332-0444--SWITCHBOARD

352/332-6722--FACSIMILE MACHINE

352/332-6733--FACSIMILE MACHINE (Accounting)

COMMENTS:

Joe, copy of AP-42 Section 8.19.1 per my e-mail message regarding estimation of fugitive PM from Champion Sawmill storage piles.

The original of the transmitted document will be sent by:

( ) Regular mail (X) Overnight Mail ( ) E-Mail

(X) This fax is the *ONLY* form of delivery

8.19.1 SAND AND GRAVEL PROCESSING

8.19.1.1 Process Description[1-3]

Deposits of sand and gravel, the consolidated granular materials resulting from the natural disintegration of rock or stone, are generally found in near-surface alluvial deposits and in subterranean and subaqueous beds. Sand and gravel are products of the weathering of rocks and unconsolidated or poorly consolidated materials and consist of siliceous and calcareous components. Such deposits are common throughout the country.

Depending upon the location of the deposit, the materials are excavated with power shovels, draglines, front end loaders, suction dredge pumps or other apparatus. In rare situations, light charge blasting is done to loosen the deposit. The materials are transported to the processing plant by suction pump, earth mover, barge, truck or other means. The processing of sand and gravel for a specific market involves the use of different combinations of washers, screens and classifiers to segregate particle sizes; crushers to reduce oversize material; and storage and loading facilities. Crushing operations, when used, are designed to reduce production of fines, which often must be removed by washing. Therefore, crusher characteristics, size reduction ratios and throughput, among other factors, are selected to obtain the desired product size distribution.

In many sand and gravel plants, a substantial portion of the initial feed bypasses any crushing operations. Some plants do no crushing at all. After initial screening, material is conveyed to a portion of the plant called the wet processing section, where wet screening and silt removal are conducted to produce washed sand and gravel. Negligible air emissions are expected from the wet portions of a sand and gravel plant.

Industrial sand processing is similar to that of construction sand, insofar as the initial stages of crushing and screening are concerned. Industrial sand has a high (90 to 99 percent) quartz or silica content and is frequently obtained from quartz rich deposits of sand or sandstone. At some plants, after initial crushing and screening, a portion of the sand may be diverted to construction sand use. Industrial sand processes not associated with construction sand include wet milling, scrubbing, desliming, flotation, drying, air classification and cracking of sand grains to form very fine sand products.

8.19.1.2 Emissions and Controls[1]

Dust emissions can occur from many operations at sand and gravel processing plants, such as conveying, screening, crushing, and storing operations. Generally, these materials are wet or moist when handled, and process emissions are often negligible. A substantial portion of these emissions may consist of heavy particles that settle out within the plant. Emission factors (for process or fugitive dust sources) from sand and gravel processing plants are shown in Table 8.19.1-1. (If processing is dry, expected emissions could be similar to those given in Section 8.19.2, Crushed Stone Processing).

Emission factors for crushing wet materials can be applied directly or on a dry basis, with a control efficiency credit being given for use of wet materials (defined as 1.5 to 4.0 percent moisture content or greater) or wet suppression. The latter approach is more consistent with current practice.

The single valued fugitive dust emission factors given in Table 8.19.1-1 may be used for an approximation when no other information exists. Empirically derived emission factor equations presented in Section 11.2 of this document are preferred and should be used when possible. Each of those equations has been developed for a single source operation or dust generating mechanism which crosses industry lines, such as vehicle traffic on unpaved roads. The predictive equation explains much of the observed variance in measured emission factors by relating emissions to the differing source variables. These variables may be grouped as (1) measures of source activity or expended energy (e. g., feed rate, or speed and weight of a vehicle traveling on an unpaved road), (2) properties of the material being disturbed (e. g., moisture content, or content of suspendable fines in the material) and (3) climate (e. g., number of precipitation free days per year, when emissions tend to a maximum).

Because predictive equations allow for emission factor adjustment to specific conditions, they should be used instead of the factors given in Table 8.19.1-1 whenever emission estimates are needed for sources in a specific sand and gravel processing facility. However, the generally higher quality ratings assigned to these equations are applicable only if (1) reliable values of correction parameters have been determined for the specific sources of interest, and (2) the correction parameter values lie within the ranges found in developing the equations. Section 11.2 lists measured properties of aggregate materials used in operations similar to the sand and gravel industry, and these properties can be used to approximate correction parameter values for use in the predictive emission factor equations, in the event that site specific values are not available. Use of mean correction parameter values from Chapter 11 reduces the quality ratings of the emission factor equations by at least one level.

Since emissions from sand and gravel operations usually are in the form of fugitive dust, control techniques applicable to fugitive dust sources are appropriate. Some successful control techniques used for haul roads are application of dust suppressants, paving, route modifications, soil stabilization, etc.; for conveyors, covering and wet suppression; for storage piles, wet dust suppression, windbreaks, enclosure and soil stablizers; and for conveyor and batch transfer points (loading and unloading, etc.), wet suppression and various methods to reduce freefall distances (e. g., telescopic chutes, stone ladders, and hinged boom stacker conveyors); for screening and other size classification, covering and wet suppression.

Wet suppression techniques include application of water, chemicals and/or foam, usually at crusher or conveyor feed and/or discharge points. Such spray systems at transfer points and on material handling operations have been estimated to reduce emissions 70 to 95 percent.[7] Spray systems can also reduce loading and wind erosion emissions from storage piles of various materials 80 to 90 percent.[8] Control efficiencies depend upon local climatic conditions, source properties and duration of control effectiveness. Wet suppression has a carryover effect downstream of the point of application of water or other wetting agents, as long as the surface moisture content is high enough to cause the fines to adhere to the larger rock particles.

71

TABLE 8.19.1-1. UNCONTROLLED PARTICULATE EMISSION FACTORS FOR SAND AND GRAVEL PRC

TSP FACTORS IN BACKGROUND REPORT FOR AP 42 SECTION 11.19.1 APRIL 1995

8.19 IS NOW 11.19 IN AP-42 BUT STORAGE FACTORS ARE OMITTED FROM SECTION 11.19.1

Uncontrolled Operation	Emissions by Particle Size: Total Particulate	Emissions by Particle Size: TSP (≤ 30 µm)			
Process Sources[c] Primary or secondary crushing (wet)	NA	0.009 (0.018)			
Open Dust Sources[c] Screening[d] Flat screens (dry product)	NA	0.08 (0.16)			
Continous drop[c] Transfer station	0.014 (0.029)	NA			
Pile formation - stacker	NA	0.065 (0.13)			
Batch drop[c] Bulk loading	0.12 (0.24)	0.028 (0.056)[f]			
Active storage piles[g] Active day	NA	14.8 (13.2)	7.1 (6.3)[e]	kg/hectare/day[h] (lb/acre/day)	D
Inactive day (wind erosion only)	NA	3.9 (3.5)	1.9 (1.7)[e]	kg/hectare/day[h] (lb/acre/day)	D
Unpaved haul roads Wet materials	i	i	i		D

[a]NA = not available. TSP = total suspended particulate. Predictive emission factor equations, which generally provide more accurate estimates of emissions under specific conditions, are presented in Chapter 11. Factors for open dust sources are not necessarily representative of the entire industry or of a "typical" situtation.
[b]Total particulate is airborne particles of all sizes in the source plume. TSP is what is measured by a standard high volume sampler (see Section 11.2).
[c]References 5-9.
[d]References 4-5. For completely wet operations, emissions are likely to be negligible.
[e]Extrapolation of data, using k factors for appropriate operation from Chapter 11.
[f]For physical, not aerodynamic, diameter.
[g]Reference 6. Includes the following distinct source operations in the storage cycle: (1) loading of aggregate onto storage piles (batch or continuous drop operations), (2) equipment traffic in storage areas, (3) wind erosion of pile (batch or continuous drop operations). Assumes 8 to 12 hours of activity/24 hours.
[h]Kg/hectare (lb/acre) of storage/day (includes areas among piles).
[i]See Section 11.2 for empirical equations.

References for Section 8.19.1

1. Air Pollution Control Techniques For Nonmetallic Minerals Industry, EPA-450/3-82-014, U. S. Environmental Protection Agency, Research Triangle Park, NC, August 1982.

2. S. Walker, "Production of Sand and Gravel", Circular Number 57, National Sand and Gravel Association, Washington, DC, 1954.

3. Development Document For Effluent Limitations Guidelines And Standards - Mineral Mining And Processing Industry, EPA-440/1-76-059b, U. S. Environmental Protection Agency, Washington, DC, July 1979.

4. Review Emissions Data Base And Develop Emission Factors For The Construction Aggregate Industry, Engineering-Science, Inc., Arcadia, CA, September 1984.

5. "Crushed Rock Screening Source Test Reports on Tests Performed at Conrock Corp., Irwindale and Sun Valley, CA Plants", Engineering-Science, Inc., Arcadia, CA, August 1984.

6. C. Cowherd, Jr., et al., Development Of Emission Factors For Fugitive Dust Sources, EPA-450/3-74-037, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1974.

7. R. Bohn, et al., Fugitive Emissions From Integrated Iron And Steel Plants, EPA-600/2-78-050, U. S. Environmental Protection Agency, Washington, DC, March 1978.

8. G. A. Jutze and K. Axetell, Investigation Of Fugitive Dust, Volume I: Sources, Emissions and Control, EPA-450/3-74-036a, U. S. Environmental Protection Agency, Research Triangle Park, NC, June 1974.

9. Fugitive Dust Assessment At Rock And Sand Facilities In The South Coast Air Basin, Southern California Rock Products Association and Southern California Ready Mix Concrete Association, P.E.S., Santa Monica, CA, November 1979.

P.O. Drawer 200
Farm Road 62
Camden, Texas 75934
409 398-2511

RECEIVED
MAY 17 1999
BUREAU OF
AIR REGULATION

Champion
Champion International Corporation

May 11, 1999

State of Florida
Department of Environmental Protection
Division of Air Resources Management
Mail Station #5505
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Attn: Joseph Kahn

Dear Joe:

Per your request, attached is a copy of the NCASI TB. No 718.

If you need additional information or have questions, please call me at (409) 398-7252 or Tom Davis (ECT) at (352) 332-0444.

Thanks,

Terry/EB

Terry Kassabaum
Environmental Health and Safety Manager
Champion International Corporation

TK/eb
attachment

cc: Tom Davis - ECT - w/o attachment
Dave Stevens - w/o attachment
John Barone - w/o attachment

ncasi

NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT, INC.
P.O. Box 13318, Research Triangle Park, NC 27709-3318
Phone (919) 558-1999 Fax (919) 558-1998

Ronald A. Yeske, Ph.D.
President
(919) 558-1995

July 1, 1996

Technical Bulletin No. 718

A SMALL-SCALE KILN STUDY ON METHOD 25A MEASUREMENTS OF VOLATILE ORGANIC COMPOUND EMISSIONS FROM LUMBER DRYING

Atmospheric emissions from all types of wood drying operations are currently the focus of considerable regulatory agency attention, particularly with respect to the permitting of panel plants and, more recently, lumber drying kilns. Many existing wood products facilities are subject to state Title V operating permit programs, and thus must prepare permit applications. In many cases, modification of existing plants or construction of new greenfield facilities requires owners to obtain pre-construction air quality permits. Estimates of emissions are necessary for all of these permitting activities.

Estimating emissions of volatile organic compounds (VOCs) from wood drying operations has proven to be one of the most important and difficult elements of permit application preparation. Emissions depend on numerous factors, such as wood species, drying conditions, time elapsed from tree harvest to processing, and seasonal variability. In addition to these factors, there has been considerable uncertainty about the methods used to measure VOC emissions from wood drying. These uncertainties have raised questions about the reliability of some published VOC measurements.

NCASI has undertaken several studies to address questions about VOC measurement methods related to wood drying sources. The first studies were carried out on veneer dryers, using EPA Method 25. A subsequent study examined the performance of EPA Methods 25 and 25A on rotary dryers located at oriented strandboard (OSB) plants. A recently completed laboratory investigation involved examination of moisture effects on the response of a Method 25A VOC analyzer. Presently, NCASI staff are conducting a more comprehensive laboratory evaluation of factors which may affect the overall accuracy of Method 25A VOC measurements on wood dryer exhaust gases.

The study described in this report deals with VOC emissions from lumber drying. A small-scale lumber kiln was used for the drying. The study represents both a continuation of Method 25A evaluations on various wood drying sources and a much-needed effort to determine VOC emissions from the drying of lumber made from several different softwood species. The effects of sample line length and sample moisture removal on the total VOC measured by the Method 25A analyzer were investigated. Simultaneous measurements with two Method 25A sampling systems, which were identical except that one system had a 25-foot heated sampling line while the other had a 100-foot line, showed that sample line length made little difference in the amount of VOCs measured over the

Street Address: 79 T.W. Alexander Drive, Building 4401, Suite 205

kiln drying cycle for three different wood species. Simultaneous measurements with two Method 25A systems, which were identical except that one system cooled the gas to 65°F to condense and remove moisture prior to introduction of the gas sample into the analyzer, showed that VOC emission measurements can be lower when the sample is cooled and moisture is removed. The moisture removal effect was dependent on the wood species being dried.

The small-scale drying kiln was used to dry ten different species of softwood lumber according to drying schedules commonly used for these species in full-scale kilns. Total VOC emissions for the entire drying cycle, after accounting for fugitive losses from the kiln, ranged from 0.12 to 3.3 lb carbon per thousand board feet dried. These emission rates are within the range of those reported at full-scale kilns, although accounting for fugitive losses from full-scale kilns is very problematic. Emissions were highest for pine species, but no relationship between lumber turpentine loss and VOC emissions was found.

NCASI would like to acknowledge the support of Boise Cascade, Georgia-Pacific, Idaho Forest Industries, Louisiana-Pacific, Plum Creek Timber, Potlatch, Simpson Timber, Stone Container, and Union Camp for this study. These companies provided financial support for kiln operations and instrumentation, and provided the lumber used in the study. The small-scale kiln was located at the University of Idaho, and was operated during the study by Dr. Richard Folk of the University of Idaho and T. Orlin Galloway of Louisiana-Pacific.

The study was directed by Mr. Andre Caron, NCASI West Coast Regional Manager (now retired). Mr. Caron was assisted by Dr. Qiusheng Pu, former Research Engineer, Leonard Smith, and Ronald Messmer of the West Coast Regional Center. The report was prepared by Dr. Pu and Mr. Caron. Questions on the report may be directed to Mr. Paul Wiegand, West Coast Regional Manager, phone (541) 752-8801; or to Dr. John Pinkerton at this office, phone (919) 558-1992.

Very truly yours,

Ronald A. Yeske

Attachment

TABLE OF CONTENTS

A SMALL-SCALE KILN STUDY ON METHOD 25A MEASUREMENTS OF VOLATILE ORGANIC COMPOUND EMISSIONS FROM LUMBER DRYING

TECHNICAL BULLETIN NO. 718
JULY 1996

ABSTRACT: EPA Method 25A measurements of VOC emissions from lumber drying were studied using a small-scale kiln. Fresh-cut commercial softwood lumbers of ten southern and western species were tested using drying conditions similar to those practiced at full-scale kilns. VOC emissions were continuously monitored over the entire drying cycle. Fugitive VOC losses due to gas leakage from the kiln were estimated using moisture recovery rates. Two Method 25A VOC measurement systems, in different configurations, were operated in parallel. Three comparisons of results, obtained using heated sample lines of 25 feet and 100 feet, showed differences in total VOC emissions over the drying cycle of 11 percent or less. Thirteen comparisons of results were made using a sample gas condensation system in one of the parallel trains. Removing moisture from the sample gas by condensation reduced the VOC measurement. The relative reduction in VOC measurement was less than 35 percent for most of the species tested, but higher (58 to 78 percent) for three species that have low VOC emission potentials.

The VOC emissions measured were between 0.12 and 0.81 lb C/MBF (pound carbon per thousand board feet) for non-pine wood species, and ranged from 1.86 to 3.32 lb C/MBF for pine species. For most species tested, VOCs emitted during the drying cycle followed a similar pattern, increasing with drying time at a nearly constant rate until the end of the drying cycle. Lumber drying schedules repeated in duplicate for six wood charges showed a relative percent difference in Method 25A VOC emissions of less than 20 percent. Emission factors presented are specific to the methods used in this study. Turpentine measurements of the lumber before and after drying indicated turpentine losses of less than 30 percent for all species tested. A comparison of the VOC emissions and turpentine losses did not show a correlation between these two measurements.

KEYWORDS: emissions, drying, lumber kiln, Method 25A, softwoods, VOC measurement, volatile organic compounds

RELATED NCASI PUBLICATIONS:

(1) "A Laboratory Study of Moisture Effects on EPA Method 25A VOC Measurements," NCASI Special Report 95-10, (August, 1995).

(2) "A Study of Organic Compound Emissions from Veneer Dryers and Means for Their Control," NCASI Technical Bulletin No. 405, (August, 1983).

A SMALL-SCALE KILN STUDY ON METHOD 25A MEASUREMENTS OF VOLATILE ORGANIC COMPOUND EMISSIONS FROM LUMBER DRYING

I INTRODUCTION

The measurement of VOC emissions from wood drying operations has proven to be a challenging task. Although EPA has two reference methods for VOC measurements, Method 25 and Method 25A, neither was developed for wood drying emission sources, nor has EPA ever evaluated the performance of either method on wood drying sources. Early measurements of VOC emissions from veneer dryers and some rotary furnish dryers were made with EPA Method 25. More recently, EPA Method 25A has come into widespread use for VOC measurements at wood products plants. In many situations, the two methods do not appear to give comparable results. Because most state regulatory agencies now require the use of Method 25A to determine VOC emissions for permit compliance purposes, industry attention is focused on the performance of this method for various types of wood drying sources.

Method 25A allows a number of variations in the sampling procedures, some of which may have a considerable impact on the ultimate VOC measurement. Stack conditions may also affect the Method 25A measurements, and these effects may be confounded by different sampling procedures. For wood drying sources, important considerations include sample moisture level, temperature, use of a filter, filter temperature, sample line temperature, presence of droplets, etc.

Within the last five years, questions about VOC emissions from softwood lumber drying kilns have arisen in connection with air quality permitting concerns. In addition to uncertainty about the applicability of EPA Method 25A to these exhausts, lumber kiln emissions are extremely difficult to sample. Lumber kilns have multiple roof vents which open and close during the drying process. Flow may be either in or out of an open vent at any given time. Not all gases leave the kiln through the roof vents; kilns are not air tight and losses occur at many locations, including door seals and wall joints. Since lumber drying is a batch process, and exhaust gas flows and VOC concentrations vary over the course of a drying cycle (which may range from fifteen to several hundred hours), sampling must be conducted over a complete drying cycle to determine the total amount of VOC emitted for a batch of lumber. Several companies have tried various approaches to measuring VOC emissions from full-scale lumber drying kilns. Sampling has proven to be time consuming and expensive, and confidence in many of the sampling results is not high. Alternative approaches to full-scale sampling are thus being sought to develop appropriate emission factors for lumber drying kilns.

The work described in this report addresses, in a limited manner, two questions related to the use of Method 25A for measuring VOCs in lumber kiln exhausts. These two questions relate to the effect of sample line length and sample cooling and moisture removal on VOC concentrations measured with a Method 25A analyzer. A previous NCASI study investigated the moisture interference to flame ionization detector (FID) responses to propane gas and α-pinene vapor (1). Exhaust gases from a small-scale lumber kiln were sampled with two Method 25A sampling systems.

The small-scale kiln also offered the opportunity to dry lumber manufactured from many different softwood species and determine the amount of VOCs released over the course of complete drying cycles. Emission factors calculated from the small-scale kiln work could then be compared to the limited data for full-scale kilns. The work included an investigation of lumber turpentine loss over the drying cycles to see if this loss was related to observed VOC emissions over the drying cycles.

II APPROACH

This study was carried out in cooperation with the University of Idaho and was sponsored by nine lumber manufacturing companies. A committee representing these companies was assembled to guide the study. The committee members were individuals experienced with lumber drying processes, operation of full-scale lumber kilns, and VOC measurement procedures. Under the guidance of this committee, an experimental design was developed. This design would:

1. employ the small-scale kiln at the Department of Forest Products, University of Idaho, for the study;
2. modify the kiln by installing a manifold system for taking fresh air from outside the building and routing the kiln exhaust to a stack;
3. install a computerized system to accurately monitor and control the drying process and instrument the kiln to track lumber moisture content during drying;
4. replicate the drying schedules of full-scale kilns;
5. conduct tests with lumbers from a variety of softwood species;
6. continuously monitor the VOC concentration in the kiln exhaust and the temperatures, flows, and relative humidities of intake air and kiln exhaust over the entire drying cycle;
7. conduct mass balances for both air and moisture entering and exiting the kiln during the drying cycle to estimate fugitive VOC losses due to gas leakage from the kiln;
8. use two Method 25A sampling trains with identical VOC analyzers to evaluate the effect of different sampling train configurations on the VOC emission measurement; and

9. measure turpentine losses of the lumber by taking composite shaving samples from a representative number of boards to assess the relationship between VOC emissions and turpentine losses.

III METHODS

A. Lumbers Tested

Lumbers of ten southern and western softwood species were tested. The wood species and corresponding acronyms are listed in Table 1. Information related to the history of the lumbers is summarized in Appendix A.

TABLE 1 LUMBERS TESTED

WOOD SPECIES	ACRONYM
Douglas fir heartwood	DFH
Douglas fir sapwood	DFS
Ponderosa pine	PP
Southern yellow (loblolly) pine from Texas	SYP-TX
Southern yellow (loblolly) pine from Arkansas	SYP-AR
Redwood	Redwood
Western Red Cedar	Cedar
Coastal Douglas fir	CDF
White fir	WF
Grand fir	GF
Hemlock	Hemlock
White pine	WP
Sugar pine	SP

B. Drying Tests

Experiments on VOC emissions from lumber drying were conducted using the small-scale kiln at the University of Idaho. This section describes the kiln and the operating conditions used for the drying tests.

(1) Description of the Kiln - The small-scale kiln at the University of Idaho is a 1978 Irvington Moore Cabinet Dryer with two vents. This kiln can accommodate 140 eight-foot 2x4 inch boards or an equivalent amount of lumber in other dimensions. It was built for commercial purposes and was not designed to be leak-free. Fugitive VOC losses due to gas leakage were expected. An effort was made to seal the interior surfaces where leakage was suspected. Silicon rubber and weather strips were used to seal joints and the door edge, respectively. A leak-proof floor was added to the kiln.

The kiln was indirectly heated by steam coils located in the kiln. The kiln was equipped with two pairs of 18-inch fans to circulate air. Each pair of fans was driven by a 1.5 horsepower, adjustable-speed motor. The speed and blow direction of all fans were synchronously adjusted by a central control panel.

Kiln operation was controlled by a computerized system to maintain the drying schedule, which was based on dry and wet bulb temperature profiles. Adjustments included steam supply to the heating coil and opening or closing of the vents. Two dry bulb and one wet bulb temperature sensors were located in the kiln. Fan speed was set at the rate specified in the drying schedule. Fan direction was controlled automatically and changed at six-hour intervals.

The moisture content of the lumber in the kiln was monitored continuously using a Delmhorst RDM-ISE&ES-8 system with eight probes placed on the surface and in the core of boards at evenly distributed locations in the kiln charge. Board temperature was used to compensate the Delmhorst system and was determined by four thermocouple probes located in the lumber charge.

A shop-built manifold connected the kiln to the outside of the building for fresh air supply and routed the kiln exhaust to a stack. A schematic of the manifold is shown in Figures 1A and 1B. The dampers of the manifold were switched automatically every six hours, matching the fan direction. Fresh air was drawn through a circular galvanized iron pipe (10 inches in diameter). The kiln exhaust was vented through a circular stainless steel stack (10 inches in diameter). The remainder of the manifold system was constructed of square galvanized iron ducts (10 inches in side length). The entire manifold system was wrapped with insulation to minimize potential for gas condensation.

As shown in Figure 1A, when the fan direction was forward, dampers D1 and D3 were opened while D2 and D4 were closed. Once the two vents (V1 and V2) of the kiln were opened, fresh air from outside the building was drawn into the kiln through vent V1 and exhaust vented through vent V2 to the stack. Conversely, when the fan direction was reversed, as shown in Figure 1B, dampers D2 and D4 were opened while D1 and D3 were closed. Fresh air was then drawn into the kiln through vent V2 and exhaust released through vent V1 to the stack.

(2) Operating Conditions - Twenty drying runs were conducted. Drying schedules used to control the wet and dry bulb temperature in the kiln throughout the drying cycle were typical of full-scale kiln operating conditions for the same types of lumber. The actual dry and wet bulb temperature profiles recorded during the drying tests are summarized in Appendix B. These profiles matched the desired drying schedules. Target moisture content of the dried lumber was set at 15 percent on a dry basis or 13 percent on a wet basis. Dimension, volume, weight, initial moisture content of the lumbers, total drying time and maximum dry bulb temperature in the drying cycle are presented in Table 2.

As shown in Table 2, dimensions of the lumbers were 1x4, 2x4, and 1.25x6 inches, with a length of 8 feet. The volume of lumber charged to the kiln for individual runs varied from 0.587 to 0.875 thousand board feet (MBF). The dry weight of lumber ranged from 976 to 1646 pounds. Lumber moisture contents were between 25 and 60 percent on a wet basis. The total drying time ranged from 18 to 329 hours. The maximum dry bulb temperature ranged from 160 to 220°F. Drying schedules were determined by wood species. Each wood species required a specific drying schedule to remove moisture without damaging the wood structure.

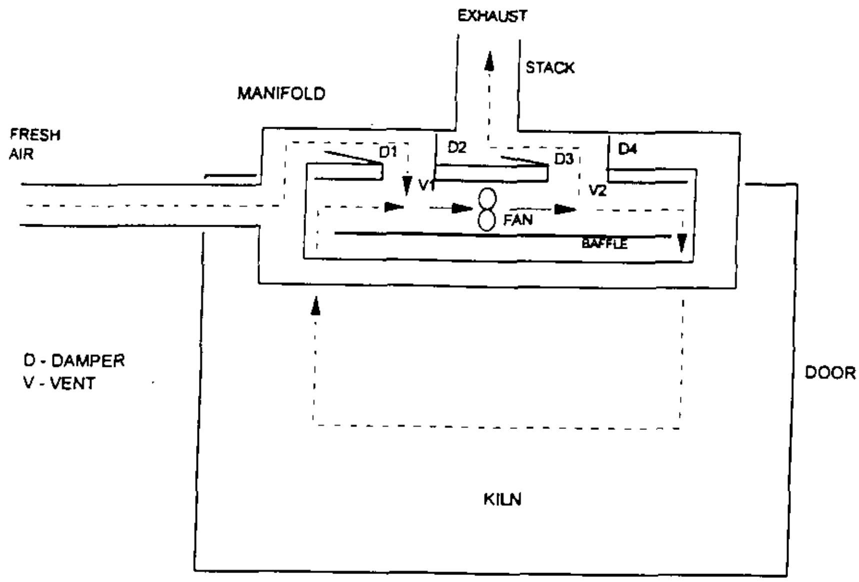


FIGURE 1A SCHEMATIC OF KILN MANIFOLD AND GAS STREAMS (FAN DIRECTION - FORWARD)

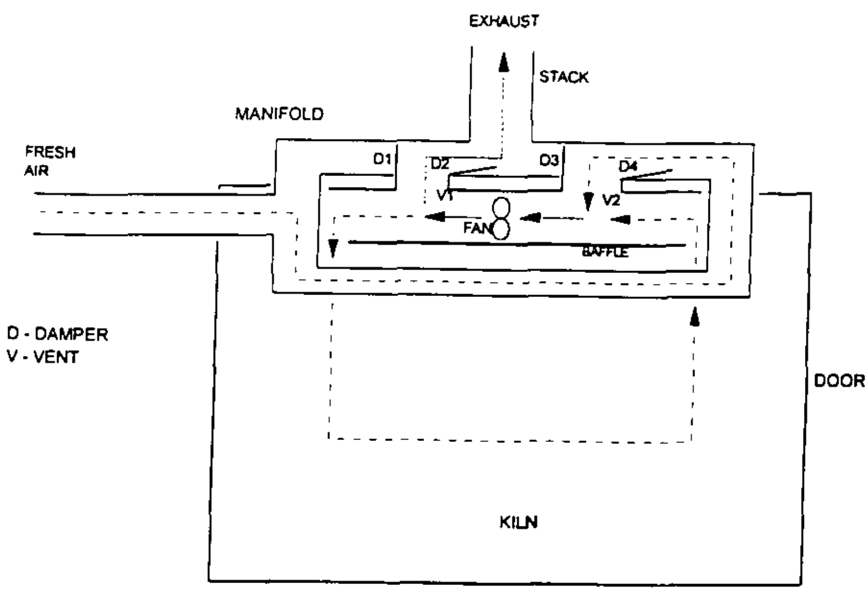


FIGURE 1B SCHEMATIC OF KILN MANIFOLD AND GAS STREAMS (FAN DIRECTION - REVERSE)

TABLE 2 INFORMATION RELATED TO DRYING TESTS

RUN NO.	WOOD SPECIES	LUMBER DIM.[a] a x b x 8'	BOARD VOLUME MDF[b]	BOARD WEIGHT lb (dry)	INITIAL MOISTURE % (wet)	DRYING TIME, hr	DRYING TEMP. °F DB[c]
1	DFH	2x4	0.747	1439	28	63	180
2	DFH	"	0.747	1387	30	53	175
3	DFH	"	0.747	1397	31	42	180
4	DFS	"	0.747	1096	36	27	180
5	PP	1x4	0.587	1083	53	29	170
6	PP	"	0.587	1110	47	28	170
7	SYP-TX	2x4	0.747	1607	35	33	200
8	SYP-TX	"	0.747	1646	38	29	220
9	Redwood	"	0.875	1285	45	329	170
10	Cedar	1x4	0.587	976	25	21	160
11	Cedar	"	0.627	1036	31	18	160
12	SYP-AR	2x4	0.672	1507	51	41	205
13	SYP-AR	"	0.640	1567	45	40	205
14	CDF	"	0.800	1245	38	21	180
15	WF	"	0.747	1127	58	70	190
16	WF	"	0.747	1091	58	75	190
17	GF	"	0.800	1356	49	47	200
18	Hemlock	"	0.768	1232	53	40	200
19	WP	1x4	0.643	1142	54	44	170
20	SP	1.25x6	0.675	1412	60	99	180
MIN			0.587	976	25	18	160
MAX			0.875	1646	60	329	220

[a] Lumber Dimension is the nominal, not actual, dimension. Variables a and b are in inches.
[b] MBF - thousand board feet = (number of boards)*a*(b/12)*8/1000
[c] DB - maximum dry bulb temperature in the drying cycle

C. VOC Emission Measurements

Measurements of VOC emissions from the small-scale kiln were conducted by continuously monitoring the VOC concentration, flow, temperature, and relative humidity of the exhaust gas. Fugitive VOC losses due to gas leakage from the kiln were estimated by conducting moisture and air mass balances. This section describes the construction of the sampling system, configurations of the Method 25A sampling train, procedures for QA/QC (quality assurance and quality control) checks on the sampling system performance, and calculations used to process the data recorded.

(1) Sampling System Construction - A schematic of the sampling system is shown in Figure 2. Eight parameters were continuously measured and recorded including intake air velocity, temperature, and relative humidity; kiln exhaust velocity, temperature, and relative humidity; and VOC concentration of kiln exhaust measured by two Method 25A systems operated in parallel.

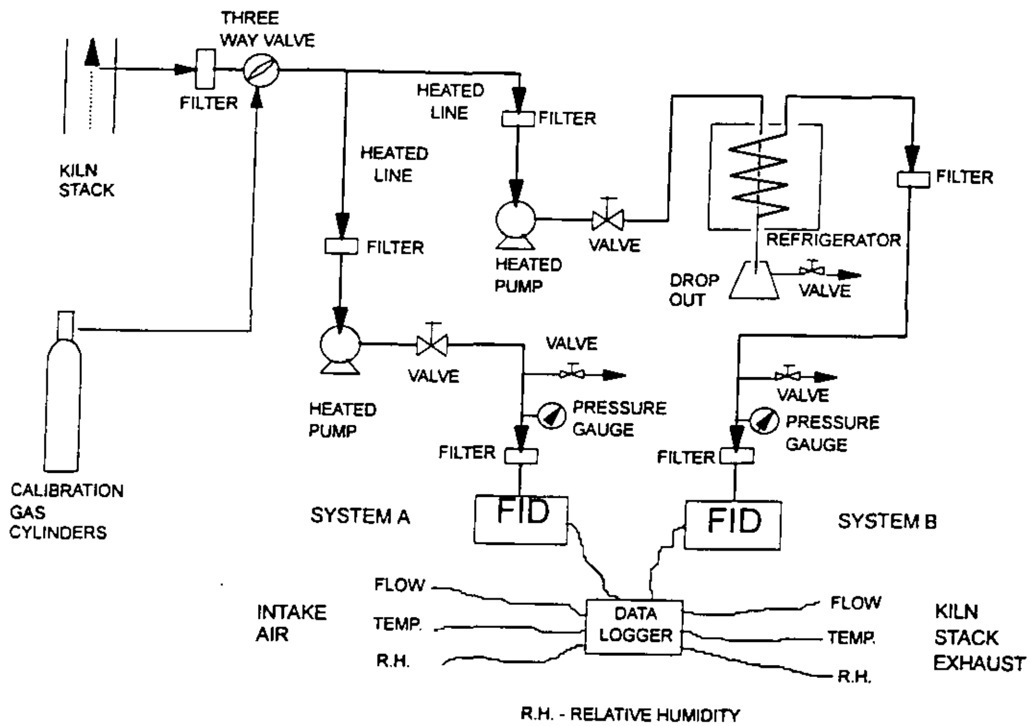


FIGURE 2 SCHEMATIC OF VOC EMISSION MEASUREMENT SYSTEMS

The velocities of the intake air and kiln exhaust were measured by EPA Method 14 (2), using propeller anemometers with a propeller diameter of 8 inches (model 27106T, R.M. Young Company). The anemometer transmitter housing was continuously flushed with fresh air to avoid contamination with moisture and VOC. The relative humidity and temperature of the intake air was monitored with an Omega HX12 system. The relative humidity of the kiln exhaust was monitored with a Hydrotest 602 (Airflow Inc.) system that was designated for use under high temperature and high moisture conditions. Kiln exhaust temperature was monitored with an Omega thermocouple probe (TJ6-ICIN-14U-18).

Two Method 25A systems (designated A and B) were used for VOC measurements. As shown in Figure 2, these two systems shared a common heated stainless steel probe (0.5 inch in diameter) and a heated stainless steel filter (5 inches in diameter). The filter was filled with glass wool to remove particulate matter. The gas sample was routed to the two gas sampling systems, each consisting of a heated Teflon line, an inert gas pump with a heated head, and a Method 25A VOC analyzer. To protect the pump and the flame ionization detector (FID) analyzer, two

2-micron mesh stainless steel filters were placed ahead of each pump and FID, respectively. The two VOC analyzers were identical FIDs, J.U.M. model VE-7.

System A conveyed a gas sample to the instrument via a 25-foot heated line that was controlled at about 250°F. System B was operated in three configurations:

1. duplication of system A,
2. modification of system A, including a condenser ahead of the FID to remove moisture, and
3. modification of system A, replacing the 25-foot line with a 100-foot line.

The heated sample line for these configurations was maintained at a temperature of about 250°F. The condenser used in system B was a 30-foot coil of Teflon line (0.25 inch in diameter) which was kept in a refrigerator. The cooled sample gas temperature was controlled at about 65°F. The condensate removed was collected in a dropout bottle. A Teflon filter holder filled with glass wool followed the condenser to capture carried-over particulate.

All the parameters monitored were recorded as 2-minute averages by a computer data logger.

(2) <u>VOC Sampling System Configurations</u> - VOC sampling system A was operated in configuration 1 for all the runs and was used as a control. Configurations for VOC sampling system B are shown in <u>Table 3</u>. Configuration 1 was used in three drying tests of fir and pine species that represented low and high VOC emission potentials. These three runs were used to verify the equivalency of system A and system B when operated in the same configuration. Configuration 3 was used in four drying runs of fir and pine lumbers to evaluate the effect of sample line length on the VOC measurement. The effect was observed to be relatively small and, therefore, configuration 3 was not used further. Configuration 2 was used in thirteen drying tests to evaluate the impact on VOC measurement of condensing the sample gas.

(3) <u>Sampling System QA/QC Checks</u> - All the instruments used to measure gas velocity, temperature, and relative humidity were manufacturer-calibrated. Calibrations were checked before installation. Stack temperature was occasionally measured with a thermometer and compared with readings of the continuous monitor.

Following the specifications of Method 25A (3), the VOC sampling systems were initially calibrated using zero air and cylinder gases prepared in accordance with EPA protocol No. 1 (3). Propane concentrations equivalent to 80 to 90 percent of the instrument span value were used for the high-level calibration. Calibration error tests were conducted using propane gases at low-level (25 to 35 percent of span) and mid-level (45 to 55 percent of span) concentrations. Zero and calibration drifts were checked with EPA-certified propane gases at several concentration levels and a manufacturer-certified α-pinene vapor at 55 ppm. QA/QC checks were conducted daily and at the end of each drying test.

TABLE 3 CONFIGURATIONS OF VOC SAMPLING SYSTEM B

RUN NO.	WOOD SPECIES	SYSTEM B CONFIGURATION[a] 1	2	3
1	Douglas fir heartwood	x		
2	Douglas fir heartwood		x	
3	Douglas fir heartwood			x
4	Douglas fir sapwood			x
5	Ponderosa pine			x
6	Ponderosa pine		x	
7	Southern yellow pine - TX		x	
8	Southern yellow pine - TX		x	
9	Redwood		x	
10	Cedar		x	
11	Cedar		x	
12	Southern yellow pine -AR		x	
13	Southern yellow pine -AR	x		
14	Coastal Douglas fir		x	
15	White fir		x	
16	White fir	x		
17	Grand fir			x
18	Hemlock		x	
19	White pine		x	
20	Sugar pine		x	

[a] configuration 1 - 25 ft heated line
configuration 2 - 25 ft heated line and a condenser
configuration 3 - 100 ft heated line

(4) Calculations - The VOC emission rate was calculated using the measured VOC concentration, flow, and temperature of the kiln exhaust gas. Air flow and moisture balances for the kiln were calculated to estimate fugitive VOC losses. Air flow balances were calculated using temperatures, relative humidities, and velocities of the intake air and kiln exhaust. Moisture balances were calculated using the measured moisture contents of the intake air and exhaust gas and the moisture removal from the lumber. Calculated VOC emission rates were adjusted, using the moisture balance data, to account for fugitive VOC losses. Calculations are presented in Appendix C.

D. Measurement of Lumber Turpentine and Moisture Losses

Turpentine content of the lumber before and after drying was measured to determine turpentine losses. Shaving samples were taken for turpentine tests by drilling four 1-inch bores in about 10 percent of the boards in the kiln charge prior to drying. After drying, another four bores adjacent to the initial ones were made in the same boards to collect shaving samples. The shaving samples were collected into Ziplock™ plastic bags and kept in a refrigerator at about 38°F. Turpentine measurements were conducted using an alkaline steam distillation procedure (4). Moisture of the shavings was determined by oven-drying a sample of 200-300 grams at 105°C for 24 hours. The sample was considered 'dry' when successive weighings differed by less than 1 percent.

Moisture loss of the lumber during drying was determined by weighing each board of the kiln charge before and after drying. A laboratory scale was used to weigh the boards to the nearest gram.

IV RESULTS AND DISCUSSION

A. Sampling System QA/QC Performance

EPA Method 25A specifications for zero drift and span drift are ±3 percent of the span value (3). During this study, zero and calibration drift checks were completed 338 times. Of these, nineteen (5.6 percent) of the drift checks exceeded ±3 percent. Because of the limited frequency at which drift checks were greater than ±3 percent and the length of most drying cycles (greater than 24 hours), all data were considered valid with respect to zero and span calibration. VOC data for sampling system B during Run 3 were invalidated because of a leak in the sample line. The QA/QC data for the two VOC sampling systems are summarized in Appendix D.

B. Estimation of Fugitive VOC Losses

Fugitive VOC losses can result from gas leakage through the door edge and cracks in the kiln walls. Mass balances of moisture and air entering and exiting the kiln were calculated to quantify these losses.

The air and moisture balances calculated are presented in Table 4. Air recovery rates varied from 68 to 103 percent, while moisture recovery ranged from 39 to 105 percent. The average air and moisture recovery rates for all the tests were 83 and 84 percent, respectively. Statistical analyses of the data indicated that the difference between the two averages is not significant. However, the average air and moisture recovery rates are significantly less than 100 percent. Therefore, it was necessary to account for these losses in calculating total VOC emissions for each lumber drying cycle. Statistical analyses are presented in Appendix E.

The variability of air and moisture recovery rates between drying runs, as shown in Table 4, may have been related to the drying schedules used. Gas leakage rate could vary with the operating temperature and gas moisture content in the kiln, as well as fan speed. Possible impacts of drying schedules on air and moisture balances are discussed in Appendix F.

VOC emissions discussed in this report were corrected for fugitive VOC losses using the moisture recovery rates listed in Table 4. This approach was based on the assumption that VOCs and moisture are removed from the wood proportionally and mix well in the gas stream during the drying process and, therefore, the moisture recovery rate may be used as a surrogate for estimating the total fugitive VOC losses due to gas leakage. The fugitive VOC loss during each run was corrected using the calculated moisture recovery rate for that run.

TABLE 4 AIR AND MOISTURE BALANCES

RUN NO.	WOOD SPECIES	DRYING TIME, hr.	AIR RECOVERY, %	MOISTURE RECOVERY, %
1	Douglas fir heartwood	63	84	60
2	Douglas fir heartwood	53	95	39
3	Douglas fir heartwood	42	68	83
4	Douglas fir sapwood	27	75	99
5	Ponderosa pine	29	81	88
6	Ponderosa pine	28	89	80
7	Southern yellow pine - TX	33	103	60
8	Southern yellow pine - TX	29	86	62
9	Redwood	329	87	86
10	Cedar	21	89	92
11	Cedar	18	85	93
12	Southern yellow pine - AR	41	80	84
13	Southern yellow pine - AR	40	70	95
14	Coastal Douglas fir	21	98	80
15	White fir	70	96	102
16	White fir	75	83	105
17	Grand fir	47	71	94
18	Hemlock	40	73	90
19	White pine	44	75	84
20	Sugar pine	99	77	102
AVG[a]			83	84
MIN		18	68	39
MAX		329	103	105
STD			10	16

[a] AVG - average, STD - standard deviation

Air recovery rate was not used to estimate fugitive VOC losses because the kiln exhaust air flow did not necessarily reflect the profile of VOC emission rate during the drying cycle. Both moisture and air leakage rates may vary with time during drying. More detailed discussions of moisture and air leakage during the drying are included in Appendix E.

C. Evaluation of VOC Measurement System Configurations

The VOC emissions measured by the two parallel sampling systems during individual drying runs were compared and the differences are summarized in Table 5.

The VOC emissions measured with identical sampling systems during Runs 1, 13, and 16 differed within ±4 percent and were within the allowable calibration error (±5 percent of the standard gas concentration) specified in Method 25A (3). This indicated that the two VOC measurement systems could yield similar results when operated in the same configuration.

TABLE 5 COMPARISON OF VOC EMISSIONS DETECTED BY DIFFERENT SAMPLING SYSTEM CONFIGURATIONS

RUN NO.	WOOD SPECIES	CONFIGURATIONS[a] SYSTEM A	SYSTEM B	VOC, lb C/ODT A	B	DIFFERENCE
13	SYP-AR	1	1	1.68	1.75	4
16	WF	1	1	0.68	0.69	1
1	DFH	1	1	1.00	0.97	-3
7	SYP-TX	1	2	3.16	3.40	8
2	DFH	1	2	0.31	0.31	0
8	SYP-TX	1	2	2.94	2.88	-2
6	PP	1	2	2.06	1.94	-6
12	SYP-AR	1	2	2.37	1.96	-17
9	Redwood	1	2	0.17	0.14	-18
14	CDF	1	2	0.44	0.35	-20
20	SP	1	2	1.98	1.38	-30
19	WP	1	2	2.54	1.67	-34
10	Cedar	1	2	0.12	0.05	-58
18	Hemlock	1	2	0.30	0.12	-60
11	Cedar	1	2	0.17	0.06	-65
15	WF	1	2	0.85	0.19	-78
3	DFH	1	3	0.71	lost	-
4	DFS	1	3	0.28	0.31	11
17	GF	1	3	0.63	0.64	2
5	PP	1	3	1.92	1.90	-1

[a] configuration 1 - 25 ft heated line
configuration 2 - 25 ft heated line and a condenser
configuration 3 - 100 ft heated line

The change in VOC measurement due to moisture removal from the sample gas varied from 8 to -78 percent during thirteen runs. For Douglas fir, redwood, and pines, the reduction was less than 35 percent. However, for hemlock, cedar, and white fir, the reduction was 58 percent and higher. This result suggests that the effect of sample gas cooling and moisture removal on Method 25A VOC measurement is related to the wood species being dried.

The condensate from the sample gas of cedar drying was analyzed with a GC/MS to identify the VOC compounds removed by condensation. The major compound found was acetic acid, which is condensable and water-soluble. Turpentine contents of hemlock, cedar, and white fir are low, as reported in the literature (4) and measured in this study (to be discussed later). Therefore, the VOC emissions from the drying of these species, which were relatively low, might have been mainly attributed to acetic acid. The large reduction of VOC measurements due to sample gas cooling may have resulted from the removal of acetic acid.

For woods of high turpentine content (e.g. pines), VOC emissions are primarily due to terpene compounds (5). Terpenes are condensable but not water-soluble. When the sample gas was cooled, the condensed turpentine could be stripped from the condensate back to the gas phase. Therefore, cooling the sample gas may not have removed a significant amount of terpene compounds. The contribution of acetic acid to the VOC emission from the drying of Douglas fir, pines, and redwood may have been relatively small. Therefore, the removal of acetic acid with condensate would not have had a large impact on the VOC measurement.

VOC emissions during the drying of Douglas fir, ponderosa pine, and grand fir (Runs 3, 4, 5, and 17) were measured with two sampling systems having different sample line lengths. The data for Run 3 were invalid, because system B failed due to leakage in the sampling system. The differences between the VOC emissions measured by the two systems were within ±11 percent. Additional experiments may need to be conducted with other wood species to confirm the effect of sample line length on measured VOC emissions.

D. <u>VOC Emission Potentials</u>

(1) <u>Experimental Reproducibility in VOC Emissions</u> - Two runs using similar drying schedules were conducted on six occasions using five wood species. The purpose of these runs was to examine the experimental reproducibility of VOC emissions measured from small-scale kiln operations. The VOC emissions measured by sampling system A were used to assess reproducibility. For Douglas fir heartwood, the data of Run 1 and Run 3 were used for the calculation because an unusual drying schedule was used in Run 2.

<u>Table 6</u> shows that the relative difference in VOC emissions in duplicate tests was less than 20 percent for the six runs. Differences in measured VOC emissions between the two runs for each wood were probably influenced by variations in lumber VOC content between charges. Slight differences in the drying schedules used also may have contributed to the differences in measured VOC emissions.

TABLE 6 EXPERIMENTAL REPRODUCIBILITY IN VOC EMISSIONS

WOOD SPECIES	RUN NO.	VOC MEASURED BY SYSTEM A, lb C/ODT	MEAN	RELATIVE DIFFERENCE, %
DFH	1	1.00	0.85	±17
	3	0.71		
PP	5	1.92	1.99	±3.5
	6	2.06		
SYP-TX	7	3.16	3.05	±3.6
	8	2.94		
Cedar	10	0.12	0.15	±17
	11	0.17		
SYP-AR	12	2.37	2.02	±17
	13	1.68		
WF	15	0.85	0.76	±11
	16	0.68		

[a] Relative Difference = (MEAN - Measured VOC)/MEAN * 100.

(2) VOC Emission Factors - VOC emission factors were calculated from the VOC measurements made with sampling system A. Data for the ten wood species dried are summarized in Table 7. The VOC emissions are expressed as lb C/ODT (pounds carbon per oven-dry ton of wood) and lb C/MBF (pounds carbon per thousand board feet). The VOC emission factors for some of the species represent the averages of duplicate runs.

As shown in Table 7, the VOC emissions ranged from 0.12 to 3.32 lb C/MBF, with redwood and cedar being the lowest and southern yellow pine from Texas the highest. The southern yellow pine lumber from Texas was made using peeler cores from a veneer mill. Wood from this (center) portion of the tree would be expected to have a higher VOC content than wood from the outer portion of the tree. The VOC emission potentials for non-pine softwood species were within the range of 0.12 to 0.81 lb C/MBF. The pine wood species had higher VOC emission potentials, ranging from 1.86 to 3.32 lb C/MBF.

VOC emissions measured for two full-scale lumber kilns drying southern pine lumber have been reported in the literature (6). Numerous company-provided VOC measurements for kilns drying southern pine lumber have been compiled by NCASI (7). The literature data show a range of VOC emissions between 0.6 and 5.4 lb C/MBF for indirectly-heated kilns. The VOC emission factors for pine species measured in this study are within that range.

Factors that may affect the VOC emission potentials from lumber drying are discussed in Appendix G.

TABLE 6 EXPERIMENTAL REPRODUCIBILITY IN VOC EMISSIONS

WOOD SPECIES	RUN NO.	VOC MEASURED BY SYSTEM A, lb C/ODT	MEAN	RELATIVE DIFFERENCE, %
DFH	1	1.00	0.85	±17
	3	0.71		
PP	5	1.92	1.99	±3.5
	6	2.06		
SYP-TX	7	3.16	3.05	±3.6
	8	2.94		
Cedar	10	0.12	0.15	±17
	11	0.17		
SYP-AR	12	2.37	2.02	±17
	13	1.68		
WF	15	0.85	0.76	±11
	16	0.68		

[a] Relative Difference = (MEAN - Measured VOC)/MEAN * 100.

(2) VOC Emission Factors - VOC emission factors were calculated from the VOC measurements made with sampling system A. Data for the ten wood species dried are summarized in Table 7. The VOC emissions are expressed as lb C/ODT (pounds carbon per oven-dry ton of wood) and lb C/MBF (pounds carbon per thousand board feet). The VOC emission factors for some of the species represent the averages of duplicate runs.

As shown in Table 7, the VOC emissions ranged from 0.12 to 3.32 lb C/MBF, with redwood and cedar being the lowest and southern yellow pine from Texas the highest. The southern yellow pine lumber from Texas was made using peeler cores from a veneer mill. Wood from this (center) portion of the tree would be expected to have a higher VOC content than wood from the outer portion of the tree. The VOC emission potentials for non-pine softwood species were within the range of 0.12 to 0.81 lb C/MBF. The pine wood species had higher VOC emission potentials, ranging from 1.86 to 3.32 lb C/MBF.

VOC emissions measured for two full-scale lumber kilns drying southern pine lumber have been reported in the literature (6). Numerous company-provided VOC measurements for kilns drying southern pine lumber have been compiled by NCASI (7). The literature data show a range of VOC emissions between 0.6 and 5.4 lb C/MBF for indirectly-heated kilns. The VOC emission factors for pine species measured in this study are within that range.

Factors that may affect the VOC emission potentials from lumber drying are discussed in Appendix G.

TABLE 7 VOC EMISSION POTENTIALS FROM LUMBER DRYING

WOOD SPECIES	VOC EMISSIONS MEASURED BY SYSTEM A lb C/ODT	lb C/MBF
NON-PINE WOOD:		
Redwood	0.17	0.12
Cedar	0.15	0.12[a]
Douglas fir sapwood	0.28	0.21
Hemlock	0.30	0.24
Coastal Douglas fir	0.44	0.34
Grand fir	0.63	0.53
White fir	0.77	0.57
Douglas fir heartwood	0.86	0.81[a]
PINE WOOD:		
Ponderosa pine	1.99	1.86[a]
Sugar pine	1.98	2.07
White pine	2.54	2.26[a]
Southern yellow pine-AR	2.03	2.36[a]
Southern yellow pine-TX	3.05	3.32[a]

[a] Average values from duplicate runs

E. Comparison of VOC Emissions and Turpentine Losses

VOC emissions from the drying of southern pine wood have been attributed mainly to terpene compounds originally contained in the wood (5). This suggests that there might be a correlation between VOC emissions and turpentine losses occurring during lumber drying. To evaluate this possibility, turpentine content of the lumber before and after drying was measured for all the drying tests conducted. The turpentine losses measured are presented in Table 8.

Table 8 shows that the initial turpentine content of the lumbers tested ranged from 0.67 to 32.01 lb C/ODT, with white fir having the lowest and southern yellow pine from Texas the highest. The initial turpentine contents measured for lumbers of duplicate drying runs were close, except for a large difference in southern yellow pine from Texas. The turpentine analyses were conducted with shaving samples taken from about 10 percent of the boards charged to the kiln. The measured variability in turpentine content for southern yellow pine from Texas may be due to a non-uniform turpentine content in this lumber. It was observed that some boards of this lumber consisted of sapwood and heartwood in different proportions. Heartwood normally contains more turpentine than sapwood (8).

Turpentine losses ranged from 0.10 to 4.16 lb C/ODT. The ratio of the turpentine loss to initial turpentine content varied from 6 to 30 percent, indicating relatively low turpentine losses. Further discussion of turpentine losses during wood drying is included in Appendix G.

TABLE 8 TURPENTINE LOSSES OF LUMBERS IN DRYING

RUN NO.	WOOD SPECIES	TURP. - IN (lb C/ODT)	TURP. - OUT (lb C/ODT)	TURP. LOSS b C/ODT	TURP. LOSS %
NON-PINE WOOD					
15	WF	0.67	0.54	0.13	19
16	WF	0.77	0.61	0.16	21
4	DFS	0.99	0.87	0.12	12
10	CEDAR	1.06	0.94	0.12	12
11	CEDAR	1.30	1.20	0.10	7
14	CDF	1.19	1.04	0.15	13
18	HEMLOCK	1.16	1.03	0.13	11
9	REDWOOD	1.22	1.06	0.16	13
17	GF	1.34	1.05	0.29	22
1	DFH	1.91	1.54	0.37	19
2	DFH	1.89	1.46	0.43	23
3	DFH	1.78	1.39	0.39	22
PINE WOOD					
12	SYP-AR	1.83	1.28	0.55	30
13	SYP-AR	1.86	1.76	0.11	6
19	WP	2.77	2.42	0.35	13
5	PP	2.90	2.52	0.38	13
6	PP	3.46	2.59	0.87	25
20	SP	4.93	4.12	0.81	16
7	SYP-TX	32.01	27.85	4.16	13
8	SYP-TX	14.47	13.65	0.82	6
MIN		0.67	0.54	0.10	6
MAX		32.01	27.85	4.16	30

The VOC emissions measured with sampling system A and lumber turpentine losses were compared. As displayed in Figure 3, the data points are scattered and fall into two groups, pine and non-pine species. This would be expected because the VOC emissions from the drying of pine species are generally higher than those from non-pine species. Except one point for pine, the data for both groups are somewhat clustered. A correlation between the VOC emissions and turpentine losses is not apparent for either pine or non-pine species. Additional data are needed to determine if such a correlation may exist.

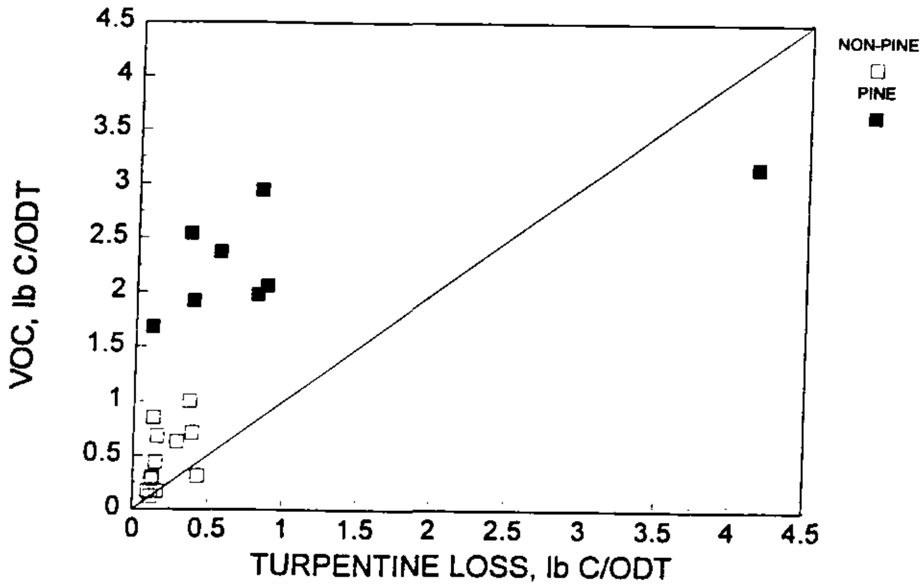


FIGURE 3 COMPARISON BETWEEN VOC EMISSIONS AND TURPENTINE LOSSES

Figure 3 shows that most data points are substantially above the diagonal line. This may indicate a relatively large contribution of non-terpene organic compounds to the VOC emissions. The significant contribution of non-terpene compounds to the VOC emissions from the drying of several non-pine species has been discussed in Section C. However, a similar observation for pine species was not expected. Ingram *et al.* reported that the VOC emissions from the drying of southern pine particles (passing 6-mm screen) and small blocks (1.9x1.9x7.6 cm) at 230°F were mostly due to terpene compounds (5). The total recoveries of terpene compounds from the emissions were low, 43 and 21 percent of the total losses from the wood particles and blocks, respectively. The low recoveries of terpene compounds were explained as possibly due to hydrolysis, oxygenation, or polymerization of monoterpenes such as α-pinene and β-pinene. Hydrolysis and oxygenation may break down monoterpenes to carbon dioxide and water, while polymerization may form less volatile compounds that do not contribute to VOCs. Further research is required to verify the result of this study and that reported in the literature.

F. Characteristics of VOC Emissions

Cumulative VOC emission rates over the entire drying cycle were plotted to characterize the VOC emissions from lumber drying. The data measured by sampling system A were used because system A represented a typical Method 25A sampling train. Cumulative VOC emission rates are plotted in Figures 4 to 15. Hourly emission rates are plotted for the runs of Douglas fir, ponderosa pine, and southern yellow pine from Texas. Two-minute cumulative VOC emission rates are plotted for other species. The zigzag appearance of the VOC emission rate curves in these figures reflect the kiln vent-operating cycles, in which the vents opened intermittently during the drying cycle.

Figure 4 shows the cumulative VOC emission rate for redwood drying. The VOC emission profile for this species was in two stages. The VOC emissions increased at a decreasing rate until about 250 hours and then elevated constantly at a relatively high rate. This may be due to the increase of dry bulb temperature from 140 to 170°F after 250 hours.

Figure 5 shows the cumulative VOC emission rates for the duplicate tests of cedar. The VOC emissions increased roughly linearly within the initial ten hours and at a lower rate thereafter.

Figure 6 presents the cumulative VOC emission rates for the drying of Douglas fir heartwood and sapwood. The VOC emissions in Run 1 and Run 3 had a similar "first-order" pattern, increasing rapidly in the initial thirty hours and then proceeding at a lower rate. In Run 1, the VOC emissions leveled off after about thirty-five hours. Due to a different drying schedule used in Run 2, the VOC emissions did not start until about thirteen hours. Kiln vents were closed during this period. The VOC emissions increased nearly linearly during the period of thirteen to twenty-seven hours and proceeded at a low rate thereafter. The accumulation of VOC emissions during the drying of Douglas fir sapwood (Run 4) was roughly linear after the first three hours.

Figure 7 displays the cumulative VOC emission profile during the drying of hemlock lumber. The VOC emissions did not start until about eleven hours. The relationship between the VOC emissions and drying time appears to be linear.

Figure 8 shows the cumulative VOC emission rate measured during the drying of coastal Douglas fir. Except for the initial several hours, the VOC emissions increased at a roughly constant rate.

As shown in Figures 9 and 10, the cumulative VOC emission rates during the drying of grand fir and white fir had a similar trend. The emissions started after about eleven hours and increased at a decreasing rate until the end of the test.

The cumulative VOC emission rates for the drying of ponderosa pine, sugar pine, white pine, and southern yellow pines are presented in Figures 11 to 15. The VOC emission rate increased nearly linearly with time.

Generally, the cumulative VOC emission rates for the drying of all wood species tested, except redwood, increased monotonically with drying time. This result differed from that reported by Banerjee *et al.* (9) for the drying of wood chips. In their laboratory experiments, freshly chipped wood was dried in a 27-inch ceramic tube furnace with a constant air flow through the chips. The VOC concentration detected in the exhaust gas from the tube followed a "double-peak" profile. The first peak was significantly lower than the second. The investigators hypothesized that the VOC profile was expected, and suggested that a "cooling effect" resulted from water evaporation on the chip surface. The "cooling effect" inhibited temperature rise inside the chip and, in turn, retarded the VOC diffusion to the chip surface. As the surface turpentine was depleted, the VOC concentration in the emission decreased. After most of the water was removed, the chip interior temperature started to increase, promoting VOC diffusion. Consequently, a sharp increase in VOC concentration was observed. The total drying period of the experiment was about sixty minutes.

The VOC emission patterns for the small-scale kiln lumber drying and the laboratory chip drying may be explained as follows. Lumber boards have a lower surface to volume ratio than wood chips. The surface turpentine may be a small portion of the total turpentine. Therefore, VOC emission during lumber drying may be largely diffusion-controlled. The low turpentine losses measured (see Table 8) support this hypothesis. This single control mechanism may have induced the monotonic VOC emission pattern for lumber drying. In addition, the "cooling effect" observed in chip drying may be insignificant in lumber drying. In lumber drying, a drying schedule is followed to control the moisture removal rate from the wood to prevent wood structure damage. A relatively high moisture content in the kiln was normally maintained during the initial drying period to heat up the inside of the lumber board. By the time the kiln started to release gases, the temperature difference between board interior and surface was reduced greatly.

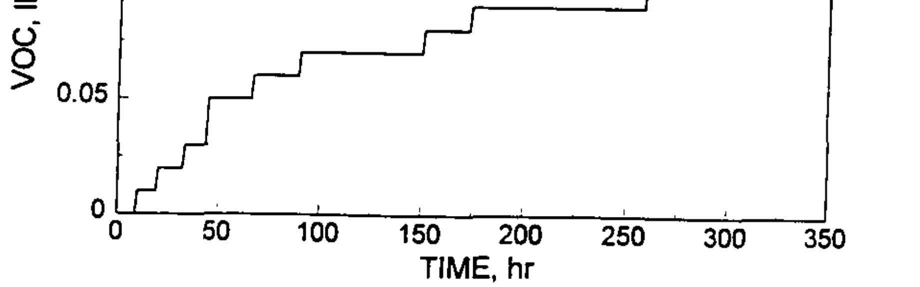


FIGURE 4 CUMULATIVE VOC EMISSION RATE DURING DRYING OF REDWOOD

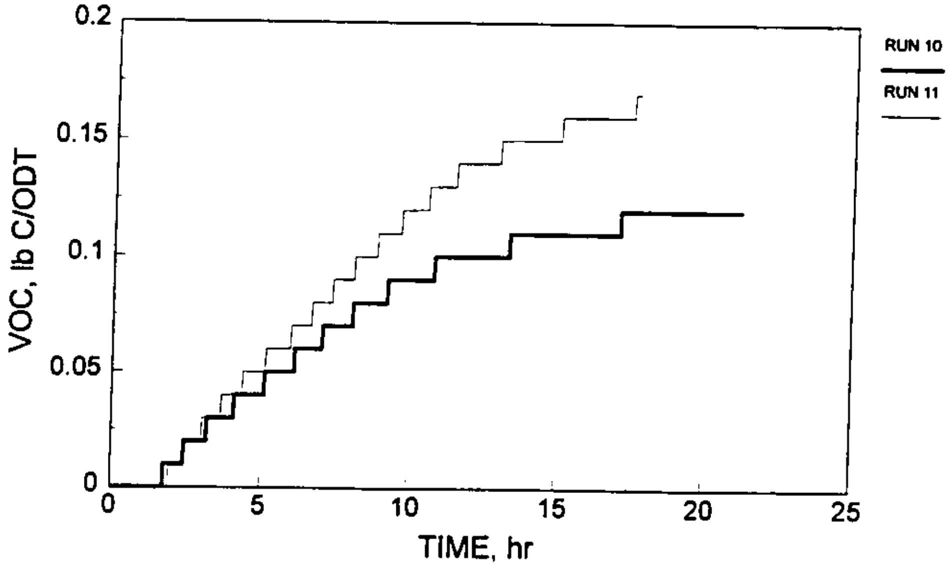


FIGURE 5 CUMULATIVE VOC EMISSION RATE DURING DRYING OF CEDAR

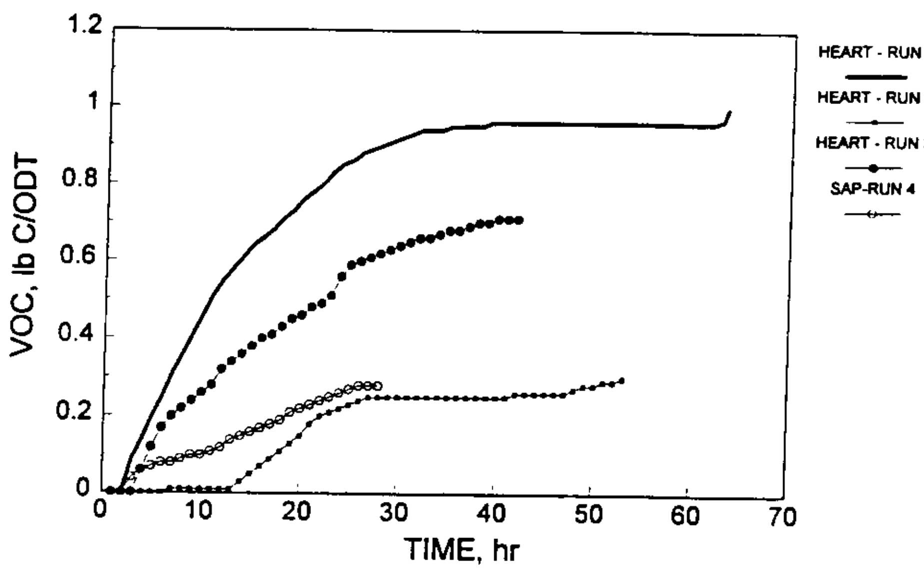


FIGURE 6 CUMULATIVE VOC EMISSION RATE DURING DRYING OF DOUGLAS FIR HEART AND SAP WOOD

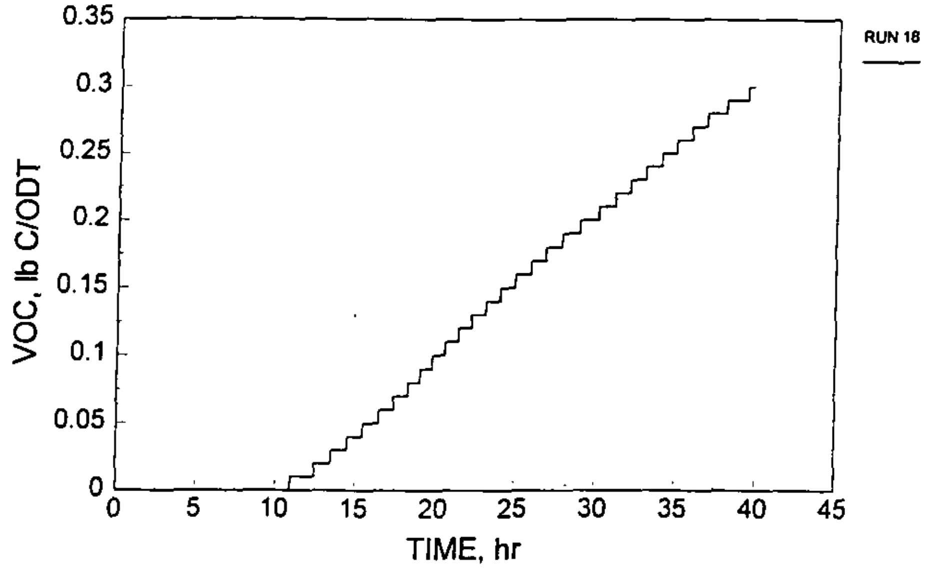


FIGURE 7 CUMULATIVE VOC EMISSION RATE DURING DRYING OF HEMLOCK

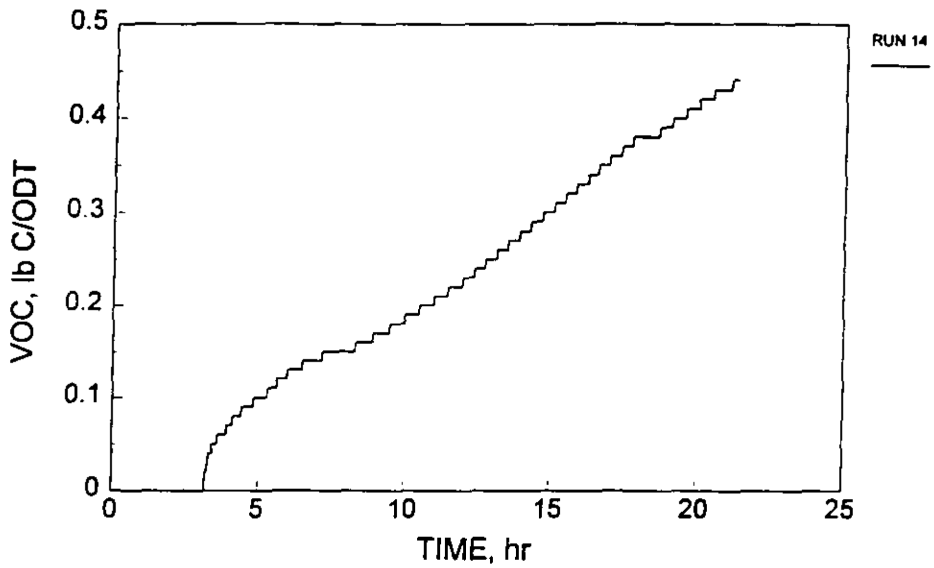


FIGURE 8 CUMULATIVE VOC EMISSION RATE DURING DRYING OF COASTAL DOUGLAS FIR

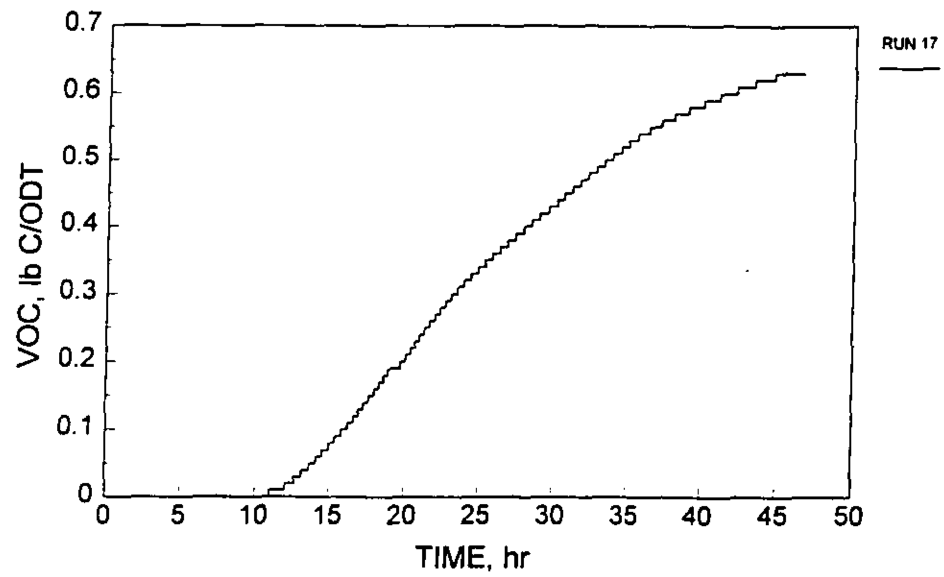


FIGURE 9 CUMULATIVE VOC EMISSION RATE DURING DRYING OF GRAND FIR

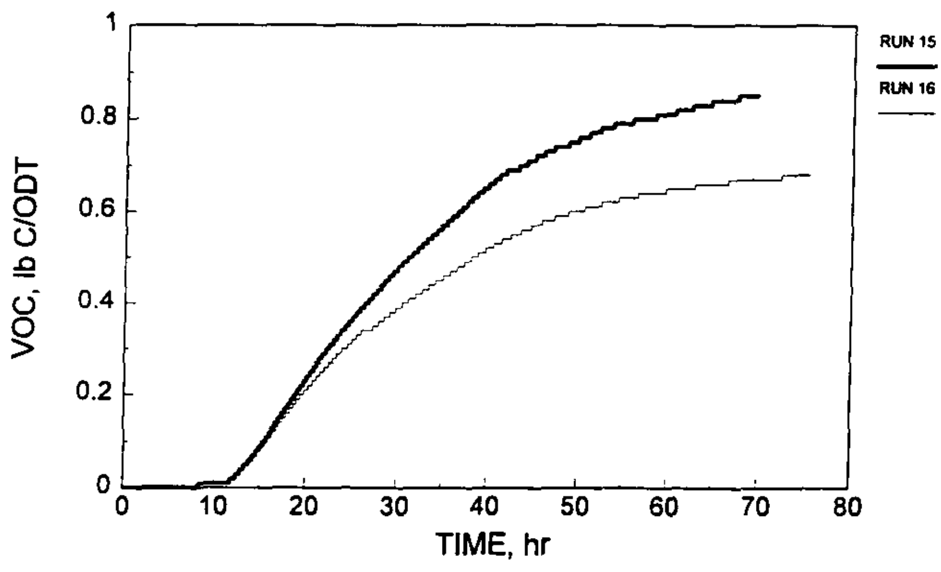


FIGURE 10 CUMULATIVE VOC EMISSION RATE DURING DRYING OF WHITE FIR

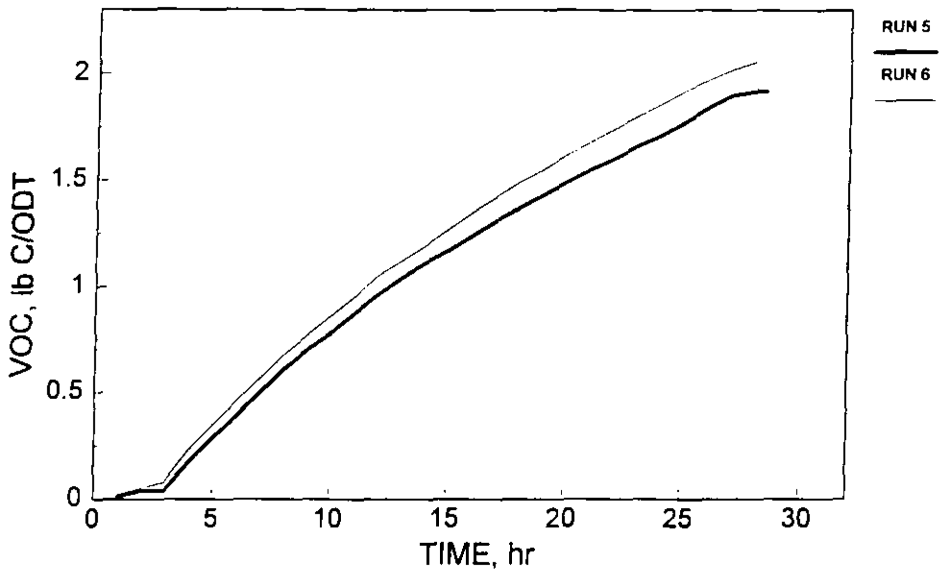


FIGURE 11 CUMULATIVE VOC EMISSION RATE DURING DRYING OF PONDEROSA PINE

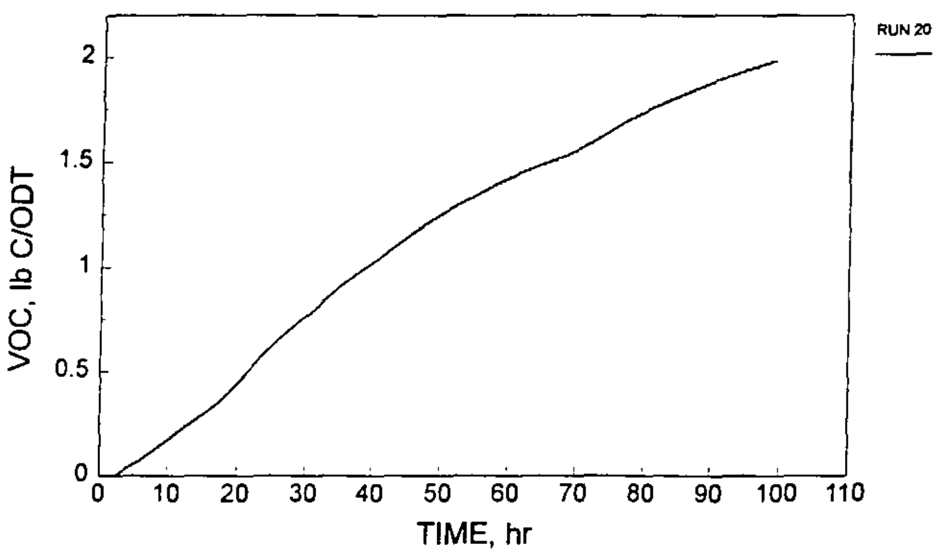


FIGURE 12 CUMULATIVE VOC EMISSION RATE DURING DRYING OF SUGAR PINE

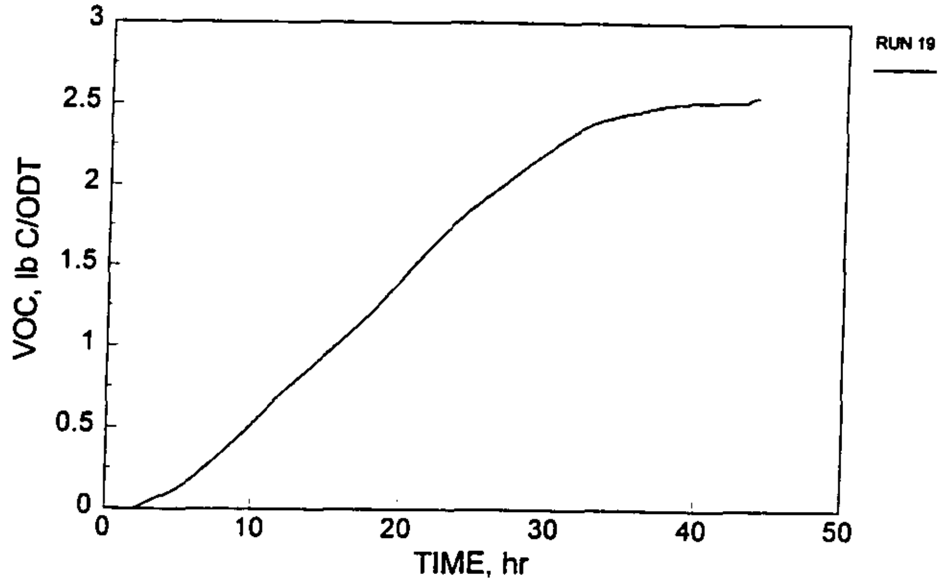


FIGURE 13 CUMULATIVE VOC EMISSION RATE DURING DRYING OF WHITE PINE

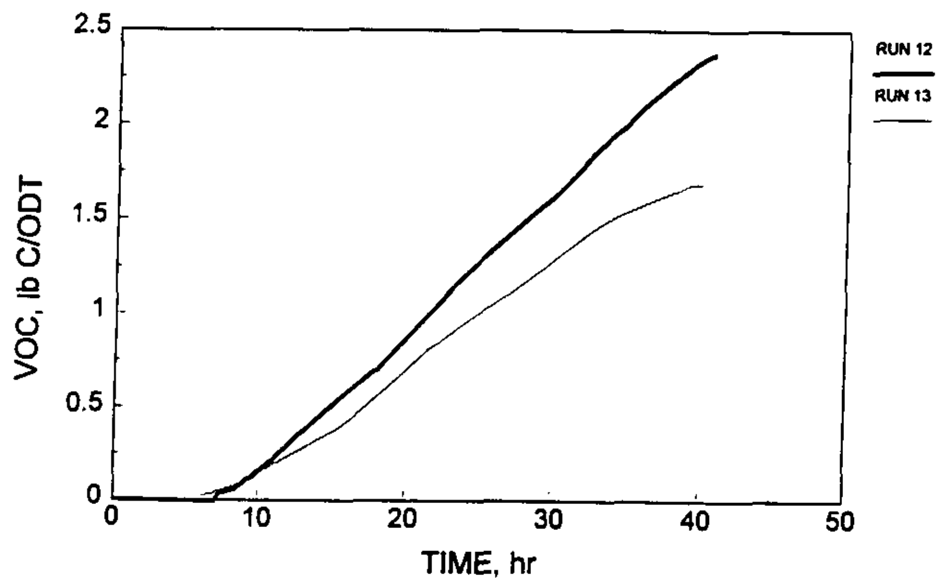


FIGURE 14 CUMULATIVE VOC EMISSION RATE DURING DRYING OF SOUTHERN YELLOW PINE FROM ARKANSAS

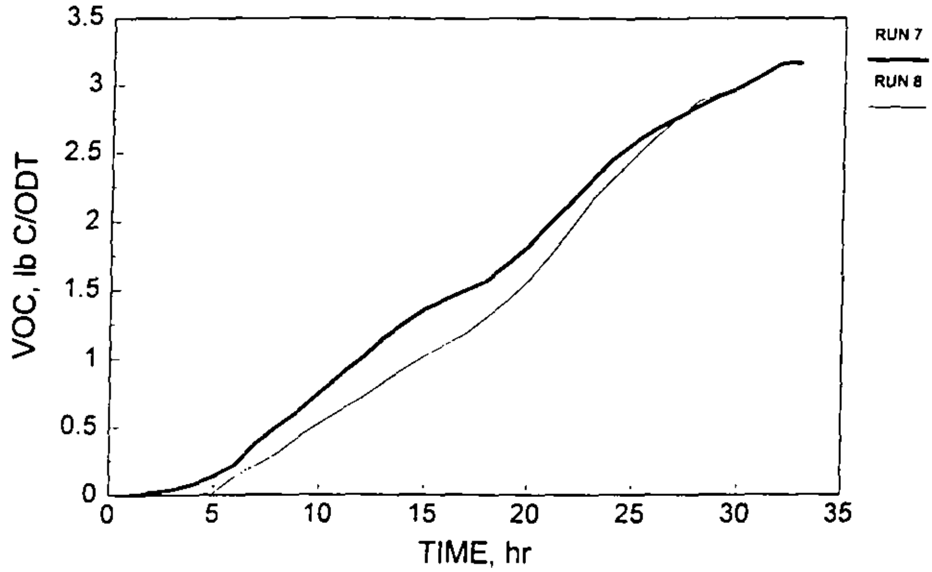


FIGURE 15 CUMULATIVE VOC EMISSION RATE DURING DRYING OF SOUTHERN YELLOW PINE FROM TEXAS

V SUMMARY AND CONCLUSIONS

A small-scale kiln was employed to study EPA Method 25A measurements of VOC emissions from lumber drying. Fresh-cut green lumbers of southern and western softwood species were tested using drying schedules similar to those for full-scale kilns. VOC concentrations in the kiln exhaust gas, and temperatures, flows, and relative humidities of the intake air and kiln exhaust were continuously monitored over the entire drying cycle. Fugitive VOC losses due to leakage from the kiln were quantified based on moisture mass balances. Parallel Method 25A VOC trains were used to evaluate the effect of sample line length and sample condensation on measured VOC emissions. Lumber turpentine losses during drying were measured.

The findings of this study were:

(1) The average air and moisture recovery rates measured during lumber drying tests were 83 and 84 percent, respectively, and indicated significant fugitive losses of air, moisture, and entrained VOC.

(2) The effect of cooling the sample gas to 65°F and removing the condensate on Method 25A VOC measurement varied with wood species. The reduction in VOC measurement was less than 35 percent for the drying of Douglas fir, redwood, and pine species.

However, the reduction ranged from 58 to 78 percent for hemlock, cedar, and white fir. The large reduction may have been due to the removal of acetic acid by condensation.

(3) The difference in the VOC measurement resulting from increasing the heated sampling line length from 25 to 100 feet was within ±11 percent for Douglas fir, grand fir, and ponderosa pine. Additional experiments may need to be conducted with other wood species to confirm the effect of sample line length.

(4) Drying schedules were duplicated for six species. Measured VOC emissions for the duplicate runs differed from the average value by less than 20 percent for each of the six species tested.

(5) VOC emission potentials measured in this study were from 0.12 to 0.81 lb C/MBF for non-pine species and from 1.86 to 3.32 lb C/MBF for pines. These values are consistent with available VOC emission measurements from full-scale lumber drying kilns.

(6) Turpentine losses from the lumber during drying were less than 30 percent for all the species tested. Comparison of the VOC emissions and turpentine losses measured in this study did not indicate a correlation between the two measurements. Further research is required to determine if such a correlation may exist.

VI LITERATURE REFERENCES

(1) "A Laboratory Study of Moisture Effects on EPA Method 25A VOC Measurements," NCASI Special Report 95-10, August 1995.

(2) "Method 14 - Determination of Fluoride Emissions from Potroom Roof Monitors for Primary Aluminum Plants," Environmental Reporter - Federal Regulations, BNA, Volume 2, 120: 1194, 59 FR 47265, September 15, 1994.

(3) "Method 25A - Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer," Environmental Reporter - Federal Regulations, BNA, Volume 2, 120: 1325, 59 FR 47265, September 15, 1994.

(4) Drew, J., Russell, J., and Bajak, H.W., Sulfate Turpentine Recovery, Pulp Chemicals Association, New York, 1971.

(5) Ingram, L.L., Taylor, F.W., Punsavon, V., and Templeton, M.C., "Identification of Volatile Organic Compounds Emitted during the Drying of Southern Pine in Pilot and Laboratory Experiments," Internal Report, Forest Products Laboratory, Mississippi State University, 1994.

(6) Glass, M.R. and Elam, D.L., "Innovative Procedures to Quantify Volatile Organic Compound Emission from Lumber Kilns," 1995 TAPPI Environmental Conference Proceedings, TAPPI Press, Atlanta, 1995.

(7) "Lumber Kiln Data Base," NCASI Internal File, 1995.

(8) Sjöström, E., Wood Chemistry - Fundamentals and Applications, Second Edition, Academic Press, New York, 1993.

(9) Banerjee, S., Hutten, M., and Su, W., "Release of Water and Volatile Organics from Wood Drying," Journal of Environmental Science and Technology, 29(4): 1135, 1995.

(10) McCabe W.L., Smith, J.C., and Harriott, P., Unit Operations of Chemical Engineering, McGraw-Hill, New York, 1985.

(11) Wapole, R.E. and Myers, R.H., Probability and Statistics for Engineers and Scientists, Macmillan Publishing Company, New York, 1989.

(12) Rydholm, S., Pulping Processes, John Wiley & Sons, New York, 1965.

(13) Kocurek, M.J., Properties of Fibrous Raw Materials and Their Preparation for Pulping, Third Edition, TAPPI Press, Atlanta, 1983.

VII ACKNOWLEDGMENTS

This work was financially supported by Boise Cascade Corporation, Georgia-Pacific Corporation, Louisiana-Pacific Corporation, Idaho Forest Industries Corporation, Plum Creek Timber Company, Potlatch Corporation, Simpson Timber Company, Stone Container Corporation, and Union Camp Corporation. The authors would like to thank the committee members of this project for their participation during the study. They are Garrett Andrew (Boise Cascade Corporation), Steven A. Petrin (Georgia-Pacific Corporation), Lawrence Otwell (Georgia-Pacific Corporation), Carl Martin (Idaho Forest Industries Corporation), Mitchell Leu (Plum Creek Timber Company), Jim Evensen (Louisiana-Pacific Corporation), Don Hejna (Potlatch Corporation), Dr. John Emery (Potlatch Corporation), Gerry Soehnlein (Simpson Timber Company), Paul Willhite (Stone Container Corporation), Jerry Ethridge (Union Camp Corporation), and Larson Harsey (then with Georgia-Pacific Corporation).

Dr. Richard Folk (University of Idaho) and Mr. T. Orlin Galloway (Louisiana-Pacific Co.) operated the small-scale kiln during this study. Dr. John Emery (Potlatch Co.) and Dr. Richard Folk prepared the discussion in Appendix G. Their contribution to this study is greatly appreciated.

APPENDIX A

HISTORY OF LUMBER

HISTORY OF LUMBER

Information on the history of the lumbers tested in this study was collected from the lumber suppliers and is shown in Table A1. The size of the log small end was reported as the log diameter. Wet storage of logs corresponded to a wood yard storage with sprinkling of water. The lumbers were produced between July and September. The harvest season of each species can then be estimated from the log storage time. The lumber was wrapped with water-proof paper right after production to prevent VOC losses and was delivered to the experimental site at the University of Idaho within three days. The ambient temperature under which the lumber was stored was between 65 and 75°F.

TABLE A1 HISTORY OF LUMBER

WOOD SPECIES[a]	HARVEST LOCATION	TREE AGE, yr.	LOG DIAMETER, in.	LOG STORAGE METHOD	LOG STORAGE TIME mo.	LUMBER STORAGE, day
DFH	Idaho	50-60	10-12	dry	3	4
DFS	Idaho	50-60	10-12	dry	3	4
PP	Washington	25-60	8-12	dry	0.5	10
SYP-TX	Texas	20-30	16-26	dry	0.25	4
Redwood	California	25-50	6-16	dry	5	25
Cedar	Idaho	90-200	6-44	wet	2	5
SYP-AR	Arkansas	30-40	11	dry	0.75	15
CDF	Washington	40-50	20-24	dry	1	15
WF	California	60	30	wet	2	10
GF	Idaho	60-100	<10	wet	1	20
Hemlock	Oregon	30-40	8-10	dry	1.5	10
WP	Idaho	N/A[b]	N/A	pond	12	5
SP	California	50	34	wet	10	10

[a] DFH - Douglas fir heartwood
DFS - Douglas fir sapwood
PP - Ponderosa pine
SYP-TX - Southern yellow (loblolly) pine from Texas(chipped from peeler cores)
Cedar - Western Red Cedar
SYP-AR - Southern yellow (loblolly) pine from Arkansas
CDF - Coastal Douglas fir
WF - White fir
GF - Grand fir
WP - White pine
SP - Sugar pine

[b] not available.

APPENDIX B

DRYING SCHEDULES

DRYING SCHEDULES

Drying schedules (dry and wet bulb temperature profiles, fan speed and direction) used for operating the small-scale kiln were provided by the lumber suppliers and were typical of those used for full-scale kilns. The recorded dry and wet bulb temperature profiles are listed in Table B1. These profiles matched the set-up schedules. In Table B1, the dry and wet bulb temperatures are expressed as time at temperature or as linearized changes to temperature during the time interval. The fan direction was reversed every six hour during all drying runs. The fan speed was adjusted to maintain an air velocity of 550 to 630 ft/min. across the stack.

TABLE B1 DRYING SCHEDULES

RUN NO.	WOOD SPECIES	TIME (t), hr.	DRY BULB TEMP. °F	TIME (t), hr.	WET BULB TEMP. °F
1	DFH	0-63	180	0-63	140
2	DFH	0-1	160	0-6	170
		1-5	162	6-18	170-(25/12)(t-6)
		5-9	164	18-53	145
		9-13	166		
		13-16	168		
		16-19	170		
		19-22	172		
		22-53	175		
3	DFH	0-42	180	0-6	160
				6-18	160-(35/12)(t-6)
				18-42	125
4	DFS	0-3	70+(110/3)t	0-3	70+(90/3)t
		3-8	180	3-8	160
		8-19	180	8-19	150-(25/11)(t-8)
		19-28	180	19-28	125
5	PP	0-1	70+100t	0-1	70+85t
		1-6	170	1-6	155
		6-24	170	6-24	155-(25/18)(t-6)
		24-28	170	24-28	130-(10/4)(t-24)
6	PP	0-1	70+100t	0-1	70+85t
		1-6	170	1-6	155
		6-24	170	6-24	155-(25/18)(t-6)
		24-27	170	24-27	130-(10/4)(t-24)
7	SYP-TX	0-1	70	0-1	70
		1-6	70+(130/5)(t-1)	1-6	70+(110/5)(t-1)
		6-12	200	6-9	180
		12-18	200-(10/6)(t-12)	9-21	180-(30/12)(t-9)

RUN NO.	WOOD SPECIES	TIME (t), hr.	DRY BULB TEMP. °F	TIME (t), hr.	WET BULB TEMP. °F
		18-24	190+(10/6)(t-18)	21-31	150
		24-31	200		
8	SYP-TX	0-1	70+130t	0-1	70+110t
		1-8	200	1-8	180
		8-20	200	8-18	170-(30/10)(t-8)
		20-24	200+(20/4)(t-20)	18-28	150
		24-28	220		
9	Redwood	0-48	110	0-48	100
		48-96	115	48-96	105
		96-144	115+(25/96)(t-96	96-144	110
		144-192	115+(25/96)(t-96)	144-192	115
		192-228	140	192-228	115
		228-252	140	228-252	100
		252-262	140+(20/10)(t-252)	252-262	100+(10/10)(t-252)
		262-277	160	262-277	115
		277-283	160+(10/6)(t-277)	277-283	115+(10/24)(t-277)
		283-301	170	283-301	115+(10/24)(t-277)
10	Cedar	0-3	70+(90/3)t	0-3	70+(65/3)t
		3-20.6	160	3-20.6	135-(15/17.6)(t-3)
11	Cedar	0-3	70+(90/3)t	0-3	70+(65/3)t
		3-17.2	160	3-17.2	135-(10/14.2)(t-3)
12	SYP-AR	0-6	70+(130/6)t	0-6	70+(110/6)t
		6-18	200-(20/12)(t-6)	6-18	180-(30/12)(t-6)
		18-32	180+(25/14)(t-18)	18-32	150
		32-40	205	32-40	150
13	SYP-AR	0-6	70+(130/6)t	0-6	70+(110/6)t
		6-18	200-(20/12)(t-6)	6-18	180-(30/12)(t-6)
		18-32	180+(25/14)(t-18)	18-32	150
		32-41	205	32-41	150
14	CDF	0-3	70+(110/3)t	0-3	70+(90/3)t
		3-8	180	3-8	160
		8-16	180	8-16	160-(30/8)(t-8)
		16-21	180	16-21	130
15	WF	0-6	70+(120/6)t	0-6	70+(105/6)t
		6-12	190	6-12	175
		12-18	190-(10/6)(t-12)	12-22	175-(35/10)(t-12)
		18-24	180	22-30	140
		24-30	180+(10/6)(t-24)	30-32	140-(10/2)(t-32)
		30-69	190	32-69	130
16	WF	0-6	70+(120/6)t	0-6	70+(105/6)t
		6-12	190	6-12	175
		12-18	190-(10/6)(t-12)	12-22	175-(35/10)(t-12)

RUN NO.	WOOD SPECIES	TIME (t), hr.	DRY BULB TEMP. °F	TIME (t), hr.	WET BULB TEMP. °F
		18-24	180	22-30	140
		24-30	180+(10/6)(t-24)	30-32	140-(10/2)(t-32)
		30-76	190	32-76	130
17	GF	0-6	70+(120/6)t	0-6	70+(105/6)t
		6-14	190	6-11	175
		14-18	190-(5/4)(t-14)	11-24	175-(45/13)(t-11)
		18-30	185	24-45	130
		30-36	185+(15/12)(t-30)		
		36-45	200		
18	Hemlock	0-5	70+(120/5)t	0-5	70+(105/5)t
		5-13	190	5-11	175
		13-18	190-(10/5)(t-13)	11-27	175-(45/16)(t-11)
		18-29	180	27-30	130
		29-33	180+(20/4)(t-29)	30-37	135
		33-39	200	37-39	130
19	WP	0-4	70+(80/4)t	0-4	70+(60/4)t
		4-12	150+(10/8)(t-4)	4-12	130+(5/8)(t-4)
		12-24	160	12-24	135-(5/12)(t-12)
		24-28	160+(10/4)(t-24)	24-28	130
		28-43	170	28-43	130
20	SP	0-2	70+(45/2)t	0-2	70+(35/2)t
		2-22	115+(55/20)(t-2)	2-22	105+(35/20)(t-2)
		22-28	170	22-28	140
		28-48	170	28-48	140-(20/20)(t-28)
		48-66	170	48-66	120
		66-72	170+(10/6)(t-66)	66-72	120-(5/6)(t-66)
		72-98	180	72-98	115

APPENDIX C

CALCULATIONS

CALCULATIONS

The following describes the equations used to calculate the air and moisture balances and the cumulative VOC emission rates from the recorded 2-minute average data.

A. Calculations of Air and Moisture Recovery Rates

Data on temperature, moisture content, and velocity measured for the intake fresh air and the stack exhaust were used to calculate moisture and air balances. Moisture loss of the lumber was used in moisture balance calculations.

$$Air\ recovery(\%) = \frac{Air_{o,d}}{Air_{i,d}} \bullet 100 \qquad (c1)$$

$$Air_{o,d} = Air_{o,a} \bullet (1 - M_o / 100) \qquad (c2)$$

$$Air_{o,a} = \sum_{j=1}^{n} \frac{\Delta t \bullet (F_{o,j} + F_{o,j-1}) / 2 \bullet (\pi \bullet (0.5 \bullet D / 12)^2) \bullet 293}{[(T_{o,j} + T_{o,j-1}) / 2 - 32] \bullet 5 / 9 + 273} \qquad (c3)$$

$$Air_{i,d} = Air_{i,a} \bullet (1 - M_i / 100) \qquad (c4)$$

$$Air_{i,a} = \sum_{j=1}^{n} \frac{\Delta t \bullet (F_{i,j} + F_{i,j-1}) / 2 \bullet (\pi \bullet (0.5 \bullet D / 12)^2) \bullet 293}{[(T_{i,j} + T_{i,j-1}) / 2 - 32] \bullet 5 / 9 + 273} \qquad (c5)$$

$Air_{o,d}$, $Air_{i,d}$ = total dry volumes of kiln exhaust and intake air, dscf (dry standard cubic feet at 1 atm and 20°C).
$Air_{o,a}$, $Air_{i,a}$ = total actual volumes of kiln exhaust and intake air, ascf (actual standard cubic feet at 1 atm and 20°C).
j = jth data recording period.
n = total data points recorded over the entire drying cycle.
Δt = interval of data recording, 2 minutes.
F_i,F_o = gas velocities at the intake duct and kiln exhaust stack, fpm (feet per minute).
T_i,T_o = temperatures of intake air and kiln exhaust, °F.
M_i,M_o = average moisture contents of intake air and kiln exhaust, % by volume. The average moisture content was determined using the average temperature and average relative humidity measured in the drying cycle from a humidity chart (10).
D = diameters of intake air duct and kiln stack, 10 inches.

$$Moisture\ recovery(\%) = \frac{Moisture_o}{Moisture_i} \bullet 100 \qquad (c6)$$

$$Moisture_o = \frac{Air_{o,a} \bullet (M_o / 100) \bullet 18}{385} \qquad (c7)$$

$$Moisture_i = \frac{Air_{i,a} \bullet (M_i / 100) \bullet 18}{385} + W_L \qquad (c8)$$

$Moisture_0$ = total moisture content of the kiln exhaust, lb.
$Moisture_i$ = total moisture content of the intake air, lb.
W_L = moisture released from the lumber (lumber weight loss), lb.

B. Calculations of Cumulative VOC Emission Rates

The cumulative VOC emission rates were calculated using 2-minute averages of VOC concentration, gas flow and temperature, as well as the average moisture content measured over the entire drying cycle. The emissions were corrected for fugitive losses based on moisture recovery.

$$VOC_1 = \sum_{j=1}^{n} \frac{\Delta t \bullet (F_{o,j} + F_{o,j-1}) / 2 \bullet (\pi \bullet [0.5 \bullet D / 12]^2) \bullet (C_j + C_{j-1}) / 2 \bullet 10^{-6} \bullet 293 \bullet 12}{385 \bullet [((T_{o,j} + T_{o,j-1}) / 2 - 32) \bullet 5 / 9 + 273] \bullet W_d} \qquad (c9)$$

For the sampling system with a condenser, the VOC emission rate calculated in Equation c9 needs to be corrected because the VOC concentration measured was on a dry basis in that case.

$$VOC_2 = (1 - M_o / 100) \bullet VOC_1 \qquad (c10)$$

Correction for fugitive VOC losses:

$$VOC_W = \frac{VOC_1}{Moisture\ recovery(\%) / 100} \qquad (c11)$$

$$VOC_W = \frac{VOC_2}{Moisture\ recovery(\%) / 100} \qquad (c12)$$

Conversion of VOC emission rate from (lb C/ODT) to (lb C/MBF):

$$VOC_V = \frac{VOC_W \bullet W_d \bullet 1000}{N \bullet h \bullet (w / 12) \bullet l} \qquad (c13)$$

VOC_1 = cumulative VOC emission rate, lb C/ODT (pound carbon per ton of dry wood).
VOC_2 = cumulative VOC emission rate corrected for moisture removal when a condenser is used in the sampling system, lb C/ODT.

VOC_W = cumulative VOC emission rate corrected for fugitive losses using moisture recovery rates, based on lumber dry weight, lb C/ODT.
VOC_V = cumulative VOC emission rate corrected for fugitive losses using moisture recovery rates, based on lumber volume, lb C/MBF (pound carbon per thousand board feet). One board foot of lumber is defined to be the volume of one square foot by one inch.
C = VOC concentration, ppm C.
W_d = dry weight of lumber, ODT.
N = board number of the load to the kiln.
h = board thickness, inch.
w = board width, inch.
l = board length, ft.

RUN NO.	MONTH/ DAY	FID SPAN	STAND. GAS, ppm propane	SYSTEM A RESPONSE ppm propane	SYSTEM A DRIFT % span	SYSTEM B RESPONSE ppm propane	SYSTEM B DRIFT % span
		1000	183.0	184.0	-0.1	182.0	-0.1
		1000	856.0	858.0	0.2	858.0	0.2
3	7/19	1000	0.0	0.0	0.0	0.0	0.0
		1000	93.8	90.0	-0.4	91.8	-0.2
		1000	856.0	830.7	-2.5	814.9	-4.1
	7/20	1000	0.0	-0.5	-0.1	0.0	0.0
		1000	93.8	89.6	-0.4	76.4	-1.7
		1000	183.0	181.2	-0.2	196.6	-1.4
3	7/20	1000	856.0	841.1	-1.5	902.8	4.7
		10000	0.0	18.4	0.2	-44.2	-0.4
		10000	93.8	107.2	0.1	34.5	-0.6
		10000	183.0	205.0	0.2	146.6	-0.3
		10000	856.0	898.5	0.4	855.8	-0.0
		10000	1430.0	1489.1	0.6	1430.1	0.0
		100	0.0	-2.6	-2.6	3.9	3.9
		100	93.8	95.0	1.2	89.1	-4.7
4	8/08	1000	0.0	0.5	0.1	-0.5	-0.1
		1000	93.8	94.4	0.1	94.6	0.1
		1000	856.0	860.3	0.4	864.6	0.9
		1000	300.7	300.3	-0.0	300.3	-0.0
		1000	501.7	505.7	0.4	506.4	0.5
		1000	901.9	900.5	-0.1	900.2	-0.2
		10000	1430.0	1440.5	0.1	1390.0	-0.4
	8/09	1000	0.0	0.4	0.0	0.4	0.0
		1000	93.8	89.9	-0.4	88.3	-0.6
		1000	856.0	826.0	-3.0	852.7	-0.3
		1000	300.7	287.5	-1.3	294.8	-0.6
		1000	501.7	485.6	-1.6	509.2	0.8
		1000	901.9	858.5	-4.3	876.4	-2.6
		10000	1430.0	1387.1	-0.4	1375.9	-0.5
		100	0.0	-1.4	-1.4	0.4	0.4
		100	93.8	89.6	-4.2	92.2	-1.6
5	8/10	1000	0.0	-	-	-	-
		1000	93.8	94.6	0.1	95.2	0.1
		1000	856.0	867.7	1.2	866.3	1.0
		1000	300.7	300.8	0.0	299.6	-0.1
		10000	501.7	524.5	0.2	519.5	0.2
		1000	901.9	901.9	0.0	900.9	-0.1
		10000	1430.0	1456.0	0.3	1458.5	0.3
	8/11	1000	901.9	933.0	3.1	919.3	1.7

RUN NO.	MONTH/ DAY	FID SPAN	STAND. GAS, ppm propane	SYSTEM A RESPONSE ppm propane	SYSTEM A DRIFT % span	SYSTEM B RESPONSE ppm propane	SYSTEM B DRIFT % span
		1000	901.9	903.0	0.1	912.0	1.0
6	8/12	1000	0.0	0.2	0.0	1.4	0.1
		1000	901.9	897.6	-0.4	917.2	1.5
7	8/13	1000	0.0	0.2	0.0	1.4	0.1
		1000	901.9	897.6	-0.4	917.0	1.5
	8/14	1000	0.0	0.1	0.0	0.3	0.0
		1000	901.9	887.1	-1.5	926.7	2.5
8	8/14	1000	0.0	0.1	0.0	0.3	0.0
		1000	901.9	900.8	-0.1	900.3	-0.2
	8/15	1000	0.0	-0.3	-0.0	0.1	0.0
		1000	901.9	898.1	-0.4	898.3	-0.4
9	8/15	100	0.0	0.1	0.1	0.2	0.2
		100	93.8	93.7	-0.1	93.6	-0.2
	8/15	1000	93.8	94.2	0.0	95.6	0.2
		1000	901.9	885.5	-1.6	911.4	1.0
	8/16	100	0.0	0.0	0.0	-0.8	-0.8
		100	93.8	94.2	0.4	93.6	-0.2
	8/17	100	0.0	0.1	0.1	-0.1	-0.1
		100	93.8	96.0	2.2	94.8	1.0
	8/18	100	0.0	0.0	0.0	0.1	0.1
		100	93.8	95.8	2.0	93.6	-0.2
	8/19	100	0.0	0.1	0.1	-0.1	-0.1
		100	93.8	95.9	2.1	95.3	1.5
	8/20	100	0.0	0.3	0.3	0.0	0.0
		100	93.8	93.6	-0.2	93.3	-0.5
	8/21	100	0.0	0.1	0.1	0.1	0.1
		100	93.8	92.5	-1.3	93.7	-0.1
	8/22	100	0.0	-0.1	-0.1	0.1	0.1
		100	93.8	95.8	2.0	93.6	-0.2
	8/23	100	0.0	-0.2	-0.2	0.4	0.4
		100	93.8	92.4	-1.4	93.5	-0.3
	8/24	100	0.0	-0.3	-0.3	-0.6	-0.6
		100	93.8	94.6	0.8	94.0	0.2
	8/25	100	0.0	-0.3	-0.3	-0.1	-0.1
		100	93.8	94.1	0.3	93.0	-0.8
	8/28	100	0.0	0.5	0.5	0.6	0.6
		100	93.8	87.8	-6.0	91.7	-2.1
10	8/28	100	0.0	0.6	0.6	0.6	0.6
		100	93.8	98.1	4.3	94.6	0.8
	8/29	100	0.0	0.6	0.6	0.6	0.6

RUN NO.	MONTH/ DAY	FID SPAN	STAND. GAS, ppm propane	SYSTEM A RESPONSE ppm propane	SYSTEM A DRIFT % span	SYSTEM B RESPONSE ppm propane	SYSTEM B DRIFT % span
		100	93.8	98.1	4.3	94.6	0.8
11	8/30	100	0.0	0.5	0.5	0.3	0.3
		100	93.8	93.6	-0.2	93.4	-0.4
12	8/30	1000	0.0	2.7	0.3	-3.8	-0.4
		1000	93.8	96.0	0.2	90.4	-0.3
		1000	901.9	899.2	-0.3	899.2	-0.3
	9/01	1000	0.0	2.3	0.2	-3.5	-0.4
		1000	93.8	97.1	0.3	88.8	-0.5
		1000	901.9	916.0	1.4	891.5	-1.0
13	9/06	1000	0.0	0.8	0.1	0.5	0.1
		1000	93.8	95.2	0.1	94.3	0.1
		1000	901.9	900.7	-0.1	902.8	0.1
14	9/08	1000	0.0	0.7	0.1	0.8	0.1
		1000	93.8	92.6	-0.1	94.5	0.1
		1000	901.9	881.8	-2.0	897.6	-0.4
15	9/09	1000	0.0	1.2	0.1	0.5	0.1
		1000	93.8	94.0	0.0	93.5	-0.0
		1000	901.9	899.2	-0.3	892.9	-0.9
	9/11	100	0.0	-1.1	-1.1	0.8	0.8
		100	93.8	93.6	-0.2	94.6	0.8
		1000	0.0	0.9	0.1	2.7	0.3
		1000	93.8	94.5	0.1	96.0	0.2
		1000	901.9	893.1	-0.9	894.5	-0.7
	9/12	100	0.0	-1.2	-1.2	0.1	0.1
		100	93.8	94.7	0.9	92.9	-0.9
16	9/12	1000	93.8	93.8	0.0	93.8	0.0
		1000	901.9	895.1	-0.7	904.1	0.2
	9/13	100	0.0	0.2	0.2	0.1	0.1
		100	93.8	95.0	1.2	95.0	1.2
	9/14	100	0.0	0.2	0.2	0.1	0.1
		100	93.8	94.0	0.2	94.3	0.5
	9/15	100	0.0	0.5	0.5	0.2	0.2
		100	93.8	90.3	-3.5	90.0	-3.8
17	9/16	100	0.0	-0.1	-0.1	0.1	0.1
		100	93.8	93.8	0.0	93.8	0.0
		1000	0.0	1.9	0.2	1.3	0.1
		1000	93.8	96.8	0.3	96.0	0.2
18	9/17	100	0.0	0.0	0.0	-0.1	-0.1
		100	93.8	97.8	4.0	95.6	1.8
	9/18	100	0.0	0.0	0.0	2.1	2.1

RUN NO.	MONTH/ DAY	FID SPAN	STAND. GAS, ppm propane	SYSTEM A RESPONSE ppm propane	SYSTEM A DRIFT % span	SYSTEM B RESPONSE ppm propane	SYSTEM B DRIFT % span
		100	93.8	97.8	4.0	94.1	0.3
	9/19	100	0.0	0.2	0.2	-0.2	-0.2
		100	93.8	94.1	0.3	87.5	-6.3
19	9/19	1000	93.8	94.7	0.1	83.5	-1.0
		1000	901.9	894.3	-0.8	830.9	-7.1
	9/20	1000	0.0	0.0	0.0	8.9	0.9
		1000	93.8	97.8	0.4	101.9	0.8
		1000	901.9	929.0	2.7	883.0	-1.9
20	9/21	1000	0.0	0.5	0.1	0.0	0.0
		1000	93.8	94.2	0.0	93.8	0.0
		1000	901.9	901.0	-0.1	901.6	-0.0
	9/22	1000	0.0	0.5	0.1	-2.4	-0.2
		1000	93.8	92.1	-0.2	90.3	-0.4
		1000	901.9	882.5	-1.9	896.0	-0.6
	9/23	1000	0.0	1.0	0.1	3.4	0.3
		1000	93.8	91.8	-0.2	92.4	-0.1
		1000	901.9	878.9	-2.3	886.0	-1.6
	9/24	1000	0.0	0.6	0.1	-0.3	-0.0
		1000	93.8	91.5	-0.2	91.6	-0.2
		1000	901.9	874.5	-2.7	880.6	-2.1
	9/25	1000	0.0	0.0	0.0	-2.4	-0.2
		1000	93.8	90.1	-0.4	88.5	-0.5
		1000	901.9	860.7	-4.1	870.7	-3.1

APPENDIX E

STATISTICAL ANALYSES OF AIR AND MOISTURE BALANCE DATA

STATISTICAL ANALYSES OF AIR AND MOISTURE BALANCE DATA

Statistical analyses based on t-distribution were conducted to test the significance of the difference between the average air and moisture recovery rates and the gas leakage during the drying tests. The procedures suggested by Wapole and Myers (11) were used for the analyses.

The averages and standard deviations of the air and moisture recovery data shown in Table 4 are presented in Table E1.

TABLE E1 STATISTICAL ANALYSES OF AIR AND MOISTURE RECOVERY DATA

	SAMPLE SIZE	AVERAGE	STD[a]
Air	$n_1 = 20$	$x_1 = 83$	$s_1 = 10$
Moisture	$n_2 = 20$	$x_2 = 84$	$s_2 = 16$

[a] STD - standard deviation.

A. Difference between Average Air Recovery and Average Moisture Recovery

Let m_1 and m_2 represent the population means of the air and moisture recoveries, respectively. The test on the significance of the difference between the average air and moisture recovery rates is shown in the following steps.

1. H_0: $m_1 - m_2 = 0$.
2. H_1: $m_1 - m_2 > 0$ or < 0.
3. Choose 95% confidence level, a=0.05.
4. Critical region ($v = 40-2 = 38$): $t > 1.960$ or $t < -1.960$, where,

$$s_p = \left[\frac{s_1^2 \bullet (n_1 - 1) + s_2^2 \bullet (n_2 - 1)}{n_1 + n_2 - 2}\right]^{0.5} \qquad t = \frac{x_1 - x_2}{s_p \bullet (1/n_1 + 1/n_2)^{0.5}}$$

5. Calculations:

$s_p = 13.494$, $t = -0.152$

6. Decision: do not reject H_0 because the calculated t is not in the critical regions.

The statistical test suggested that the difference between the average air and moisture recovery rates for the twenty drying runs was not significant.

B. Significance of Air and Moisture Leakage

The significance of gas leakage from the kiln was determined by testing to determine if the average air and moisture recovery rates were equal to 100 percent. The procedures are presented as follows.

For air recovery:

1. H_0: $m_1 = 100$.
2. H_1: $m_1 < 100$.
3. Choose 95% confidence level, a=0.05.
4. Critical region (v = 20-1 =19): t < -1.729, where,

$$t = \frac{x_1 - 100}{s_1 / n_1^{0.5}}$$

5. Calculation:

$$t = (83-100)/(10/20^{0.5}) = -7.781$$

6. Decision: reject H_0.

For moisture recovery:

1. H_0: $m_2 = 100$.
2. H_1: $m_2 < 100$.
3. Choose 95% confidence level, a=0.05.
4. Critical region (v = 20-1 =19): t < -1.729, where,

$$t = \frac{x_2 - 100}{s_2 / n_2^{0.5}}$$

5. Calculation:

$$t = (84-100)/(16/20^{0.5}) = -4.370$$

6. Decision: reject H_0.

The statistical tests suggest that air and moisture leakage from the kiln were significant.

APPENDIX D

QA/QC PERFORMANCE CHECK OF VOC SAMPLING SYSTEMS

QA/QC PERFORMANCE CHECK OF VOC SAMPLING SYSTEMS

For QA/QC (quality assurance and quality control) purposes, the two VOC sampling systems used were checked for zero and calibration drift at the beginning of a run, during the run on a daily basis, and at the end of the run. The data are summarized in Table D1. Zero air, EPA-certified propane gases at several concentrations, and a manufacturer-certified α-pinene vapor (expressed as 183 ppm propane in the table) were used for the QA/QC checks. The concentrations of standard gases and FID responses in Table D1 are expressed as ppm propane.

TABLE D1 QA/QC PERFORMANCE DATA OF VOC SAMPLING SYSTEMS

				SYSTEM A		SYSTEM B	
RUN NO.	MONTH/ DAY	FID SPAN	STAND. GAS, ppm propane	RESPONSE ppm propane	DRIFT % span	RESPONSE ppm propane	DRIFT % span
1	7/13	100	0.0	0.1	0.1	0.0	0.0
		100	93.8	93.9	0.1	93.7	-0.1
		1000	856.0	884.0	2.8	843.0	-1.3
	7/14	100	0.0	0.0	0.0	0.0	0.0
		100	93.8	93.8	0.0	93.8	0.0
		1000	183.0	172.0	-1.1	173.0	-1.0
	7/15	1000	0.0	-0.9	-0.1	0.0	0.0
		1000	93.8	83.6	-1.0	77.6	-1.6
		1000	183.0	179.3	-0.4	175.0	-0.8
	7/16	1000	0.0	0.6	0.1	0.0	0.0
		1000	93.8	85.3	-0.9	78.8	-1.5
		1000	183.0	179.3	-0.4	167.1	-1.6
		1000	856.0	804.0	-5.2	820.0	-3.6
2	7/16	1000	0.0	0.5	0.1	0.0	0.0
		1000	93.8	93.8	0.0	93.8	0.0
		1000	183.0	178.7	-0.5	178.7	-0.5
		1000	856.0	857.0	0.1	857.0	0.1
	7/18	1000	0.0	-1.1	-0.1	0.7	0.1
		1000	93.8	83.5	-1.0	89.6	-0.4
		1000	183.0	180.2	-0.3	182.0	-0.1
		1000	856.0	836.4	-2.0	855.5	-0.1
		10000	0.0	-19.6	-0.2	-10.6	-0.1
		10000	93.8	84.5	-0.1	89.6	-0.0
		10000	856.0	849.8	-0.1	871.4	0.2
		10000	1430.0	1407.6	-0.2	1458.0	0.3
		1000	0.0	0.0	0.0	0.0	0.0
		1000	93.8	92.6	-0.1	91.2	-0.3

APPENDIX F

IMPACTS OF DRYING SCHEDULE ON MOISTURE AND AIR LEAKAGE

IMPACTS OF DRYING SCHEDULE ON MOISTURE AND AIR LEAKAGE

Fugitive VOC losses can result from gas leakage through the door edge and wall cracks of the small-scale kiln. Mass balances of moisture and air entering and exiting the kiln were calculated to quantify these losses. The possible impacts of the drying schedule on moisture and air leakage are described in this appendix.

The total recovery rates of moisture and air can be expressed using the gas leak rates during vent operating cycles. One vent operating cycle is defined as a close-period and the following open-period. The expressions of air and moisture recovery rates over the entire drying cycle are shown in Equations f1 and f2. To simplify the discussion of moisture balance, moisture recovery is expressed considering only the moisture release from the lumber because the amount of moisture carried by the intake fresh air is relatively small.

$$r_{H_2O} = 100 - \frac{\sum_{i=1}^{n}[M_{c,i} \bullet t_{c,i} \bullet R_{c,i} + ((1-R_{c,i}) \bullet M_{c,i} \bullet t_{c,i} + M_{o,i} \bullet t_{o,i}) \bullet R_{o,i}]}{\sum_{i=1}^{n}(M_{c,i} \bullet t_{c,i} + M_{o,i} \bullet t_{o,i})} \bullet 100 \qquad (f1)$$

r_{H2O}	= total moisture recovery rate, % by weight.
i	= ith vent operating cycle.
n	= number of vent operating cycles.
$M_{c,i}$,$M_{o,i}$	= moisture release rates from the lumber during the close-period and open-period in the ith cycle, lb H_2O/hr.
$R_{c,i}$,$R_{o,i}$	= gas leak rates during the close-period and open-period in the ith cycle, %/100 (volume fraction).
$t_{c,i}$,$t_{o,i}$	= duration of the close-period and open-period during the ith cycle, hour.

$$r_{air} = 100 - \frac{\sum_{i=1}^{n}[V_i \bullet R_{c,i} + ((1-R_{c,i}) \bullet V_i + F_i \bullet t_{o,i}) \bullet R_{o,i}]}{V + \sum_{i=1}^{n}(F_i \bullet t_{o,i})} \bullet 100 \qquad (f2)$$

r_{air}	= total air recovery rate, % by volume.
V	= air volume in the kiln at the start of the drying cycle, corrected to standard conditions, dscf (dry standard cubic feet at 20°C and 1 atm).
V_i	= air volume in the kiln at the beginning of the ith vent operating cycle, dscf.
F_i	= intake fresh air flow into the kiln during the open-period of the ith cycle, dscf/hr.

In Equations f1 and f2, the total moisture recovery rate in a drying run is expressed on a weight basis, and the air recovery rate on a volume basis. The gas leak rate is defined as a fraction of the total volume of the gas stream (moisture + air) in each vent operating cycle. By assuming a good mixing of moisture and air, the leakage of moisture and air in volume fraction is equal to the gas leak rate for the same vent operating cycle. Moisture leakage in weight fraction is equal to that in volume fraction.

Equations f1 and f2 show that the total moisture and air recovery rates during a drying run are dependent on the operating conditions during individual vent operating cycles. The operating conditions include temperature, gas moisture content, and fan speed. In each vent operating cycle, the gas leak rate is expected to be higher in the close-period than in the open-period, due to higher kiln pressure. The gas leak rate may also be affected by moisture content in the gas stream. Gas pressure serves as the driving force for gas leak, and moisture content may affect the pore size of the leak pathways. A high gas moisture content may promote swelling of the kiln wall material and the door edge seals to increase the resistance to gas leak and reduce the leakage.

Two simple drying schedules are used to describe the possible effects of the drying schedule on moisture and air balances. It is assumed that the dry bulb temperature is set constant throughout the drying cycle, while the wet bulb temperature is reduced gradually. Dry bulb temperature is set at the same level for both schedules, but initial wet bulb temperatures are different. The possible effects of the drying schedule on the total moisture and air recovery rates during a drying run are illustrated in Table F1.

TABLE F1 EFFECTS OF DRYING SCHEDULE ON MOISTURE AND AIR BALANCES

DS[a]	DB	WB	MOISTURE BALANCE					AIR BALANCE				
			$t_{c,i}$	$t_{o,i}$	$R_{c,i}$	$R_{o,i}$	r_{H2O}	$t_{c,i}$	$t_{o,i}$	$R_{c,i}$	$R_{o,i}$	r_{air}
1	T_d	high	x		high		low		x		low	high
2	T_d	low		x		low	high		x		high	low

[a] DS - drying schedule.
DB - dry bulb temperature, set at T_d °F.
WB - wet bulb temperature, decrease gradually with time.
x - indication of the period that dominates the total moisture or air recovery rate.

The higher wet bulb temperature in Schedule 1 would result in a higher moisture content in the kiln gas. To maintain the high moisture level, the close-period would be longer than the open-period during each vent operating cycle. This is due to the reduced moisture release rate from the lumber because of the higher moisture level in the kiln gas. From Equation f1, the total moisture recovery rate in the drying run would be more dependent on the gas leak rates in the close-periods. Therefore, a higher moisture leakage or a lower recovery rate is expected because the gas leak rates during the close-periods are higher than during the open-periods.

Air leakage during the open-period may be dominant during each vent operating cycle, due to the relatively small kiln volume compared to the total intake air flow through the kiln in each vent operating cycle. From Equation f2, the total air recovery rate over the entire drying cycle is more related to the gas leak rate during the open-period. Therefore, a lower leakage or a higher recovery rate of air, compared to moisture, would be expected, due to the lower gas leak rate during the open-period.

During the drying under Schedule 2, the lower set-up wet bulb temperature limits the moisture content in the air in the kiln. The close-period would be shorter than the open-period during each vent operating cycle. From Equation f1, the total moisture recovery rate in the entire drying cycle would be more related to gas leak during the open-periods. Therefore, a lower moisture leakage or a higher recovery rate would be observed, due to the lower gas leak rate during the open-period.

Similar to that for Schedule 1, the total air recovery rate for Schedule 2 may be mainly related to the leakage during the open-periods. However, due to the low moisture content of the kiln gas in Schedule 2, the gas leak rate during the open-period may increase with decreasing moisture content in the gas stream. The moisture content profile of the gas stream over the entire drying cycle is determined by the moisture removal rate of the lumber. A high moisture removal rate could result from a low moisture content controlled in the kiln. Most of the moisture in the wood may be removed within the initial period of the drying cycle. The moisture content in the gas stream during the rest of the drying cycle may be low, which may result in an increased gas-leak rate. Therefore, a higher air leakage or a lower recovery rate over the entire drying cycle could be observed.

The above discussion suggests that the total moisture and air recovery rates are related to the drying schedule used. There could be a significant difference between the total moisture and air recovery rates for a specific drying run. Also, these two measurements can vary for different drying runs.

APPENDIX G

FACTORS AFFECTING VOC EMISSIONS FROM WOOD DRYING

FACTORS AFFECTING VOC EMISSIONS FROM WOOD DRYING

The small-scale kiln tests conducted in this study indicated that VOC emission potentials from lumber drying varied with wood species and drying conditions. To better interpret the VOC emissions data gathered from either field surveys or pilot studies, it is imperative to understand the factors that may affect the VOC emissions from lumber drying. The following discussions are based on information presented in several references (8,12,13), and also represent industrial experience.

A. Basics on Wood Drying and Sources of VOCs

The moisture content of wood in living trees can range from about 30 to over 100 percent on a dry basis. To assure proper performance and facilitate further processing, lumber is normally dried before it is sold. The drying of lumber serves both to reduce shipping weight and to prevent shrinkage and warpage after it is put into service. Most lumber is either kiln-dried or air-dried to 15 to 19 percent moisture on a dry basis.

Drying schedules (dry and wet bulb temperature profiles, fan speed) for various species and dimensions of lumber have been developed to accommodate the porosity of the wood and the rate of moisture diffusion through the cell walls. To avoid splitting and warping caused by stresses produced when the surfaces dry too fast, it is important not to dry the wood too quickly. If the surface layers dry significantly faster than the inner core, the surface tries to shrink, but is restrained by the core; and this produces splits and other defects in the wood. Lumber from some species, such as redwood and white oak, requires very long drying schedules to accommodate their dense cellular structure.

When wood is dried, it emits both water and naturally-occurring volatile organic compounds (VOCs). At low drying temperatures, virtually all of the VOCs originate from extractives in the wood. Extractives are chemicals that are not structural components of wood and can be removed by extraction with cold water and organic solvents that do not break down the structure of the wood. Extractives are mostly present in the cell lumen or in specialized ducts and canals (e.g. resin canals, gum ducts). If drying temperatures are sufficiently high, some of the structural components of the wood can be degraded, causing the release of additional VOCs such as acetic acid, formaldehyde, and methanol. Little information is available concerning the temperatures at which this degradation begins, but it is known that the degree of degradation depends on the wood species being dried and on the drying time.

B. Basic Wood Structures

In order to understand wood drying and VOC emissions, it is necessary to appreciate the basic structure of wood. All woods are comprised of long, narrow cells, which are joined together by a natural cement called lignin. The structure can be likened to straws cemented together. The walls of these cells consist of layers of cellulose and hemicellulose molecules, arranged in helices and also cemented together by lignin. Numerous tiny openings, called pits, interconnect the cells; but many of these openings become clogged with organic materials as the tree ages. Most of the cells in wood are arranged axially (along the "grain"), but some are aligned radially (along the "rays") from the center of the tree to the outside (across the "grain").

The materials comprising the cell wall, especially the cellulosics, have a very strong affinity for water. A considerable amount of energy is needed to remove water from wood when the moisture content is below the "fiber saturation point" (the moisture content at which all water is held in the cell walls by hydrogen bonds). This point ranges from 25 to 30 percent moisture content on a dry basis for most woods. Water in excess of the fiber saturation point is termed "free-water," and the energy needed to remove it is simply the amount of energy needed to evaporate water. The "bound" water requires additional energy to break the hydrogen bonds.

C. Wood Species and Characteristics in Structure

VOC emissions from wood drying are related to species. Tree species are classified as softwoods (gymnosperms) and hardwoods (angiosperms). All softwood tree species, except gingko, have either needle-shaped leaves (e.g. pines) or scale-shaped leaves (e.g. cedars), and most are evergreen (a notable exception is larch, which loses its needles in the winter). Softwoods are normally divided into two main groups, resinous and non-resinous. Resinous species include pines, spruces, larches, and Douglas fir, while non-resinous species include "whitewoods" (true firs and hemlocks), redwood, and cedars.

Resinous species characteristically contain specialized structures called resin canals, which are, literally, small tubes that extend both axially and radially in the tree. These canals are filled with "oleoresin," which is produced by specialized parenchyma cells that line the canals. This oleoresin is comprised of a mixture of organic chemicals, primarily terpenoid compounds (molecules built from 5-carbon isoprene units). Significant amounts of fats and fatty acids are also present in resinous softwoods. The terpenoid compounds, especially mono-terpenes such as α-pinene, are the primary VOCs that are emitted from resinous softwoods. The fatty substances can contribute to the VOC emission, depending on the drying temperature. Smaller quantities of other potential VOCs, many peculiar to individual tree species, are also present (waxes, phenolics, gums, proteins, sterols, etc.). Hundreds of such compounds have been identified, but they are present in very small amounts. There is a great deal of variability, both within and between species, relative to the quantities of potential VOCs.

Non-resinous softwoods do not normally have resin canals, and most do not contain appreciable quantities of terpene compounds. However, like all woods, they contain fatty substances. As with the resinous softwoods, other substances are also present. Typically, the potential VOC content of non-resinous woods is much lower than that of resinous woods.

Hardwoods are broad-leaf trees, most of which are deciduous in temperate climates (a noticeable exception is live oak). They do not have resin canals, but some have "gum" canals, which are filled with polysaccharides and other organic compounds. Hardwoods also contain fatty substances and other organic compounds, many unique to the individual wood species. A much lower VOC emission potential from hardwood drying would be expected, compared to that from softwood drying.

D. VOC Emissions

During wood drying, some of the potential VOC chemicals are "evaporated" along with the water. However, unlike water, the VOCs are extremely hard, if not impossible, to remove entirely. This is because they have lower vapor pressures (or higher boiling points) than water and because they literally become "trapped" in the cellular structure of the wood due to their relatively larger molecular size. Because of their small size and polar nature, water molecules can penetrate the cell walls of wood and can diffuse directly through the cell walls to the surface of the lumber. VOCs, on the other hand, can not penetrate the cell wall, and must migrate through the labyrinth of "openings" in the resin canals, severed cells, or pits between the cells. These physical limitations greatly retard the diffusion of VOCs from the interior to the surface of the lumber. Therefore, only a faction of VOCs are normally removed during drying, and they emanate from wood long after it is put into service, and sometimes, as in the case of cedars, for hundreds of years.

Another important factor influencing VOC emissions from wood drying is the wood's internal structure. As trees get older, heartwood is formed. Heartwood forms after a certain period of time, the length of which depends upon genetics and environmental factors. Heartwood formation involves the death of ray cells and the deposition or formation of additional extractive chemicals. In most species, plugging of many of the pits between cells also occurs. With most species the wood darkens in color as these changes take place (true firs and hemlocks are notable exceptions). Typically, heartwood is harder to dry due to the plugging of pits, and it often contains more VOCs.

VOC emissions from wood drying are also dependent on dimensions of the wood. Small pieces of wood dry faster and lose more VOCs under the same drying conditions than large pieces. This is due both to increased surface area and to the exposure of more natural openings, such as resin canals and severed cells. The openings facilitate more rapid migration of the water and VOCs from the wood. To demonstrate the impact of wood dimension on VOC emissions from wood drying, the results on turpentine losses during wood drying, reported in the literature (5) and generated in this study, were compared and are presented in Table G1. The reported results, generated with laboratory-scale experiments, indicated that the turpentine losses during drying of wood particles and small wood blocks were more than 90 percent. However, the turpentine losses during drying of lumbers, as found in this study, were less than 30 percent. The higher turpentine losses observed in the reported studies may be also due to the higher drying temperatures used.

The quantities of potential VOCs produced by trees, as well as the porosity of the wood, are affected by genetics and environmental factors. Therefore, there is a great variability in VOC content between trees of the same species. It is important to realize that VOCs are continually emitted from trees and wood, so the amount of VOCs emitted from wood drying is affected by the time the wood is stored prior to processing and by the temperature and humidity during storage.

TABLE G1 IMPACT OF WOOD DIMENSION ON VOC EMISSIONS

WOOD SPECIES	DRYING TEMP.,°F	WOOD DIMENSION	TURPENTINE LOSS, %
SYP[a]	230	0.24"[b]	97
SYP[a]	230	0.75"x0.75"x3"	93
SOFTWOODS[c]	<220	2"x4"x8' and 1"x4"x8'	<30

[a] SYP -southern yellow pine, results generated with laboratory-scale experiments (5).
[b] wood ground to pass through a 0.24 inch screen.
[c] results generated with a small-scale kiln in this study.

In summary, factors that may affect the VOC emissions from lumber drying include (1) wood species, (2) tree age, log harvest season and location, log size, log storage method and time, (3) lumber storage time, (4) ambient conditions (temperature, humidity , and wind speed) under which logs and lumber are stored, (5) heartwood content of lumber, and (6) drying schedule.

FLORIDA'S EXPEDITED PERMITTING PROCESS

CHAMPION INTERNATIONAL CORPORATION
MCDAVID SAWMILL FACILITY
ESCAMBIA COUNTY
PRE-APPLICATION MEETING
May 6, 1999, 8:30 a.m.

AGENDA

I. Welcome - Mary Helen Blakeslee, OTTED

II. Self-Introductions

III. Discussion of Process

IV. Company Presentation

V. Discussion of Impacts/Permits/Approval

- Transportation
- Environmental
- Comp. Plan
- Local Approvals
- Others

VI. Breakout Sessions (if needed)

VII. Summary and Checklist of Pre-Application Meeting Outcomes

- Designation of Lead Agency for Project Coordination
- Designation of Primary Contact within each Agency
- List of Agencies with Jurisdiction
- Comprehensive List of Permits Required
- Special Studies or Reviews
- Areas of Significant Concern
- Review of Time Schedules
- Review of Information Requests
- Other

INDIV. CONTACT FOR AIR: JOE KAHN
- DEP: DICK FANCHER DIST. PENSACOLA

VIII. Schedule of next meeting(s) (if needed)

IX. Wrap-up and Adjournment

Champion International Corporation
McDavid Sawmill Facility
Expedited Permitting Pre-application Meeting
Champion International Mill
Cantonment, Escambia County
May 6, 1999
8:30 a.m.

SIGN IN SHEET

NAME / ORGANIZATION	ADDRESS	PHONE / FAX	E-MAIL
Andrea S. Cornelius Enterprise FL	325 John Knox Rd. STE 201 Atrium Bldg.	850/487-2157 850/922-9595	acornelius@ enterprise.state.fl.us
Richard Morgan NWFWMD	RT 1 Box 3100 Havana, FL 32333	850-539-5999 850-539-4380	
Roger Miller	325 John Knox Rd	850/922-8751	RMILLER@ENTERPRISE STATE.FL.US.
G CLIFF STREET	FDEP 160 GOV T CTR	850 595 8300	
Phil FERGUSON	ONE CHAMPION PLAZA STAMFORD, CT	203-358-7232	FERGUP@CHAMPINT.com
Andy Allen	FDEP 160 Governmental Center	595-8364	
TERRY KASSABAUM	Champion P.O.Box 200 Camden, TX 75941	409-398-7252 P 409-398-7224	Kassat@champint.com
ROBERT MERRITT ESC. CO. HEALTH DEPT	1190 W. LEONARD ST. SUITE 2, PENS., FL 32506	850-595-6722 850-595-6707	ROBERT_MERRITT@DOH.STATE.FL.US
DAVE STEVENS Project Director - Champion	117 Pace Parkway P.O. Box 875 Cantonment, Fla. 32514	850-937-4849	stevedb@Champint.com
Dave Burlison	FDOT Chipley Fla	850 638-0250 Ext 275	
Charles Odom	F.D.O.T. Chipley Fla.	850-638-0250 EXT 241	
HEIDI ALLEN	FDOT - P'COLA MAINT. PERMITTING OFFICE	850 484 5055	
John Willem	WFRPC	850 595-8910	

Champion International Corporation
McDavid Sawmill Facility
Expedited Permitting Pre-application Meeting
Champion International Mill
Cantonment, Escambia County
May 6, 1999
8:30 a.m.

SIGN IN SHEET

NAME / ORGANIZATION	ADDRESS	PHONE / FAX	E-MAIL
Mike Frey Pensacola Area C of C	117 W. Garden St	(850) 438-4081 (850) 438-6369 (FAX)	MFrey@pensacolachamber.com
Jerry Campbell	P.O. Box 607 Chipley, FL	850-638-0250	
Bill Schaal	160 Governmental Center, Pens.	(850) 595-8300 FAX 850 595-8417	Schaal_W@PW51.DEP.STATE.FL.US
Jack McNulty	DEP 160 Gov Center Pns	"	mcnulty_j@PW51.dep.state.fl.us
Shellie Johnson	1190 W. Leonard St.	850.595.3470	Michelle_Johnson@escambiaco.fl.us
Scott Hale	" "	5956727	Health Dept.
JOSEPH KAHN FDEP/DARM/NSR	MS #5505 2600 BLAIR STONE RD. TALLAHASSEE FL 32399-2400	850-921-9519	KAHN_J@DEP.STATE.FL.US
LARRY O'DONNELL FDEP	160 GOVERNMENTAL CENTER Pensacola, 32501	850-595-8300 850-595-8311 (FAX)	ODONNELL_L@DEP.STATE.FL.US
Don Johnson	117 PACE PARKWAY CANTONMENT FL, 32533	850-937-4816	don_johnson@Weldwood.com
Mary Helen Blakeslee	OTTED Suite 2001 The Capitol Talla FL 32399-0001	850-922-8743 F 487-3014	blakesm@eog.state.fl.us
Linda J. Gampher	Jobs + Benefits 3670-A North "L" ST Pensacola, FL 32505	850-595-5200 F 850 595-5249	Linda_Gampher@jb.dles.state.fl.com
Cal Evans	OTTED 2001 The Capitol Tall FL 32399-0001	850-4872974 487-3014	evansc@eog.state.fl.us

Champion
Champion International Corporation

RECEIVED

APR 23 1999

BUREAU OF
AIR REGULATION

State of Florida
Department of Environmental Protection
Division of Air Resources Management
Mail Station #5505
2600 Blair Stone Rd.
Tallahassee, FL 32399-2400

Attn: Joseph Kahn

Dear Joe:

Per your request at our meeting on April 14th, attached is:

1. PSD application (March 1998) and permit for Champion, Camden, TX for the addition of one steam heated kiln.
2. PSD application for I. P. in Riegelwood, NC (September 1996) for the addition of one steam heated kiln.

If you need additional information or have questions, please call me at (409) 398-7252 or Tom Davis (ECT) at 352-332-0444.

Thanks

Terry Kassabaum

Terry Kassabaum
Environmental Health and Safety Manager
Champion International Corporation

cc: Tom Davis - ECT - without attachment 1
Dave Stevens - without attachment 1
John Barone - without attachment 1

RECEIVED

APR 23 1999

BUREAU OF
AIR REGULATION

MAY 6, 1999 CHAMPION EXPEDITED PERMITTING

→ 30 DAYS - STATEMENT OF PERMITABILITY BY AGENCY.
FROM TODAY

DUE JUNE 7TH

MEETING - 10 ASPECTS OF PROJECT, PERMITS, SPECIAL APPROVALS

N. OF PINE BARREN, S. OF MCDAVID

250-300 TRUCKS, 150-175 AUTOS

18-60 HRS IN KILN

MOIST. 50% → 19% (17)

20% OF FINISHED PROD → RAIL, 80% BY TRUCK

FILING ROOM - DISCHARGE INTO BASEMENT FROM COLLECTION SYSTEM - SAW SHARPENING

METAL DETECTED - CUT OUT - HOGGED

100 HRS/WK - STARTUP, ULTIMATELY 3 SHIFTS 6 DAYS/WK.

KILNS - 24 HRS 50-51 WKS/YR., GAS FIRED

MID-SOUTH ENGINEERING - ARK. DESIGN, CIVIL

ECT - TOM DAVIS - AIR

KILN CONDENSATE - STEAM BLOWDOWN

180 DAYS FOR TITLE V.

PSD WILL INCL. PERIODIC MONITORING

→ FINAL AGENCY ACTION BY STATE AGENCY FOR CERTIFIED EXPEDITED PERMITTING PROJECTS - GOES IMMEDIATELY TO SUMMARY HEARING.

→ CHECK STATUTORY LANGUAGE RE. NOTICE OF INTENT & FINAL NOTICE OF RIGHTS

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Office Of Air Quality

Prevention Of Significant Deterioration Permit Application

NEW LUMBER DRYING KILN

Submitted by

Champion

Champion International Corporation

Camden Mill
Farm Road 62
Camden, Texas

Prepared by

WESTON
MANAGERS DESIGNERS/CONSULTANTS

5599 San Felipe, Suite 700
Houston, Texas

March 1998

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

Protecting Texas by Reducing and Preventing Pollution

November 12, 1998

Mr. Jason Haynes
Environmental Manager
Champion International Corporation
P.O. Box 200
Camden, Texas 75934

Re: Permit Amendment
Permit Nos. 5628 and PSD-TX-905
Lumber Kiln No. 3
Camden, Polk County
Account ID No. PF-0003-N

Dear Mr. Haynes:

This is in response to your permit application, Form PI-1, received March 30, 1998 concerning the proposed amendment to Permit Nos. 5628 and PSD-TX-905. We understand that you propose to add an additional kiln and increase the drying capacity for lumber. Also, this will acknowledge that your application for the above-referenced permit is technically complete as of November 7, 1998.

Pursuant to 30 TAC Sections 116.116(b) and §116.160, Permit No. 5628 is hereby amended and PSD-TX-905 is modified. This information will be incorporated into the existing permit files. Enclosed are revised special conditions pages and a maximum allowable emission rates table for the combined permits. Please replace those conditions and/or the maximum allowable emission rates table currently attached to your permit with those enclosed.

This amendment will be automatically void upon the occurrence of any of the following, as per §116.115(b)(1):

1. Failure to begin construction of the changes authorized by this amendment within 18 months from the date of this authorization.

2. Discontinuance of construction of the changes authorized by this amendment for a period of 18 consecutive months or more.

3. Not completing the changes authorized by this amendment within a reasonable time.

Re: Permit Nos. 5628 and PSD-TX-905

Your cooperation in this matter is appreciated. If you have any questions, please call Mr. Kevin Ellis of our Office of Air Quality, New Source Review Permits Division at (512) 239-1599 or write him at Texas Natural Resource Conservation Commission, Office of Air Quality, New Source Review Permits Division (MC-162), P.O. Box 13087, Austin, Texas 78711-3087.

Sincerely,

Jeffrey A. Saitas, P.E.
Executive Director

JS/KE/ss

Enclosures

cc: Ms. Jole Luehrs, Chief, New Source Review Section (6PD-R), Environmental Protection Agency, Region 6, Dallas
Mr. Marion Everhart, Air Program Manager, Beaumont

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION

AIR QUALITY PERMIT - GENERAL CONDITIONS

AND PERTINENT RULES EFFECTIVE FOR PERMITS ISSUED
OR AMENDED ON OR AFTER AUGUST 16, 1994

TNRCC

1. The **facilities** covered by this permit shall be constructed and operated as specified in the application for the permit. All representations regarding construction plans and operation procedures contained in the permit application shall be conditions upon which the permit is issued. Variations from these representations shall be unlawful unless the permit holder first makes application to the Executive Director of the Texas Natural Resource Conservation Commission (TNRCC or Commission) to amend this permit in that regard and such amendment is approved. (Title 30 Texas Administrative Code Section 116.116 (30 TAC 116.116))

2. **Voiding of Permit**. A permit or permit amendment is automatically void if the holder fails to begin construction within 18 months of date of issuance, discontinues construction for more than 18 consecutive months prior to completion, or fails to complete construction within a reasonable time. Upon request, the Executive Director may grant a onetime 18-month extension of the date to begin construction. (30 TAC 116.115(b)(2)(A))

3. **Construction Progress**. Start of construction, construction interruptions exceeding 45 days, and completion of construction shall be reported to the appropriate Regional Office of the TNRCC not later than 15 working days after occurrence of the event. (30 TAC 116.115(b)(2)(B))

4. **Start-up Notification**. The appropriate Air Program Regional Office of the Commission shall be notified prior to the commencement of operations of the facilities authorized by the permit in such a manner that a representative of the TNRCC may be present. Phased construction, which may involve a series of units commencing operations at different times, shall provide separate notification for the commencement of operations for each unit. (30 TAC 116.115(b)(2)(c))

5. **Sampling Requirements**. If sampling of stacks or process vents is required, the permit holder shall contact the TNRCC Office of Air Quality prior to sampling to obtain the proper data forms and procedures. All sampling and testing procedures must be approved by the Executive Director and coordinated with the regional representatives of the Commission. The permit holder is also responsible for providing sampling facilities and conducting the sampling operations or contracting with an independent sampling consultant. (30 TAC 116.115(b)(2)(D))

6. **Equivalency of Methods**. It shall be the responsibility of the permit holder to demonstrate or otherwise justify the equivalency of emission control methods, sampling or other emission testing methods, and monitoring methods proposed as alternatives to methods indicated in the conditions of the permit. Alternative methods shall be applied for in writing and must be reviewed and approved by the Executive Director prior to their use in fulfilling any requirements of the permit. (30 TAC 116.115(b)(2)(E))

7. **Recordkeeping**. A copy of the permit along with information and data sufficient to demonstrate compliance with the permit shall be maintained in a file at the plant site and made available at the request of personnel from the TNRCC or any air pollution control program having jurisdiction. For facilities that normally operate unattended, this information shall be maintained at the nearest staffed location within Texas specified by the permit holder in the permit application. This information shall include, but is not limited to, production records and operating hours. Additional recordkeeping requirements may be specified in special conditions attached to the permit. Information in the file shall be retained for at least two years following the date that the information or data is obtained. (30 TAC 116.115(b)(2)(F))

8. **Maximum allowable emission rates**. The total emissions of air contaminants from any of the sources of emissions listed in the table entitled "Emission Sources - Maximum Allowable Emission Rates" shall not exceed the values stated on the table attached to the permit. (30 TAC 116.115(b)(2)(G))

9. **Maintenance of Emission Control**. The facilities covered by the permit shall not be operated unless all air pollution emission capture and abatement equipment is maintained in good working order and operating properly during normal facility operations. Notification for upsets and maintenance shall be made in accordance with §101.6 and §101.7 of this title (relating to Notification Requirements for Major Upset and Notification Requirements for Maintenance). (30 TAC 116.115(b)(2)(H))

10. **Compliance with Rules**. Acceptance of a permit by a permit applicant constitutes an acknowledgement and agreement that the holder will comply with all rules, regulations, and orders of the Commission issued in conformity with the Texas Clean Air Act and the conditions precedent to the granting of the permit. If more than one state or federal rule or regulation or permit condition are applicable, then the most stringent limit or condition shall govern and be the standard by which compliance shall be demonstrated. Acceptance includes consent to the entrance of Commission employees and agents into the permitted premises at reasonable times to investigate conditions relating to the emission or concentration of air contaminants, including compliance with the permit. (30 TAC 116.115(b)(2)(I)).

11. This **permit may not be transferred**, assigned, or conveyed by the holder except as provided by rule. (30 TAC 116.110(d)).

12. There may be **additional special conditions** attached to a permit upon issuance or modification of the permit. Such conditions in a permit may be more restrictive than the requirements of Title 30 of the Texas Administrative Code. (30 TAC 116.115(c))

13. **Emissions** from this facility must not cause or contribute to a condition of "air pollution" as defined in Section 382.003(3) of the Texas Clean Air Act (TCAA) or violate Section 382.085 of the TCAA. If the Executive Director determines that such a condition or violation occurs, the holder shall implement additional abatement measures as necessary to control or prevent the condition or violation.

SPECIAL CONDITIONS

Permit Nos. 5628 and PSD-TX-905

EMISSION STANDARDS AND FUEL SPECIFICATIONS

1. Emissions from the facilities under this permit are based on and compliance with emission limits shall be demonstrated through the following operational limits (Table 1):

TABLE 1

Unit	Short-Term	Long-Term	notes
Presses	51,729 ft^2/hr (on a finished 3/8-in basis)	419,689,000 ft^2/year (on a finished 3/8-in basis)	
Dryers (1-4)	66,400 ft^2/hr (on a finished 3/8-in basis)	441,344,000 ft^2/yr (on a finished 3/8-in basis)	
Boiler No. 1	35,000 lbs/hour	421,632,000 lbs/year (combined steam to the kilns - calculated)	
Boiler No. 2	35,000 lbs/hour		
Boiler No. 3	160,000 lbs/hour		
Kiln No. 1	11,054,000 board·ft/month (combined lumber production)	129,800,000 board·ft/year (combined lumber production)	SC12=3.0
Kiln No. 2			
Kiln No. 3	6,454,000 board·ft/month	64,896,000 board·ft/year	SC3=2.5

2. Fuel for the Boilers (Emission Point Nos. [EPNs] S-01, S-02, and S-03) shall be limited to wood fuel (wood fuel comprising bark, saw dust, and other pieces of wood from plant operation). Use of any other fuel will require prior written approval from the Executive Director of the Texas Natural Resource Conservation Commission (TNRCC).

3. Disposal of ash shall be accomplished in a manner that shall prevent the ash from becoming airborne.

OPACITY AND VISIBLE EMISSION LIMITATIONS

4. Opacity of emissions from the Veneer Dryer Stacks (EPNs S-04, S-05, S-06, and S-07), the Boiler Stacks (EPNs S-01, S-02, and S-03), and all plant cyclones shall not exceed 20 percent averaged over a six-minute period, except for those periods as provided in 30 TAC Sections 101.6 and 101.7 and 30 TAC Section 111.111 (a)(1)(E).

5. Opacity of emissions from all plant baghouses shall not exceed 10 percent averaged over a six-minute period, except for those periods as provided in 30 TAC Sections 101.6 and 101.7.

6. No visible fugitive emissions shall leave the plant boundary.

CONTINUOUS DETERMINATION OF COMPLIANCE

7. At the request of the TNRCC Executive Director, the holder of this permit shall perform stack sampling and other testing as required to establish the actual pattern and quantities of air contaminants being emitted into the atmosphere. The holder of this permit is responsible for providing sampling and testing facilities and conducting the sampling and testing operations at his expense.

RECORDKEEPING REQUIREMENTS

8. In order to determine compliance with the emission limits and other conditions of this permit and representations made in the permit application, the holder of this permit must keep and maintain the following records:

   A. Total monthly and previous 12-month cumulative lumber kiln production. Kiln Nos. 1 and 2 shall be recorded together while Kiln No. 3 shall be recorded separately.

   B. Total monthly and previous 12-month combined cumulative press production.

   C. Total monthly and previous 12-month combined cumulative veneer dryer production.

   D. Short-term (hourly) compliance with the steam production rates on Table 1 will be demonstrated by maintaining a continuous chart recorder of the steam production (lbs/hour) for each boiler.

   E. Long-term (monthly) compliance with the steam production rates on Table 1 will be calculated as follows:

$$\frac{lbs\ of\ Steam}{month} = (K_{12} \times SC_{12}) + (K_3 \times SC_3)$$

Where: K_{12} = Sum of Kiln No. 1 and Kiln No. 2 production, in board·ft/month
K_3 = Kiln No. 3 production, in board·ft/month
SC_{12} = Steam Consumption (lbs steam/board·ft) for Kiln Nos. 1 and 2
SC_3 = Steam Consumption (lbs steam/board·ft) for Kiln No. 3
(see Table 1 for SC factors)

Long-term (annual) compliance with the steam production rates on Table 1 will be demonstrated by maintaining a rolling 12-month total of the monthly steam production.

These records must be kept on-site on a two-year rolling retention basis from the date the data is obtained and made available to the TNRCC Executive Director or any local air pollution control agency having jurisdiction upon request.

TEMPORARY PACKAGE BOILER USED FOR STEAM REPLACEMENT

9. A temporary package boiler may be installed and operated to provide steam lost during Boiler No. 3 maintenance that requires shutdown. The installation and operation shall be in accordance with the following:

   A. Operation of the temporary boiler shall be limited to 30 days per year.

   B. The temporary boiler steam production shall be limited to 100,000 pounds per hour.

   C. Fuel-fired in the temporary boiler shall be limited to low sulfur diesel containing no more than 0.05 percent sulfur by weight.

   D. Prior to each installation of the temporary boiler, the TNRCC Beaumont Regional Office will be notified of the proposed dates of installation and operation.

   E. Records of dates of operation and fuel use shall be kept for two years.

Dated November 12, 1998

EMISSION SOURCES - MAXIMUM ALLOWABLE EMISSION RATES

Permit Nos. 5628 and PSD-TX-905

This table lists the maximum allowable emission rates and all sources of air contaminants on the applicant's property covered by this permit. The emission rates shown are those derived from information submitted as part of the application for permit and are the maximum rates allowed for these facilities. Any proposed increase in emission rates may require an application for a modification of the facilities covered by this permit.

AIR CONTAMINANTS DATA

Emission Point No. (1)	Source Name (2)	Air Contaminant Name (3)	Emission Rates * lb/hr	TPY
S-01	Boiler No. 1	NO_x	10.00	43.80
		CO	35.00	153.30
		VOC	5.00	21.90
		SO_2	0.42	1.83
		PM_{10}	10.00	43.80
S-02	Boiler No. 2	NO_x	10.00	43.80
		CO	35.00	153.30
		VOC	5.00	21.90
		SO_2	0.42	1.83
		PM_{10}	10.00	43.80
S-03	Boiler No. 3	NO_x	45.00	162.06
		CO	1062.00	4651.56
		VOC	32.00	140.16
		SO_2	1.85	8.11
		PM_{10}	44.00	192.72
S-04	Dryer No. 1	VOC	46.22	**
		PM	9.92	
		PM_{10}	6.83	
S-05	Dryer No. 2	VOC	59.88	**
		PM	12.85	
		PM_{10}	8.85	
S-06	Dryer No. 3	VOC	60.24	**
		PM	12.93	
		PM_{10}	8.90	

EMISSION SOURCES - MAXIMUM ALLOWABLE EMISSION RATES

AIR CONTAMINANTS DATA

Emission Point No. (1)	Source Name (2)	Air Contaminant Name (3)	Emission Rates * lb/hr	TPY
S-07	Dryer No. 4	VOC	71.26	**
		PM	15.29	
		PM_{10}	10.53	
S-04 through S-07	Dryer Nos. 1 through 4 Combined Annual Allowables	VOC		789.34
		PM		169.26
		PM_{10}		116.52
K-01	Kiln No. 1	VOC	28.80	**
		PM_{10}	0.71	
K-02	Kiln No. 2	VOC	28.80	**
		PM_{10}	0.71	
K-03	Kiln No. 3	VOC	28.80	**
		PM_{10}	0.71	
	Kiln Nos. 1, 2, and 3 Combined Annual Allowables	VOC		249.83
		PM_{10}		8.00
S-14	Dry Hog Baghouse	PM_{10}	0.89	3.90
S-15	Dry Waste Baghouse	PM_{10}	0.79	3.46
S-17	Sander Dust Baghouse	PM_{10}	0.04	0.18
S-19	Fuel House Cyclone	PM_{10}	0.30	1.32
S-18	Truck Bin Cyclone	PM_{10}	2.06	9.03
S-16	Dry Waste Cyclone	PM_{10}	0.21	0.92

EMISSION SOURCES - MAXIMUM ALLOWABLE EMISSION RATES

AIR CONTAMINANTS DATA

Emission Point No. (1)	Source Name (2)	Air Contaminant Name (3)	Emission Rates * lb/hr	Emission Rates * TPY
V-01/C-12	Hot Press Roof Vent	VOC	15.11	**
		PM	11.44	
		PM_{10}	4.81	
		HCHO	0.42	
V-01/C-13	Hot Press Roof Vent	VOC	15.11	**
		PM	11.44	
		PM_{10}	4.81	
		HCHO	0.42	
V-01/C-12 and V-01/C-13	Hot Press Roof Vents Combined Annual Allowables	VOC		122.52
		PM		92.75
		PM_{10}		39.04
		HCHO		3.38
F-09	Log Soaking Vats (Traditional Lathe)	VOC	14.00	61.32
F-09A	Log Soaking Vats (Centerless Lathe)	VOC	4.20	18.40
F-03	Ring Debarker (4)	PM_{10}	2.42	10.60
F-04	Drum Debarker (4)	PM_{10}	0.31	1.36
F-01	MTL Sawline (4)	PM_{10}	<0.01	0.01
F-02	Fiber Deck (4)	PM_{10}	<0.01	0.01
F-05	Even End Saws (4)	PM_{10}	<0.01	0.01
F-08	Trim Saws (4)	PM_{10}	<0.01	0.01
F-12	Truck Bin (4)	PM_{10}	<0.01	0.02
F-14	Truck Bin (4)	PM_{10}	<0.01	0.02

EMISSION SOURCES - MAXIMUM ALLOWABLE EMISSION RATES

AIR CONTAMINANTS DATA

Emission Point No. (1)	Source Name (2)	Air Contaminant Name (3)	Emission Rates * lb/hr	TPY
F-13	Rail Loading - Chips (4)	PM_{10}	<0.01	0.02
F-17	Shavings Truck Bin (4)	PM_{10}	<0.01	0.02

(1) Emission point identification - either specific equipment designation or emission point number from plot plan.
(2) Specific point source name. For fugitive sources use area name or fugitive source name.
(3) NO_x - total oxides of nitrogen
CO - carbon monoxide
VOC - volatile organic compounds as defined in General Rule 101.1
SO_2 - sulfur dioxide
PM - particulate matter, suspended in the atmosphere, including PM_{10}.
PM_{10} - particulate matter equal to or less than 10 microns in diameter. Where PM is not listed, it shall be assumed that no particulate matter greater than 10 microns is emitted.
HCHO - formaldehyde
(4) Fugitive emissions are an estimate only and should not be considered as a maximum allowable emission rate.

* Emission rates are based on and the facilities are limited by the following maximum operating schedule:

24 Hrs/day 7 Days/week 52 Weeks/year or 8,760 Hrs/year

** Annual emission limits are based on a combined total for several points. The annual limit is specified after the last point in the group.

Dated November 12, 1998

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
OFFICE OF AIR QUALITY
PREVENTION OF SIGNIFICANT DETERIORATION
PERMIT APPLICATION
NEW LUMBER DRYING KILN

Submitted by

Champion International Corporation
Camden Mill
Farm Road 62
Camden, TX 75934

Prepared by

Roy F. Weston, Inc.
5599 San Felipe, Suite 700
Houston, TX 77056

March 1998

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
OFFICE OF AIR QUALITY
PREVENTION OF SIGNIFICANT DETERIORATION
PERMIT APPLICATION
NEW LUMBER DRYING KILN

TABLE OF CONTENTS

SECTION	TITLE	PAGE

TABLE OF CONTENTS (Continued)

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
OFFICE OF AIR QUALITY
PREVENTION OF SIGNIFICANT DETERIORATION
PERMIT APPLICATION
NEW LUMBER DRYING KILN

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

SECTION 1
INTRODUCTION

Champion International Corporation (Champion) is submitting this application to the Texas Natural Resource Conservation Commission (TNRCC) Office of Air Quality for Champion's existing wood products manufacturing facility, Account No. PF-0003-N, located on Farm Road 62 in Camden, Polk County, Texas. The facility currently holds TNRCC air permit R-5628. This application covers the installation of a new lumber drying kiln that Champion is proposing to install at this location.

1.1 FACILITY OVERVIEW

Champion's Camden mill is located on Farm Road 62 in Camden, Polk County, Texas. The location of the facility is illustrated on a U.S. Geological Survey 7.5-minute series map in Appendix A. This map has been marked with circles delineating 3,000-foot and one-mile distances from the center of the facility. There are no schools located within 3,000 feet of the facility. The nearest residence is approximately 2,985 feet south of the location of the proposed new kiln.

Appendix B contains a plot plan showing the location of the buildings, structures, and emission points at the Champion facility. A plant benchmark is included.

The Camden mill produces plywood, lumber, and wood chips from logs transported to the facility by truck. Steam is provided by three wood waste fired boilers, with provisions in the existing permit for the temporary use of a fuel-oil fired package boiler (not presently installed at the facility).

Two general types of logs are received at the facility. Larger diameter logs known as "Modified Tree Length" (MTL) are used in the plywood process as a source of veneer. Smaller diameter logs known as "Small Sort Trees" (SST) may be used for plywood veneer, lumber, or chips.

MTLs are cut to length on a sawline, debarked in a ring debarker, soaked in hot water vats for conditioning, and peeled into veneer on conventional lathes. Bark from the debarker is used as fuel in the boilers. SSTs are cut to length on a fibersaw, debarked in a drum debarker, and then sorted for further processing in one of four areas. Pieces that are suitable for the conventional lathes are soaked in hot water vats like the MTLs, then peeled into veneer. Other pieces, generally of smaller diameter, are peeled into veneer on a centerless lathe. A third processing option is the chip-n-saw process that produces raw green lumber (e.g., 2x4s, 4x4s, etc.). Cores left over from the peeling process on the conventional and centerless lathes are also processed by the chip-n-saws. The final option for debarked SSTs is chipping in the whole log chipper.

Plywood is constructed from veneer produced on the lathes. Glue is sprayed or spread onto sheets of veneer, which are stacked in layers to make up the plywood. A sequence of unheated and heated presses bonds the veneer layers. After pressing, the panels may be patched to correct surface defects, then they are trimmed to size and may also be sanded or textured before being packaged for shipment.

Lumber from the chip-n-saws is dried in steam-heated kilns to reduce moisture content under controlled conditions. Champion is proposing to supplement the capacity of the two existing kilns with a new kiln of similar design. After drying, the lumber is planed, graded, and packaged for shipment.

Bark, wood waste, and wood trimmings are transported to the boiler fuel house for use in the boilers. These materials include bark from the debarking processes, wood waste from chip-n-saw and sanding operations, and trimmings from the plywood process. They may also be sold, depending upon availability and demand.

1.2 PROJECT SUMMARY

Champion is proposing to install a third lumber drying kiln similar in design and operation to the two existing kilns. This kiln will have a nominal capacity of 156,000 board feet (156 MBF) of lumber per drying cycle, and will be heated with steam produced by the three existing wood waste boilers. The planned operating schedule is up to eight drying cycles per week, 52 weeks per year, for an annual production capacity of 64,896 MBF. Existing log and lumber processing equipment will be used prior to the drying process to prepare the lumber and after drying to finish the lumber for shipment.

No modifications will be made to the boilers to produce the additional steam for the new kiln. In addition, no short-term steam production increases are anticipated for the boilers. This is because steam use at the mill is balanced by timing the operation of steam-using equipment to limit short-term peaks in steam demand. In addition, the boilers have each operated at capacity in the recent past, so none of the boilers will be operated at increased short-term levels. There will, however, be long-term increases in steam demand and production as a result of the new kiln installation. This will result in increased emissions from the boilers on an annual basis. These increases are discussed in Subsection 3.3 of this application.

No modifications will be made to the log and lumber processing equipment to support production from the new kiln. However, there will be an increase in the total amount of pieces processed through the log preparation areas (storage, handling, saws, debarkers, etc.). This may result in increased particulate emissions from these areas. These increases are discussed in Subsection 3.3 of this application.

Production of wood chips in chip-n-saw and dry lumber planing operations will also increase. This may result in increased particulate emissions from the cyclones at the planer shavings bin. These increases are discussed in Subsection 3.3 of this application.

1.3 APPLICATION SUMMARY

The remainder of this application has been organized into the following sections.

TNRCC New Source Review information, including:

- Subsection 2.1—TNRCC Forms and Tables includes a CORE Checklist, Form PI-1, Table 1(a), Table 30, and PSD Tables PSD-1, PSD-2, and PSD-3.

- Subsection 2.2—Permit Application Requirements includes the information requested in Sections VI through VIII of Form PI-1.

Prevention of Significant Deterioration (PSD) permitting information, including the following:

- Subsection 3.1—Introduction and Project Overview provides a summary of PSD permitting requirements, an overview of Champion's proposed kiln project, and a discussion of affected emission sources at the mill.

- Subsection 3.2—Emissions Information includes project-related emissions increases and a netting summary of contemporaneous increases of VOCs and CO.

- Subsection 3.3—Regulatory Applicability summarizes the applicability of state and federal regulations.

- Subsection 3.4—Best Available Control Technology includes an analysis of potential VOC control technologies for kiln emissions.

- Subsection 3.5—Proposed Compliance Demonstration Methods outlines Champion's proposed method of demonstrating compliance with production and steam limits that will be established by the permit.

- Subsection 3.6—Air Quality Impacts Analysis presents the results of the ambient air quality impacts analysis conducted for the kiln project, and the results of the ozone formation modeling conducted by TNRCC.

- Subsection 3.7—Additional Impacts Analysis addresses other possible impacts of the proposed kiln project on the surrounding area. This includes impacts due to growth associated with the new kiln, impacts to air quality from pollutants that will be emitted in increased quantities, and impacts to soils and vegetation resulting from the emissions.

SECTION 2
FORM PI-1 AND SUPPORTING INFORMATION

2.1 TNRCC FORMS AND TABLES

The following TNRCC forms and tables are included in this section:

- CORE—Administrative Completeness Checklist
- Form PI-1—General Application, Air Quality Permit
- Table 1(a)—Emission Sources
- Table 30—Certification of Estimated Capital Cost and Permit Application Fee
- Certificate of Good Standing—State Comptroller's Office
- Table PSD-1—PSD Air Quality Applicability Supplement
- Table PSD-2—Project Contemporaneous Changes
- Table PSD-3—Description of Creditable Reductions

OTE TO APPLICANT: Please mark an "X" in the column labeled "Applicant use" to indicate that the information has been provided. You may also use the column ·beled "Comments & Discussions" to further explain your action.

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
NEW SOURCE REVIEW DIVISION
AIR QUALITY PERMIT APPLICATION (PI-1)
ADMINISTRATIVE COMPLETENESS CHECKLIST

TNRCC USE ONLY

:MPANY ______	PROJ No: ______	PROJ TYPE: ______	CORE ENGR ______ RECORD No: ______
:GION ______ COUNTY ______		Tech Contact ______	Phone ______
ATE RECD by CORE: ______	Comments ______		DATE ADMN COMP: ______
ATE RECD by TECH ENGR: ______	Comments ______	TECH ENGR: ______	TECHNICAL SECT.: ______

'I-1 EE	REQUIRED INFORMATION	APPLICANT USE		<-- TNRCC USE ONLY --> DATE ADMN COMPLETE	NOT COMPLETE	NOTHING SUBMITTED	COMMENTS & DISCUSSION
	ONFIDENTIAL Information?[1]						[ ] YES [✓] NO
	CONFIDENTIAL page marked?						[ ] YES [ ] NO
	CORE Checklist attached	✓	•				[✓] YES [ ] NO
	NOV related notification						[ ] YES [✓] NO
	Net number of new jobs created	✓					
	Name of elected State Senator	✓					Form PI-1
	Name of elected State Repr.	✓					Form PI-1
I.	Type of Application	✓	•				[ ] PERMIT [✓] AMENDMENT
A.	Permittee Name, Tax ID & Addr.	✓					Form PI-1
	Technical Contact (addr./phone)	✓					Form PI-1
B.	Owner Name, Tax ID & Addr.	✓					Form PI-1
C.	Product/Business & SIC Code	✓	•				Form PI-1
II. A.	Plant/Site Name	✓					Form PI-1
B.	Address of Facility	✓					Form PI-1
C.	Nearest City, County, and Zip	✓	•				Form PI-1
D.	Latitude and Longitude	✓					Form PI-1
E.	TNRCC Air Quality Acct. No.	✓	•				PF-0003-N
II. A.	Name of Facility	✓					Form PI-1
B.	Facility Type	✓					[✓] PERMANENT [ ] PORTABLE
C.	Operating Schedule	✓					24/7/52
D.	Start Dates	✓	•				CONST DATE 5/15/98 OPER DATE 7/15/98
/. A.	New Permit Unit - grass roots						New grass roots facility at this location.
B.	New Permit Unit - nonpermitted						Modification of exist. non-permitted facility.
C.	Amendment - permitted facility	✓					[✓] Present Permit No. R-5628
D.	Change in Location						[ ] Present Permit No.
/. A.	Compliance History - Exempt						[ ] YES [✓] NO
B.	Comp. Hist. - site ≥ 5 yr old	✓					[✓] YES [ ] NO
C.	Comp. Hist. - new site						[ ] YES [✓] NO
D.	Comp. Hist. - site < 5 yr old						[ ] YES [✓] NO
I. A.	Area Map	✓					Appendix A
	School within 3,000 feet?	✓					[ ] YES [✓] NO
B.	Plot Plan	✓					Appendix B
C.	Table 1(a) & Emission Calc.	✓					Section 2.2.3
D.	BACT Analysis	✓					Section 2.2.4 and Section 3.4
E.	Franchise Tax Certificate	✓	•				[✓] YES [ ] Certificate good thru 5/15/98
F.	Permit Fee Required?	✓					[✓] YES [ ] NO
	Fee Certification & Table 30	✓					Section 2.2.5
G.	Actual emissions past 2 yr	✓					[✓YES [ ] NO Section 2.2.6
H.	Stand. exempt. or grandfather unit rolled into permit?	✓					[ ] YES [✓] NO
	Information on units provided?	✓					[ ] YES [✓] NO
I. A.	Process Flow Diagram	✓					
B.	Process Description	✓					Section 2.2.7
C.	Material Balance	✓					Section 3.1
I.	116.111(1) TNRCC Rules & Regs	✓					
	116.111(2) Emissions Measurement	✓					
	116.111(3) BACT Analysis	✓					
	116.111(4) NSPS	✓					
	116.111(5) NESHAPS	✓					
	116.111(6) Facility Performance	✓					
	116.111(7) Nonattainment Review	✓					Major Source/Modification? [ ]YES [✓]NO
	116.111(8) PSD Review	✓					Major Source/Modification? [✓]YES [ ]NO
	116.111(9) Impacts/Modeling	✓					To be provided when complete
:.	Copy to EPA Region 6 office	✓	•				[✓] YES [ ] N/A
	Copy to TNRCC Regional office	✓	•				[✓] YES City - Beaumont
	Copy to Local Program(s)		•				[ ] YES [✓] N/A
.	Application sealed by Prof. Engr.?	✓					[✓] YES [ ] N/A
.	Int'l Boundary Water Com. notified?		•				[ ] YES [✓] N/A
.	Authorizing Signature/Date	✓					

These items will not result in the application being considered administratively deficient; however, they MUST be submitted prior to final action or approval of the application.
CONFIDENTIAL information MUST be clearly marked on each page and separated from non-confidential information. The application must include a non-confidential version describing the confidential information for the public file. To be considered confidential, each page must be marked "CONFIDENTIAL" at the time of submittal. *Rev. 5/15/96*

npion:ckcore.doc(rfo)

TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
FORM PI-1, GENERAL APPLICATION -- AIR QUALITY PERMIT -- (Page 1 of 2)

A PERMIT TO CONSTRUCT MUST BE APPROVED BEFORE ANY ACTUAL WORK IS BEGUN ON THE FACILITY. This is not a stand alone document. Please refer to the "Form PI-1, Permit Application Instructions" manual (Instructions) for specific details to complete this application. Please print or type all information. All information requested herein must be completed and submitted before public notification procedures may be authorized. Please contact the CORE Section of the New Source Review Division with any questions at 512 239-1240 (FAX No. 512 239-1300). Written inquiries may be addressed to: Texas Natural Resource Conservation Commission, Office of Air Quality, New Source Review Division (MC-162), P.O. Box 13087, Austin TX 78711-3087.

☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆VERY IMPORTANT!☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆

- Is **CONFIDENTIAL** information being submitted with this application? [ ]-YES [✓]-NO
  - If YES, is each "confidential" page so marked in big red letters? [ ]-YES [ ]-NO
- Has a **CORE** checklist been attached to this application? [✓]-YES [ ]-NO
- Is this application in response to or related in any way to a **Notice of Violation** at this location? [ ]-YES [✓]-NO
  - If YES, date of Notice of Violation: ______
  - Also, if YES, pursuant to Rule: ______

Please furnish the following information pertaining to this facility **SITE**:

1. Please estimate the net number of new jobs which will be created in the community as a result of the operation of the facility authorized by this application: ______
2. Name of elected State Senator: Drew Nixon
3. Name of elected State Representative: Alan Hightower

Please furnish the following information pertaining to Compliance History:

Submit a 5-year Compliance History in accordance with Sections 116.120-116.126 (Regulation VI) for all facilities classified in Sections V.C and V.D of Form PI-1 below.

I. TYPE OF APPLICATION: [ ]-CONSTRUCTION PERMIT [✓]-AMENDMENT, Permit No. R-5628
[ ]-FLEXIBLE PERMIT [ ]-FLEXIBLE PERMIT AMENDMENT

A. PERMIT ISSUED TO: Champion International Corporation
(Entity legally responsible for permit; i.e., Owner or Operator of the facility)
Permittee's Texas State Comptroller's Tax ID No.: 3-00013-0562-9
Permittee's address (Person, Title, Address): Champion International Corporation
P.O. Box 200, Camden, TX 75934
phone: (409) 398-7200 FAX: (409) 398-7226
Permittee's Technical Contact (Person, Title, Address): Jason Haynes, Environmental Manager, Champion Camden Complex, Farm Road 62, Camden, TX 75934
phone: (409) 398-7200 FAX: (409) 398-7226
Please indicate desired recipient of all correspondence: (___)**Permittee** (_✓_)**Technical Contact**

B. OWNER OF FACILITY: same as above (permittee)
(If different from permittee; include names of proprietor/general partner(s) if applicable)
Owner's Texas State Comptroller's Tax ID No.: same as above
Owner's address (Person, Title, Address): same as above

C. PRINCIPAL COMPANY PRODUCT OR BUSINESS: Softwood Veneer and Plywood
Plant SIC Code: 2436

II. FACILITY PHYSICAL LOCATION:

A. Name of plant or site: Camden Complex
B. Street Address: Farm Road 62 (near FM 942)
C. Nearest City Camden County: Polk Site Zip Code: 75934
D. Latitude: 30 ° 54 ' 56 "N Longitude: 90 ° 44 ' 27 "W (must be to nearest second)
E. Plant Site TNRCC Air Quality Account Number: PF - 0003 - N

III. FACILITY TYPE AND OPERATING SCHEDULE:

A. Name of facility to be permitted: Lumber Kiln #3
B. Facility Type (Check One): [✓] Permanent, [ ] Portable.
C. Facility Operating Schedule: (24)Hours/day; (7)Days/week; (52)Weeks/year
( ) Seasonal - explain: ______
D. Start Dates (Proposed/Actual): Construction: 5/15/98 (P/A)____ Operation: 7/15/98 (P/A)____

IV. FACILITY CLASSIFICATION (Check only one block):

A. [ ] New Permitted Facility - New grass roots Facility at this location.
B. [ ] New Permitted Facility - Modification of existing non-permitted Facility.
C. [✓] Amendment to Permitted Facility. Permit No(s) R-5628
D. [ ] Change in Location of Permitted Facility. Permit No(s) ______
Location of Present Facility: ______

V. COMPLIANCE HISTORY (See attached Supplemental Information Sheet):

A. [ ] Exemption claimed under §116.121, or
B. [✓] Existing Site => 5 years old. TNRCC will compile Compliance History, or
C. [ ] New Site (This is a new grass roots site with no operating history), or
D. [ ] Existing Site < 5 years old.
  1. If "C" or "D", does applicant have similar facilities in Texas? [ ]-YES [ ]-NO.
  2. If NO, attach one of the following:
     a. [ ] Compliance History for similar sites in other States. If none, then:
     b. [ ] Compliance History as required by §116.122(b) (Regulation VI).

VI. SUBMIT THE FOLLOWING GENERAL INFORMATION:

A. Submit a current area map as specified in the Instructions.
Are any schools located within 3000 feet of this facility? [ ]-YES [✓]-NO.

B. Submit a plot plan of the plant property as specified in the Instructions.

C. Submit emission data, including fugitive emissions and stack parameters, on Table 1(a). Attach emission calculations and information showing how emissions were determined. See Instructions for further details.

D. Submit an analysis of Best Available Control Technology, including the estimated installed capital and operating costs for all abatement equipment associated with the facility. See Instructions for further details.

☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆VERY IMPORTANT!☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆☆

E. Franchise Tax. Submit a copy of a Certificate of Good Standing from the State Comptroller's Office with each application if the permit is to be issued to a corporation. See Instructions if you are not a corporation or for further information.

F. Permit Fee. Enclose required fee, fee certification and estimated capital cost (Table 30); or furnish explanation why fee is not required. (See §116.141[Regulation VI].)

G. Please submit actual emissions (tons per year) for the last two (2) years to determine federal applicability.

H. Are there any standard exemptions or grandfathered units related to this permit that you wish to roll into the permit or amendment at this time? [ ] Yes [✓] No
Provide information on these units.

VII. SUBMIT (A) PROCESS FLOW DIAGRAM, (B) PROCESS DESCRIPTION AND (C) MATERIAL BALANCE AS SPECIFIED IN THE INSTRUCTIONS (see Instructions concerning submittal of confidential information.)

VIII. GENERAL APPLICATION REQUIREMENTS: Submit itemized information and/or analysis that will demonstrate that all general application requirements as specified in §116.111 of TNRCC Regulation VI are met. **Each requirement in §116.111 must be addressed in this application.** See Instructions for further details. Atmospheric dispersion modeling may be required as part of the air quality impact analysis per §116.111(9).

Is this facility a **MAJOR SOURCE/MODIFICATION** with regard to one of the following:

1. §116.111(7) - Nonattainment [ ]-YES [✓]-NO
2. §116.111(8) - Prevention of Significant Deterioration [✓]-YES [ ]-NO.

IX. APPEAL PROCESS:

Commission §116.114(a)(3) should be consulted for the procedure to be used to appeal the failure of the agency to process an application within the prescribed time limits.

X. A COPY OF THIS APPLICATION AND ALL ATTACHMENTS MUST BE SENT by the applicant to the EPA Region 6 office in Dallas if PSD or Nonattainment Review is applicable in any form, the appropriate TNRCC Regional Office and to any local air pollution control program having jurisdiction. Copies of the application were sent to:

EPA Region 6 Office in Dallas [✓]-YES [ ]-Not applicable.
TNRCC Regional Office sent to: (city) Beaumont
Copies sent to these local programs: 1. ____
[✓]-NOT APPLICABLE. 2. ____

XI. §116.110(d). PE Seal.

Is the estimated capital cost of the project for which application is made greater than $2 million dollars? [✓]-YES [ ]-NO
if **YES**, application must be submitted under seal of a Texas registered Professional Engineer, unless exemption is claimed pursuant to the Texas Engineering Practice Act.
[ ] - Exemption is claimed pursuant to Section — of the TEPA.

XII. The International Boundary Water Commission (IBWC) wishes to be notified of any new construction within 100 kilometers of the Rio Grande River. For the mailing address of the IBWC, please refer to the PI-1 instructions.

XIII. I, Ed Taylor, Operations Manager
(Name - Please print or type) (Title: Owner, Plant Manager, President, Vice-President, Environmental Director, etc.)

state that I have knowledge of the facts herein set forth and that the same are true and correct to the best of my knowledge and belief. I further state that to the best of my knowledge and belief, the project for which application is made will not in any way violate any provision of the Texas Health & Safety Code (THSC), Chapter 382, Texas Clean Air Act, as amended, or any of the air quality Rules and Regulations of the Texas Natural Resource Conservation Commission or any local governmental ordinance or resolution enacted pursuant to the Texas Clean Air Act. I further state that I have read and understand Section 382.091, THSC, which defines CRIMINAL OFFENSES for certain violations, including intentionally or knowingly making or causing to be made false material statements or representations in this application, and Section 382.092, THSC, pertaining to CRIMINAL PENALTIES.

DATE 3-23-98 SIGNATURE Ed Taylor

NOTE - ORIGINAL SIGNATURE IN INK IS REQUIRED.

TABLE 1(a)
EMISSION SOURCES

Review of applications and issuance of permits will be expedited by suppying all necessary information requested on this Table

AIR CONTAMINANT DATA						EMISSION POINT DISCHARGE PARAMETERS									
EMISSION POINT [1]		CHEMICAL COMPOSITION OF TOTAL STREAM		AIR CONTAMINANT EMISSION RATE		UTM COORDINATES OF EMISSION PT. [6]			STACK SOURCES [7]					AREA SOURCES [8]	
									HEIGHT ABOVE GROUND (ft)	HEIGHT ABOVE STRUCT. (ft)	EXIT DATA				
NUMBER	NAME	COMPONENT OR AIR CONTAMINANT NAME [2]	CONC (%) [3]	#/HR [4]	TONS/YR [5]	ZONE	EAST (meters)	NORTH (meters)			DIA. (ft)	VEL. (fps)	TEMP. (deg F)	LENGTH (ft)	WIDTH (ft)
K-03	No. 3 Kiln	VOC		28.8*	92.15	15	333892.5		20	0	2.63	16	200		
		PM_{10}		0.71	2.66			3421431.3	(5 rectangular roof vents, 28" square)						

GROUND LEVEL ELEVATION OF FACILITY ABOVE SEA LEVEL:
STANDARD CONDITIONS ARE 68 deg F AND 14.7 PSIA

* The hourly VOC emission rate is based on a cycle average rather than a peak hourly emission rate, as described in Section 3 of this application. The hourly and annual VOC emission rates are based on different emission factors to reflect the difference between short-term peaks and longer-term average emission rates.

Note: No existing mill emission sources affected by this project will emit more than their existing permitted emission rates. Therefore, no existing emission limits will be changed by this permit modification application, and no existing emission sources have been included on this Table 1(a).

TABLE 30

CERTIFICATION OF ESTIMATED CAPITAL COST AND PERMIT APPLICATION FEE

Title 30 Texas Administrative Code §116.141

ude estimated cost of the equipment and services that would normally be capitalized according to ndard and generally accepted corporate financing and accounting procedures.

	Estimated Capital Cost
ECT COSTS	
cess and control equipment not previously owned by the applicant and permitted in Texas	$430,000
iliary equipment, including exhaust hoods, ducting, fans, pumps, piping, conveyors, cks, storage tanks, waste disposal facilities, and air pollution control equipment cifically needed to meet permit and regulation requirements	244,600
ght charges	57,000
preparation (including demolition), construction of fences, outdoor lighting, road and king areas	161,000
allation (including foundations), erection of supporting structures, enclosures or ather protection, insulation and painting, utilities and connections, process integration process control equipment	942,000
iliary buildings, including materials storage, employee facilities, and changes to sting structures	97,000
ient air monitoring network	N/A
IRECT COSTS	
al engineering design and supervision and administrative overhead	60,000
istruction expense (including construction liaison), securing local building permits, irance, temporary construction facilities and construction clean-up	100,000
itractor's fee and overhead	N/A

TOTAL ESTIMATED CAPITAL COST = $2,091,600

rtify that the total estimated capital cost of the project as defined in Title 30 Texas Administrative le Section 116.141 is equal to or less than the above figure.

Larry J. Lasiter , P. E. **Signed by:** [signature]

Title: Vice President

Company: Goodwin - Lasiter, Inc.

Date: 3-23-98

timated Capital Cost	Permit Application Fee	PSD Application Fee
ss than $300,000	$450 (minimum fee)	$1,500 (minimum fee)
00,000 to $50,000,000	0.15% of capital cost	
0,000 to $15,000,000		0.5% of capital cost
ater than $50,000,000	$75,000 (maximum fee)	
ater than $15,000,000		$75,000 (maximum fee

. 11-03-95

PERMIT APPLICATION FEE (from table above) = $10,458.00

COMPTROLLER OF PUBLIC ACCOUNTS
STATE OF TEXAS
AUSTIN, 78774

JOHN SHARP
Comptroller

CERTIFICATION OF ACCOUNT STATUS

THE STATE OF TEXAS

COUNTY OF TRAVIS

I, John Sharp, Comptroller of Public Accounts of the State of Texas, DO HEREBY CERTIFY that according to the records of this office

CHAMPION INTERNATIONAL CORP

is, as of this date, in good standing with this office having no franchise tax reports or payments due at this time.

This certificate is valid through the date that the next franchise tax report will be due 05-15-98.

This certificate is valid for the purpose of conversion when the converted entity is subject to franchise tax as required by law.

This certificate is not valid for the purpose of dissolution, merger or withdrawal.

GIVEN UNDER MY HAND AND SEAL
OF OFFICE in the City of Austin,
this 12th day of December, 1997 A.D.

John Sharp

JOHN SHARP
Comptroller of Public Accounts

Charter/COA NO.: 000166173-6
Form 05-304 (Rev. 9-97/9)

Texas Natural Resource Conservation Commission
Prevention of Significant Deterioration (PSD) Review

TABLE PSD-1
PSD AIR QUALITY APPLICABILITY SUPPLEMENT

TO BE COMPLETED BY APPLICANT AT TIME OF APPLICATION

A permit applicant must complete this table if PSD netting is required or if requested by permit engineer. This is not a stand-alone document. Please refer to the TNRCC *PSD Air Quality Guidance Document* for specific details regarding information required by this form. For additional information regarding PSD applicability and review, please refer to 40 CFR Part 52 Section 21 and EPA's Draft *New Source Review Workshop Manual* of October 1990 which provides examples for illustration.

Permit Application No. ______________

Company: Champion International Corporation — TNRCC Air Quality Account I.D. PF-0003-N

Company Contact: Jason Haynes — Phone Number (409) 398-7200

Facility Location or Street Address: Farm Road 62

City: Camden — County: Polk

Permitted Unit I.D. and Name ______________

Permit Activity: ☐ New Major Source ☒ Major Modification

Project or Process Description: New Lumber Kiln

Operating Schedule: 24 hrs/day 7 days/wk 52 wks/yr ____ hrs/yr ____ Continuous
Or throughput ______

The information provided on this form (and Tables PSD-2 and PSD-3, if applicable) is true and correct.

Ed Taylor — Signature
Operations Manager — Title
3-23-98 — Date

If Prevention of Significant Deterioration (PSD) review is required, then the applicant must send a complete application to EPA Region 6 at the address below. EPA Region 6 must also receive copies of all subsequent correspondence.

EPA Region 6
New Source Review Section
1445 Ross Avenue
Dallas, TX 75202-2733

LIST RELEVANT DATES:

A. 5/15/98 Estimated start of construction.
B. 5/15/93 5 years prior to estimated start of construction.
C. 7/15/98 Estimated start of operation.

DEFINE CONTEMPORANEOUS PERIOD (from B to C): 5/15/93 to 7/15/98
From 5 years prior to estimated start of construction through estimated start of operation.

	Yes	No	Regulated Pollutant[1]						
			VOCs	PM*	PM_{10}*	NO_x	CO	SO_2	Pb
xisting site potential to emit[2] (tpy)			1,771	566	460	399	6,57 0	12	
·oposed project increases[2] (tpy)			120	14.9	14.9	16.2	294	0.5	0.01
onattainment New Source Review Applicability: 'the proposed project will be located in an area that designated nonattainment for any pollutants, place a ıeck to the right in the column under that ›llutant(s) and complete a Table 1N.									
the existing site one of the 28 named sources?[3]		X							
the existing site a major source?[4]	X								
ıisting site is a major source:									
netting required? If "Yes" attach Tables PSD-2 ı.l PSD-3.[5]		X							
gnificance level as defined in 40 CFR 52.21(b)(23)[6]			40	25	15	40	100	40	0.6
ɛt contemporaneous change from Table PSD-2 (tpy)			120	14.9	14.9	16.2	294	0.5	0.01
PSD review applicable? Answer "Yes" or "No" ıder each applicable pollutant.			Yes	No	No	No	Yes	No	No
·isting site is NOT a major source: N/A									
the proposed project by itself one of the 28 named urces[3]									
the proposed project a major source by itself? (No .nsideration is given to any emissions decreases.)[4]									
ıce the project is considered major all other ›llutants are compared to their respective ʒnificance levels.[6] Netting is not allowed. **Is PSD view applicable?** Answer "Yes" or "No" under ch applicable pollutant.									

Regulated pollutants include criteria pollutants (pollutants for which a National Ambient Air Quality Standard [NAAQS] exists) and noncriteria pollutants (pollutants regulated by EPA for which no NAAQS exists).
Defined in Part A of the TNRCC *PSD Air Quality Guidance Document.*
The 28 named source categories are listed in 40 CFR 52.21(b)(1) and Table A of the TNRCC *PSD Air Quality Guidance Document.*
Refer to Part C "major source determination" of the TNRCC *PSD Air Quality Guidance Document.*
Refer to Part E2 of the TNRCC *PSD Air Quality Guidance Document.*
Significant emissions are defined in 40 CFR 52.21(b)(23) and Table B of the TNRCC *PSD Air Quality Guidance Document.*
For this permit application, emissions of PM were presumed to consist entirely of PM_{10}, which probably overstates actual PM_{10} emissions.

PROJECT CONTEMPORANEOUS CHANGES[1]

Company: Champion International Corporation

Permit Application No.____________

Regulated Pollutant VOCs

	PROJECT DATE[2]	EMISSION UNIT AT WHICH REDUCTION OCCURRED[3] FIN	EMISSION UNIT AT WHICH REDUCTION OCCURRED[3] EPN	PERMIT NO.	PROJECT NAME OR ACTIVITY	A ALLOWABLE EMISSIONS AFTER THE ACTIVITY[4] (tons/year)	B ACTUAL EMISSIONS PRIOR TO THE ACTIVITY[4] (tons/year)	C DIFFERENCE (A-B)[5] (tons/year)	CREDITABLE DECREASE OR INCREASE[6]	REASON CODE[7]
1	Aug. 1995		K-01/ K-02	5628	Kiln Moisture Detection System*			1.44	N/A**	
2	Aug. 1995		S-01	5628	Kiln Moisture Detection System			0.03	N/A	
3	Aug. 1995		S-02	5628	Kiln Moisture Detection System			0.03	N/A	
4	Aug. 1995		S-03	5628	Kiln Moisture Detection System			1.45	N/A	
5										
6										
7	June 1997		F-09A	5628	New Log Soaking Vats*			18.4***	N/A	
8	June 1997		V-01, S-12, S-13	5628	New Log Soaking Vats			0.19	N/A	
9	June 1997		S-04 to S-07	5628	New Log Soaking Vats			1.16	N/A	
10	June 1997		S-01	5628	New Log Soaking Vats			2.28	N/A	
11	June 1997		S-02	5628	New Log Soaking Vats			2.28	N/A	
12	June 1997		S-03	5628	New Log Soaking Vats			13.69	N/A	
13										
14										
							PAGE SUBTOTAL[8]	18.40		
	Summary of Contemporaneous Changes						TOTAL			

* This project was not related to or contingent upon the new kiln project under review.

** Not Applicable - There have been no changes during the contemporaneous period that have resulted in any creditable emission decreases or increases.

*** Fugitive emissions only.

03/97

champion:22468901:tblpsd2.doc(bmm)

PROJECT CONTEMPORANEOUS CHANGES[1]

Company: Champion International Corporation

Permit Application No.____________

Regulated Pollutant CO

	PROJECT DATE[2]	EMISSION UNIT AT WHICH REDUCTION OCCURRED[3]		PERMIT NO.	PROJECT NAME OR ACTIVITY	A ALLOWABLE EMISSIONS AFTER THE ACTIVITY[4] (tons/year)	B ACTUAL EMISSIONS PRIOR TO THE ACTIVITY[4] (tons/year)	C DIFFERENCE (A-B)[5] (tons/year)	CREDITABLE DECREASE OR INCREASE[6]	REASON CODE[7]
		FIN	EPN							
1	Aug. 1995		S-01	5628	Kiln Moisture Detection System*			0.19	N/A**	
2	Aug. 1995		S-02	5628	Kiln Moisture Detection System			0.19	N/A	
3	Aug. 1995		S-03	5628	Kiln Moisture Detection System			15.7	N/A	
4										
5										
6										
7	June 1997		S-01	5628	New Log Soaking Vats*			15.96		
8	June 1997		S-02	5628	New Log Soaking Vats			15.96		
9	June 1997		S-03	5628	New Log Soaking Vats			TBD***		
10										
11										
12										
13										
14										
							PAGE SUBTOTAL[8]	18.40		
	Summary of Contemporaneous Changes						TOTAL			

* This project was not related to or contingent upon the new kiln project under review.

** Not Applicable - There have been no changes during the contemporaneous period that have resulted in any creditable emission decreases or increases.

*** To Be Determined - Emission testing has been scheduled for March 1998 to determine CO emissions from this boiler.

1 Individual PSD-2 Tables should be used to summarize a combination of activities which may be considered a single project for each regulated pollutant.

2 Date activity occurred and is documented. Attach Table PSD-3 for each project reduction claimed which explains how the reduction is creditable.

3 Emission Point No. as designated in TNRCC Permit or Emissions Inventory.

4 All records and calculations for these values need to be available upon request. Actual emissions should be estimated as an average of the actual emissions over the two-year period prior to the Project's Activity Date.

5 Allowable (column A) - Actual (column B) for all emissions.

6 If portion of the decrease not creditable, enter creditable amount. If all of decrease is creditable or if this line is an increase, enter column C again. Sum all values in this column and place in box at bottom of column.

7 For emission decreases:
Enter one of the following reason codes:
e1a - 101.29(e)1(A) Shutdowns
e1b - 101.29(e)1(B) Continuous Emission Monitors
e1c - 101.29(e)1(C) Reduction by Review
e1d - 101.29(e)1(D) Reduction by Standardized Calculation
oth - oth Describe on Table PSD-3.
Also reference appropriate PSD-3 page of this submittal

8 Sum all values for this page.

TABLE PSD-3
DESCRIPTION OF CREDITABLE REDUCTIONS

Company Name: Champion International Corporation Contaminant: VOC

Date Action Occurred: August 1995 SIC code for this plant site: 2436

Check ONE of the following: ☒ Permit No. R-5628 ☐ Grandfathered Facility ☐ Standard Exemption

For CREDITABLE reductions, verify each statement by checking all appropriate boxes:

- ☐ The reductions occurred within the contemporaneous period.[1]
- ☐ For each unit at the source at which the change occurred, the reductions were calculated as the allowable emissions after the change minus the actual emissions averaged over the 2-year period immediately preceding the change.
- ☐ The reductions occurred at the applicant's contiguous or adjacent plant site and came from units with the same 2-digit major group SIC code and under the same common ownership or control.[1]
- ☐ The reductions have not been relied upon in issuing a previous PSD permit (including use in PSD netting).[1]
- ☐ The reductions have not been relied upon in issuing a nonattainment permit and the reductions have not been used as an offset[2] in a nonattainment permit or reserved in an application for use as an offset.[1]
- ☐ The reductions will be federally enforceable[3] by the start of construction of the proposed project and actually accomplished by the start of operation.[1]
- ☐ The reductions have the same qualitative significance for public health as the increase from the proposed project.[1]

Note: A reduction cannot occur at, and therefore, cannot be credited from an emissions unit which was never constructed or operated, including units that received a PSD permit.

For grandfathered facilities or standard exemptions:

- ☐ Records for this facility are available to demonstrate the actual emissions of this facility for a two-year period prior to the reduction claimed.

Please give a complete description of project's reductions and credits. Provide all emission point numbers affected by this project. Provide any explanation for above exceptions.

No reductions or credits resulted from this project. Tables PSD-2 and PSD-3 have been included for completeness only.

Units' Allowable: ____________ Units' Actual[4]: ____________

1 For a reduction (or increase) to be creditable these boxes must be checked. This change in emissions may not be used in netting calculations without this verification.

2 An offset is a required reduction of equal or greater magnitude (depending on the nonattainment area) than the emissions increase from the project for which nonattainment new source review is being conducted. An offset does not refer to reductions used in nonattainment netting calculations.

3 To ensure federal enforceability for standard exemptions at emission levels below those levels specified by the exemptions specifically in use, or by TNRCC Regulation VI, §116.211, the applicant should keep on-site a signed registration certification Form PI-8, verifying the maximum emission rate resulting from operations authorized by a standard exemption. The registration and certification must include the basis for estimating the emission rate.

To ensure federal enforceability of grandfathered emission rates, the grandfathered emission rates should be incorporated into the MAERT of an existing State permit on site or into an Agreed Order if no such permit exists.

4 Averaged over the two-year period prior to activity.

TABLE PSD-3
DESCRIPTION OF CREDITABLE REDUCTIONS

Company Name: Champion International Corporation Contaminant: VOC

Date Action Occurred: June 1997 SIC code for this plant site: 2436

Check ONE of the following: ☒ Permit No. R-5628 ☐ Grandfathered Facility ☐ Standard Exemption

For CREDITABLE reductions, verify each statement by checking all appropriate boxes:

- ☐ The reductions occurred within the contemporaneous period.[1]
- ☐ For each unit at the source at which the change occurred, the reductions were calculated as the allowable emissions after the change minus the actual emissions averaged over the 2-year period immediately preceding the change.
- ☐ The reductions occurred at the applicant's contiguous or adjacent plant site and came from units with the same 2-digit major group SIC code and under the same common ownership or control.[1]
- ☐ The reductions have not been relied upon in issuing a previous PSD permit (including use in PSD netting).[1]
- ☐ The reductions have not been relied upon in issuing a nonattainment permit and the reductions have not been used as an offset[2] in a nonattainment permit or reserved in an application for use as an offset.[1]
- ☐ The reductions will be federally enforceable[3] by the start of construction of the proposed project and actually accomplished by the start of operation.[1]
- ☐ The reductions have the same qualitative significance for public health as the increase from the proposed project.[1]

Note: A reduction cannot occur at, and therefore, cannot be credited from an emissions unit which was never constructed or operated, including units that received a PSD permit.

For grandfathered facilities or standard exemptions:

- ☐ Records for this facility are available to demonstrate the actual emissions of this facility for a two-year period prior to the reduction claimed.

Please give a complete description of project's reductions and credits. Provide all emission point numbers affected by this project. Provide any explanation for above exceptions.

No reductions or credits resulted from this project. Tables PSD-2 and PSD-3 have been included for completeness only.

Units' Allowable: ________ Units' Actual[4]: ________

1 For a reduction (or increase) to be creditable these boxes must be checked. This change in emissions may not be used in netting calculations without this verification.

2 An offset is a required reduction of equal or greater magnitude (depending on the nonattainment area) than the emissions increase from the project for which nonattainment new source review is being conducted. An offset does not refer to reductions used in nonattainment netting calculations.

3 To ensure federal enforceability for standard exemptions at emission levels below those levels specified by the exemptions specifically in use, or by TNRCC Regulation VI, §116.211, the applicant should keep on-site a signed registration certification Form PI-8, verifying the maximum emission rate resulting from operations authorized by a standard exemption. The registration and certification must include the basis for estimating the emission rate.

To ensure federal enforceability of grandfathered emission rates, the grandfathered emission rates should be incorporated into the MAERT of an existing State permit on site or into an Agreed Order if no such permit exists.

4 Averaged over the two-year period prior to activity.

TABLE PSD-3
DESCRIPTION OF CREDITABLE REDUCTIONS

Company Name: Champion International Corporation Contaminant: CO

Date Action Occurred: August 1995 SIC code for this plant site: 2436

Check ONE of the following: ☒ Permit No. R-5628 ☐ Grandfathered Facility ☐ Standard Exemption

For CREDITABLE reductions, verify each statement by checking all appropriate boxes:

- ☐ The reductions occurred within the contemporaneous period.[1]
- ☐ For each unit at the source at which the change occurred, the reductions were calculated as the allowable emissions after the change minus the actual emissions averaged over the 2-year period immediately preceding the change.
- ☐ The reductions occurred at the applicant's contiguous or adjacent plant site and came from units with the same 2-digit major group SIC code and under the same common ownership or control.[1]
- ☐ The reductions have not been relied upon in issuing a previous PSD permit (including use in PSD netting).[1]
- ☐ The reduct.ons have n.ot been relied upon in issuing a nonattainment permit and the reductions have not been used as an offset[2] in a nonattainment permit or reserved in an application for use as an offset.[1]
- ☐ The reductions will be federally enforceable[3] by the start of construction of the proposed project and actually accomplished by the start of operation.[1]
- ☐ The reductions have the same qualitative significance for public health as the increase from the proposed project.[1]

Note: A reduction cannot occur at, and therefore, cannot be credited from an emissions unit which was never constructed or operated, including units that received a PSD permit.

For grandfathered facilities or standard exemptions:

- ☐ Records for this facility are available to demonstrate the actual emissions of this facility for a two-year period prior to the reduction claimed.

Please give a complete description of project's reductions and credits. Provide all emission point numbers affected by this project. Provide any explanation for above exceptions.

No reductions or credits resulted from this project. Tables PSD-2 and PSD-3 have been included for completeness only.

Units' Allowable: ____________ Units' Actual[4]: ____________

1 For a reduction (or increase) to be creditable these boxes must be checked. This change in emissions may not be used in netting calculations without this verification.

2 An offset is a required reduction of equal or greater magnitude (depending on the nonattainment area) than the emissions increase from the project for which nonattainment new source review is being conducted. An offset does not refer to reductions used in nonattainment netting calculations.

3 To ensure federal enforceability for standard exemptions at emission levels below those levels specified by the exemptions specifically in use, or by TNRCC Regulation VI, §116.211, the applicant should keep on-site a signed registration certification Form PI-8, verifying the maximum emission rate resulting from operations authorized by a standard exemption. The registration and certification must include the basis for estimating the emission rate.

To ensure federal enforceability of grandfathered emission rates, the grandfathered emission rates should be incorporated into the MAERT of an existing State permit on site or into an Agreed Order if no such permit exists.

4 Averaged over the two-year period prior to activity.

TABLE PSD-3
DESCRIPTION OF CREDITABLE REDUCTIONS

Company Name: Champion International Corporation Contaminant: CO

Date Action Occurred: August 1995 SIC code for this plant site: 2436

Check ONE of the following: ☒ Permit No. R-5628 ☐ Grandfathered Facility ☐ Standard Exemption

For CREDITABLE reductions, verify each statement by checking all appropriate boxes:

☐ The reductions occurred within the contemporaneous period.[1]

☐ For each unit at the source at which the change occurred, the reductions were calculated as the allowable emissions after the change minus the actual emissions averaged over the 2-year period immediately preceding the change.

☐ The reductions occurred at the applicant's contiguous or adjacent plant site and came from units with the same 2-digit major group SIC code and under the same common ownership or control.[1]

☐ The reductions have not been relied upon in issuing a previous PSD permit (including use in PSD netting).[1]

☐ The reductions have not been relied upon in issuing a nonattainment permit and the reductions have not been used as an offset[2] in a nonattainment permit or reserved in an application for use as an offset.[1]

☐ The reductions will be federally enforceable[3] by the start of construction of the proposed project and actually accomplished by the start of operation.[1]

☐ The reductions have the same qualitative significance for public health as the increase from the proposed project.[1]

Note: A reduction cannot occur at, and therefore, cannot be credited from an emissions unit which was never constructed or operated, including units that received a PSD permit.

For grandfathered facilities or standard exemptions:

☐ Records for this facility are available to demonstrate the actual emissions of this facility for a two-year period prior to the reduction claimed.

Please give a complete description of project's reductions and credits. Provide all emission point numbers affected by this project. Provide any explanation for above exceptions.

No reductions or credits resulted from this project. Tables PSD-2 and PSD-3 have been included for completeness only.

Units' Allowable: ______ Units' Actual[4]: ______

1 For a reduction (or increase) to be creditable these boxes must be checked. This change in emissions may not be used in netting calculations without this verification.

2 An offset is a required reduction of equal or greater magnitude (depending on the nonattainment area) than the emissions increase from the project for which nonattainment new source review is being conducted. An offset does not refer to reductions used in nonattainment netting calculations.

3 To ensure federal enforceability for standard exemptions at emission levels below those levels specified by the exemptions specifically in use, or by TNRCC Regulation VI, §116.211, the applicant should keep on-site a signed registration certification Form PI-8, verifying the maximum emission rate resulting from operations authorized by a standard exemption. The registration and certification must include the basis for estimating the emission rate.

To ensure federal enforceability of grandfathered emission rates, the grandfathered emission rates should be incorporated into the MAERT of an existing State permit on site or into an Agreed Order if no such permit exists.

4 Averaged over the two-year period prior to activity.

2.2 PERMIT APPLICATION REQUIREMENTS

This section discusses and provides detail on the permit application requirements listed in Sections I, VII, and VIII of Form PI-1. Compliance with additional requirements related to PSD permitting is demonstrated in Section 3 of this application.

2.2.1 Area Map—Section VI.A.

USGS 7.5 minute quadrangle maps representing at least a 1-mile radius around the Champion facility, and showing distances of 3,000 feet and one mile, are located in Appendix A. There are no schools located within 3,000 feet of the facility.

2.2.2 Property Plot Plan—Section VI.B.

A property plot plan depicting buildings and emission points is located in Appendix B.

2.2.3 Emissions Data—Table 1(a)—Section VI.C.

The facility's emission points and emission rates are summarized in the preceding Section 2.1 on Table 1(a). Only emission sources that will experience emission rate increases or decreases are included on this table. Emissions from other mill sources will not be affected. The assumptions and calculations underlying the emission rates presented on Table 1(a) are documented in Section 3.3 and in Appendix C. Further discussion of emission rate calculations and changes is presented in Sections 3.2 and 3.4.

2.2.4 Best Available Control Technology (BACT)—Section VI.D.

BACT is required by TNRCC new source review (NSR) and PSD permitting rules. While the level of control considered to be BACT is generally equivalent under both sets of rules, the pollutants for which BACT must be specified for PSD is limited to those for which a new or modified source will experience a PSD-significant increase. Under TNRCC NSR, BACT must be reviewed for each new or increased pollutant. BACT for both programs is discussed in Section 3.5 of this application.

2.2.5 Certificate of Good Standing and Permit Fee—Sections VI.E. and VI.F.

A copy of Champion's Certificate of Good Standing from the State Comptroller's Office is included in Section 2.1. A completed copy of Table 30 with the estimated capital cost of the proposed project and the calculated fee amount is also in Section 2.1. A check for the amount of the fee is being submitted with this application.

2.2.6 Actual Emissions—Section VI.G.

The applicability of PSD review to a pollutant is based on the amount of increase of that pollutant due to a proposed new source or modification. Part of the determination of the amount of an increase is a calculation of the difference between actual emissions over a two-year period prior to the modification and the maximum potential emissions from the facility after the modification. The Champion facility's actual emissions over the past two years are detailed in Section 3.4 along with a more detailed discussion of PSD applicability.

2.2.7 Process Description

An overview of the operations at Champion's Camden mill is presented in Section 1. The proposed new drying kiln will supplement the operation of the two existing kilns, will perform the same function, and will operate in a similar manner. Figure 2-1 is a simplified process flow diagram of the kiln and associated processing steps.

Logs are brought to the mill by truck and are stored in the woodyard storage area. From storage, the logs are cut, then transported by flume to a drum debarker where bark is removed from the wet logs. From the drum debarker, logs destined for the kilns are sent to the chip-n-saw machines where they are cut to appropriate size. The cores remaining from veneer peeling on the lathes are also sent to the chip-n-saw machines. Lumber from the chip-n-saw may be stored in the air-dry storage area or transported directly to one of the kilns. Emissions from these process steps are limited to small quantities of fugitive particulate matter, primarily from the debarkers and the chip-n-saws.

In the kilns, lumber is dried to a desired moisture content under controlled conditions before being further processed. Heat is supplied to the drying kiln by steam within steam coils. Air is circulated around the coils and throughout the kiln by fans located near the ceiling of the kiln. The fans move the air horizontally across the top of the kiln's interior, causing the air to circulate past the steam coils and through the stacked lumber. To ensure even drying throughout the stack, the fans periodically reverse direction, which reverses the circulation within the kiln.

Fresh air is brought into the kiln, and moisture-laden air is exhausted, through vents located on top of the kiln. When the fans are reversed, the function of the vents is also reversed, such that the vents that were exhaust vents now let in fresh air, and the vents that had been fresh air vents now exhaust wet air. These reversing cycles continue throughout the drying period, which typically lasts from 18 to 36 hours.

Emissions during the drying cycle consist of VOCs released from the wood as it is heated and particulate matter that condenses as the emissions cool in the atmosphere.

Dried lumber is planed and graded, then readied for shipment. Planer shavings are transported to the planer shavings bin, and are loaded into trucks through the truck bin. Emissions consist of particulate matter (wood particles) from the planer shavings cyclone. In addition, small amounts of fugitive emissions are released from the truck bin during truck loading. The effect of the proposed new kiln on emissions from pre- and post-drying operations is discussed in Section 3.2.

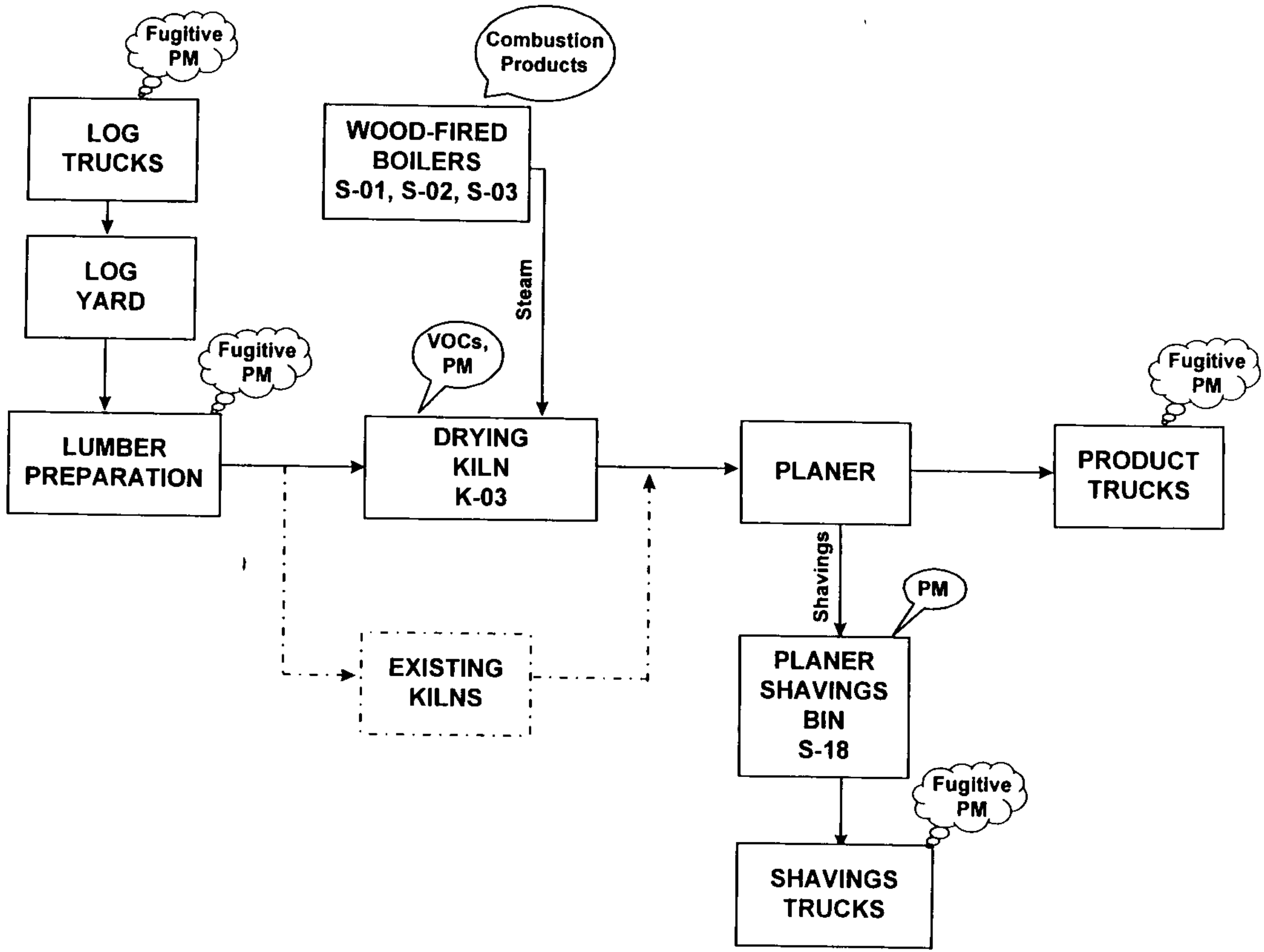


FIGURE 2-1
SIMPLIFIED FLOW DIAGRAM
LUMBER DRYING KILN AND SUPPORTING OPERATIONS

champion:22468901:fig2-1.ppt

2.2.8 General Application Requirements

Rule 116.111(1) Protection of Public Health and Welfare

As outlined below, the emissions from the proposed new kiln will comply with all air quality rules and regulations and with the intent of the Texas Clean Air Act, including protection of the health and physical property of the people.

General Rules

The new kiln will be operated in accordance with the General Rules relating to circumvention, nuisance, traffic hazard, notification requirements for major upset, notification requirements for maintenance, sampling, sampling ports, emissions inventory requirements, sampling procedures and terminology, compliance with Environmental Protection Agency Standards, the National Primary and Secondary Air Quality Standards, inspection fees, emissions fees and all other applicable General Rules.

Regulation I—Control of Air Pollution from Visible Emissions and Particulate Matter

The operation of the kiln is not expected to result in visible emissions, but any that do occur will not be in excess of the opacity limits specified in Regulation I, §111.111. The kiln will comply with the allowable particulate matter (PM) emission rate specified in §111.151. The provisions of §111.141, 111.143, 111.145, 111.147, and 111.149 are not applicable because the Champion facility is not within Harris County or El Paso County.

Regulation II—Control of Air Pollution from Sulfur Compounds

Regulation II regulates the emission of sulfur compounds, in part by setting net ground level concentration limits for sources of sulfur dioxide (SO_2) emissions. The wood waste fired boilers emit small quantities of SO_2 as a result of the presence of sulfur compounds in the wood waste fuel, and Champion has permitted authority to operate a temporary fuel-oil fired package boiler (not currently installed). However, the level of emissions from these sources will not cause the ground level concentration limits to be exceeded.

Regulation II also limits emissions of hydrogen sulfide, sulfuric acid, and total reduced sulfur. Champion's Camden facility does not emit these compounds, so the limits established for these pollutants will not be exceeded.

Regulation III—Control of Air Pollution from Toxic Materials

Regulation III regulates the emission of beryllium, inorganic fluorides and lead, and incorporates portions of the federal Maximum Achievable Control Technology (MACT) standards. There will be no emissions of beryllium, inorganic fluorides, or lead from any source at the Camden facility, except for small quantities of lead emissions from the wood waste fired boilers. However, Regulation III applies only to lead smelters in El Paso and Dallas Counties. In addition, none of the activities regulated by the various MACT standards are carried out at the facility. Therefore, this regulation does not apply to the Camden facility.

Regulation IV—Control of Air Pollution from Motor Vehicles

All motor vehicles owned or operated by the applicant will comply with the applicable provisions of this regulation including maintenance and operation of air pollution control systems or devices, inspection requirements, equipment evaluation procedures for vehicle exhaust gas analyzers, and use of oxygenated fuels, as applicable.

Regulation V—Control of Air Pollution from Volatile Organic Compounds (VOCs)

The only portion of Regulation V with potential applicability to the proposed addition of the new kiln is the section of Subchapter B that establishes vent gas control requirements. However, the requirements do not apply in Polk County where the Camden facility is located.

Regulation VII—Control of Air Pollution from Nitrogen Compounds

The provisions of this regulation apply in specified ozone nonattainment areas. Polk County is not in an ozone nonattainment area, so the regulation does not apply.

Regulation VIII—Control of Air Pollution Episodes

Regulation VIII specifies actions that must be taken by sources if TNRCC determines that an air pollution episode is occurring or if an imminent localized threat exists to human health or safety. Champion will comply with the requirements of this regulation if such a determination is made. Section 118.5, which requires certain major sources in specified ozone nonattainment counties to prepare an emission reduction plan, does not apply to the Camden mill because the mill is not located in one of the specified counties.

Regulation IX—Control of Air Pollution from Carbon Monoxide

The proposed facility will not emit carbon monoxide from any of the specified processes regulated by Regulation IX.

Regulation X—Control of Air Pollution from Hazardous Waste or Solid Waste Management Facilities

The proposed facility is not a hazardous waste or solid waste management facility. Therefore, Regulation X does not apply.

Regulation XI—Control of Air Pollution from Municipal Solid Waste Facilities

The proposed facility is not a municipal solid waste management facility. Therefore, Regulation XI does not apply.

Regulation XII—Federal Operating Permits

The Camden mill is subject to the requirement to obtain a Regulation XII (Title V) operating permit. An abbreviated permit application was submitted by the due date of 1 February 1998, and a full application will be due by 25 July 1998. Champion will submit this application when due, in compliance with Regulation XII.

Rule 116.111(1) Impact on Schools

There are no schools within 3,000 feet of the proposed facility. Emissions from the proposed new kiln will not have an adverse impact on any schools.

Rule 116.111(2) Measurement of Emissions

Emissions from air emission sources at the Champion facility will be sampled upon request of the Executive Director of the TNRCC.

Rule 116.111(3) Best Available Control Technology (BACT)

Subsection 3.4 of this application contains a discussion of Best Available Control Technology (BACT).

Rule 116.111(4) Federal New Source Performance Standards (NSPS)

There are no proposed sources listed in 40 CFR 60 to be constructed at the facility. Therefore, these rules do not apply.

Rule 116.111(5) National Emission Standards for Hazardous Air Pollutants (NESHAP)

There are no hazardous air pollutants listed in 40 CFR 61 that will be emitted from this facility. Therefore, these rules are not applicable.

Rule 116.111(6) Performance Demonstration

The facility will perform as represented in the permit application.

Rule 116.111(7) Nonattainment Review

The new kiln is proposed to be constructed in an area that has not been designated as a nonattainment area for any pollutant. Therefore, nonattainment new source review is not applicable.

Rule 116.111(8) Prevention of Significant Deterioration (PSD) Review

The proposed new kiln is located in an attainment area for all regulated pollutants. The proposed project will result in significant increases in emissions of VOC and CO. Therefore, PSD permitting requirements are applicable to the project. Compliance with these requirements is demonstrated in Section 3.

Rule 116.111(9) Air Dispersion Modeling

Champion has conducted dispersion modeling as part of the PSD compliance demonstration. The results have been included in subsection 3.6 of this application.

SECTION 3
PREVENTION OF SIGNIFICANT DETERIORATION

3.1 INTRODUCTION AND PROJECT OVERVIEW

The Camden mill is a major stationary source due to its potential to emit PSD regulated pollutants at rates in excess of 250 tons per year. Modifications at a major source are subject to PSD review if they are major modifications. A modification is major if any of the net emission increases that result from the modification exceed the PSD significant emission increase thresholds. PSD review includes several interrelated components which demonstrate that the proposed project will not result in significant deterioration of air quality in the vicinity of the source to be modified. The components are addressed in this section of the application, which includes the following topics.

- Emissions information, including calculation approaches and methods.
- A regulatory applicability review.
- An analysis of Best Available Control Technology for units that will be affected by the project.
- A proposed method of demonstrating compliance with a proposed lumber kiln steam cap.
- An analysis of the air quality impacts associated with the project.
- An analysis of air quality related values associated with the project.

As noted in Section 1.2, the proposed project includes the addition of a new lumber drying kiln to the mill's lumber operation that currently includes two drying kilns. The new kiln will have a nominal capacity of 156,000 board feet of lumber. The addition of a third kiln will result in a throughput increase for processing equipment such as debarkers and wood waste handling equipment, and a steam production increase from the existing wood waste boilers. The lumber kiln itself will emit VOCs released from the lumber as it dries, and a small amount of particulate matter. The existing processing equipment (excluding the two existing kilns) will emit additional amounts of fugitive and point source particulate matter. The boilers will emit more combustion products as a result of supplying additional steam to the lumber drying kilns. These emission increases are calculated and discussed in the following section.

Table 3-1 lists net emission increases that will result from the new kiln project, and compares the increases with the significant increase levels. This table shows that only VOCs and CO will increase by significant amounts.

TABLE 3-1
SUMMARY OF EMISSION INCREASES

POLLUTANT	ANNUAL EMISSION INCREASES (tons per year)	PSD SIGNIFICANCE LEVELS (tons per year)	PSD SIGNIFICANT?
PM*	14.9	25	No
PM_{10}	14.9	15	No
VOCs (as C)	119.65	40	**Yes**
NO_x	16.1	40	No
CO	293.6	100	**Yes**
SO_2	0.45	40	No
Lead	0.002	0.6	No

* Note that all PM has been conservatively assumed to be PM_{10}.

The proposed project is subject to PSD review for VOC and CO emissions based on the projected emission increases. All other criteria and PSD pollutant emissions are projected to be less than the significant emissions increase levels identified in the PSD regulations.

To establish the emission increases that will occur from the boilers, Champion has calculated the additional amount of steam that can be produced by the boilers without resulting in a PSD significant PM_{10} emission increase. This additional steam, along with the amount of steam used historically by the existing kilns, was used to develop a steam cap of 423,242,000 pounds of steam per year for the three kilns combined. This steam cap ensures that the PSD significant emission level for PM_{10} is not exceeded by the project. In order to demonstrate compliance with the proposed steam cap, Champion is proposing to track lumber production through the kilns as a surrogate for actual steam usage. This approach is feasible because the lumber production rate is directly related to steam use by the kilns.

VOC and CO Netting Summary

At the request of TNRCC, Champion has determined the net CO and VOC emission increases that occurred due to changes made at the mill during the contemporaneous period between 1993 and 1998. Two projects were identified during this review that had the potential to result in increases in emissions of VOCs and/or CO, the pollutants for which the proposed kiln project is significant.

In 1995, a moisture detection system was installed on the existing drying kilns. This system allowed increased kiln production by improving control of kiln drying conditions. The increased throughput resulted in increased emissions of VOCs from the kilns, and in increased emissions of VOCs and CO from the boilers due to increased steam production. This project was authorized under Standard Exemption 106 (now §106.261).

In 1997, two new log soaking vats were installed. Operation of these vats increased production in the plywood presses and in the veneer dryers, resulting in increased VOC emissions from these sources. In addition, the vats and presses required additional steam for process heat, which resulted in VOC and CO emission increases from the boilers. The vats themselves were also new sources of fugitive VOC emissions. This project was carried out under a TNRCC minor new source review permit.

The emission increases discussed above are summarized on the following table.

TABLE 3-2
CO AND VOC EMISSION NETTING SUMMARY

PROJECT	VOCs tons per year	CO tons per year
Kiln Moisture Detection System		
• Kiln Increases	1.44	NA
• Boiler No. 1 Increases	0.03	0.19
• Boiler No. 2 Increases	0.03	0.19
• Boiler No. 3 Increases	1.45	15.7
New Soaking Vats		
• Vat Increases (fugitive)	18.4	NA
• Press Increases	0.19	NA
• Veneer Dryer Increases	1.16	NA
• Boiler No. 1 Increases	2.28	15.96
• Boiler No. 2 Increases	2.28	15.96
• Boiler No. 3 Increases	13.69	To be determined*
Proposed New Kiln		
• Kiln Increases	92.15	NA
• Boiler No. 1 Increases	0.5	3.4
• Boiler No. 2 Increases	0.5	3.4
• Boiler No. 3 Increases	26.5	286.8

* In accordance with the requirements of the permit amendment authorizing this change, the increase in CO emissions from Boiler No. 3 will be determined based on the results of emission tests scheduled for March 1998. This information will be provided to TNRCC under separate cover after the tests have been conducted.

3.2 EMISSIONS INFORMATION

3.2.1 Introduction

Champion has evaluated the changes in air contaminant emission rates at the Camden mill that will occur as a result of the proposed new lumber kiln. Installation of the kiln will result in new point source emissions consisting of VOCs and PM from the kiln, increased point source emissions of

PM from the planer shavings bin cyclone, and increased point source emissions of combustion products from the boilers. In addition, use of the new kiln will result in increased fugitive emissions from slightly increased truck traffic and from increased throughput and processing of logs. The amounts of these emissions have been calculated using the best available information, as detailed in the following subsections. It should be noted that, for the purpose of determining PSD major source status and PSD applicability, only point source emission rates are included. Fugitive emissions have been estimated and included in this application for the purpose of state NSR completeness.

Champion developed the emission rate increase estimates listed in Table 3-1 by using the best available emission information and by incorporating a proposed limit on the steam to be utilized by all three kilns combined. As part of the new kiln project, Champion is proposing to establish a steam cap of 423,242,000 pounds of steam per year for the three kilns. By establishing this cap, the proposed new kiln project will result in PSD significant increases for only VOC and CO.

The net emission increase from the project includes the increase from the new kiln itself plus related increases from other point sources at the mill that will experience increases in throughput or, in the case of the boilers, steam production due to the operation of the new kiln. The emission increases from these other sources consist of the incremental increases in emissions directly related to the increase in throughput or production (e.g., steam production in the boilers). The net emission increase from the project is the sum of the individual point source emission increases from all units affected by the project.

The following subsections provide detailed information on the methods used to calculate the net emissions increases on a unit-by-unit basis.

3.2.2 Emissions from New Kiln

As the green lumber is heated it releases volatile constituents (such as turpentine and terpenes) along with water, which are expelled from the kiln through the vents. In addition, small amounts of particulate matter are emitted from the vents. The source of the particulate matter may be entrainment of dust particles present on the green lumber or condensation of some of the volatile constituents as they cool upon being released from the kiln.

VOC Emissions from New Kiln

Lumber kilns have only recently been recognized as VOC emission sources, so emissions information is limited. The most recent emissions information has been found in Technical Bulletin No. 718 issued in July 1996 by the National Council of the Paper Industry for Air and Stream Improvement (NCASI). This bulletin details the results of kiln emissions testing that was conducted primarily to compare emission test methods. However, the document also presents drying kiln emissions data for several types of lumber from various locations.

Most of the lumber processed at the Camden mill is southern yellow pine (SYP). The NCASI technical bulletin reports two VOC emission factors for SYP, 2.36 pounds per thousand board feet (lb/MBF) and 3.32 lb/MBF. The higher factor was used to calculate short-term emission rates and an average of the two was used to calculate annual emissions.

The differences between the two factors reported by NCASI appear to relate primarily to size and storage characteristics. Specifically, the lower emission factor was derived from the drying of SYP from Arkansas that was smaller in diameter and had been stored longer than the East Texas lumber from which the higher emission factor had been developed. Volatile materials are released from lumber as it is stored, so a longer storage time before sawing and drying results in less volatile material driven off in the kiln, and a lower VOC emission factor. In addition, smaller diameter logs have a larger surface area per unit of wood, further increasing the loss of volatile material during storage.

Storage times vary widely at the Camden mill. Logs may be used shortly after delivery to the mill, or logs may be retrieved from the mill's storage area. Because of this variability, long-term emission estimates for the new kiln have been based on an average of the two emission factors discussed above. A simple arithmetic average was used since the amount of detail available did not permit a more sophisticated statistical evaluation. The average emission factor of 2.84 lb/MBF was used, along with nominal kiln capacity and operating schedule noted in Section 1.2, to calculate annual emissions from the new kiln, as follows:

$$\frac{2.84 \text{ lb VOC/MBF} \times 156 \text{ MBF/cycle} \times 8 \text{ cycles/week} \times 52 \text{ weeks/yr}}{2{,}000 \text{ lb/ton}} = \mathbf{92.15 \text{ ton VOC/year}}$$

In addition to these annual emissions, Champion has also calculated short-term emission rates for the new kiln based on the higher of the two emission factors, 3.32 lb/MBF. This emission factor was developed from kiln emissions measured over entire kiln cycles, which can typically last from 18 to 36 hours. The rate of emissions varies during the course of a drying cycle, so the emission factor may not represent maximum hourly emissions. For this reason, the short-term emission rates should be considered as drying cycle averages rather than actual hourly maximums. It should be noted that the emission calculations are based on cycle times at the short end of the range (18 hours), resulting in conservatively higher emission estimates than if longer cycle times had been assumed. The short-term emissions were calculated as follows:

$$3.32 \text{ lb VOC/MBF} \times \frac{156 \text{ MBF/cycle}}{18 \text{ hr/cycle}} = \mathbf{28.8 \text{ lb VOC/hr}}$$

Particulate Emissions from New Kiln

Particulate emissions from the new kiln were estimated in a similar manner using an emission factor of 0.082 lb/MBF. Like the hourly VOC estimate, the short-term PM emission rate is an average over the course of a drying cycle rather than an actual one-hour maximum. Based on these assumptions, PM emissions have been calculated as follows:

$$0.082 \text{ lb PM/MBF} \times \frac{156 \text{ MBF/cycle}}{18 \text{ hr/cycle}} = \mathbf{0.71 \text{ lb PM/hr}}$$

$$\frac{0.082 \text{ lb PM/MBF} \times 156 \text{ MBF/cycle} \times 8 \text{ cycles/week} \times 52 \text{ weeks/yr}}{2{,}000 \text{ lb/ton}} = \mathbf{2.66 \text{ ton PM/year}}$$

Even though PM_{10} emissions are probably lower than total PM emissions, it has been assumed that all PM emitted from the new kiln will be PM_{10} because of the infeasibility of quantifying the difference.

3.2.3 Boiler Emissions

Calculation of Steam Cap

The mill's existing wood waste boilers will experience increased utilization in supplying the steam needed by the proposed new kiln. This increased steam utilization will result in an increase in emissions from the boilers on a long-term (annual) basis. There will not be a short-term increase over currently permitted rates since the boilers routinely operate at their permitted capacity. Champion is proposing to accept a cap on steam use from the boilers in order to ensure that the total mill-wide increase in PM_{10} emissions is less than the PSD significant increase level of 15 tons per year. The steam cap, which will be applied to all three kiln operations, is based on the sum of:

- the actual amount of steam used by the two existing kilns for the last two years (1996 and 1997), and
- the incremental amount of steam that can be produced without exceeding the PSD significant increase level for PM_{10} (note: this includes emissions of PM_{10} from all other PM_{10} point sources affected by the project).

Several factors have been used to develop this steam cap for the two existing kilns and the proposed new kiln combined. These factors are described below and discussed in more detail in the following paragraphs.

- Boiler efficiency determines how much fuel is required to produce a pound of steam (bone dry pounds of fuel per thousand pounds of steam, or BDlb fuel/Mlb steam). The value of 169.4 BDlb fuel/Mlb steam used in these calculations is an average for the three boilers derived from boiler efficiency testing conducted at the mill in 1997. A summary of the test results is provided in Appendix D.
- The heat content of the fuel determines the heat input rate from a given amount of fuel (millions of British thermal units per BDlb fuel, or MMBtu/BDlb fuel).
- Emission factors express emissions in terms of heat input (pounds of emissions per MMBtu, or lb/MMBtu).
- Kiln-specific steam demand factors indicate the amount of steam needed to dry one board foot of lumber (lb steam/BF).

As established in subsections 3.2.2 and 3.2.4, PM_{10} emissions from sources other than the boilers will consist of 2.66 ton/yr from the new kiln and 1.48 ton/yr from the planer shavings bin cyclone, for a total of 4.14 ton/yr. Therefore, an increase in overall steam demand from the three kilns that results in an incremental PM_{10} emission increase from the boilers of 10.76 ton/yr will result in a PM_{10} emission increase from the project that is less than the PSD significant increase level of 15 ton/yr (10.76 + 4.14 = 14.9).

The three boilers that provide steam for the lumber kilns each have a PM_{10} emission limit of 0.2 lb/MMBtu. This limit was used to calculate the total heat input required to achieve an incremental increase in emissions of 10.76 ton/yr.

$$\frac{10.76 \text{ ton/yr} \times 2{,}000 \text{ lb/ton}}{0.2 \text{ lb/MMBtu}} = 107{,}600 \text{ MMBtu/yr}$$

The amount of wood waste fuel needed to provide this heat input will be:

$$\frac{107{,}600 \text{ MMBtu/yr}}{8{,}800 \text{ Btu/BD lb fuel}} = 12{,}227{,}273 \text{ BD lb fuel/yr}$$

The incremental amount of steam that will be provided by this fuel input will be:

$$\frac{12{,}227{,}273 \text{ BD lb fuel/yr}}{169.4 \text{ BD lb fuel/Mlb steam}} = 72{,}179{,}886 \text{ lb steam/yr}$$

Actual steam usage by the kilns over the past two years has been calculated on the basis of actual kiln throughput and the existing kilns' steam demand factor of 3.0 lb steam/BF.

$$116{,}484 \text{ MBF/yr} \times 3.0 \text{ lb steam/BF} = 349{,}452{,}000 \text{ lb steam/yr}$$

Therefore, the proposed steam cap for the three kilns combined is the sum of current actual steam usage plus the amount of steam that can be produced without resulting in a significant increase in PM_{10} emissions.

349,452,000 lb steam/yr + 72,179,886 lb steam/yr = **421,631,890 lb steam/yr**
(rounded to **421,632 Mlb/yr)**

Boiler Emission Factors

The emission factors used as the basis for the boilers' current permitted emission limits were used to identify annual boiler emission increases resulting from production of the additional steam that can be used under the proposed steam cap. These factors are listed in the mill's permit renewal application dated 1 March 1996, and are summarized in Table 3-3.

TABLE 3-3
BOILER EMISSION FACTORS

POLLUTANT	NO. 1 BOILER	NO. 2 BOILER	NO. 3 BOILER
PM[1]	0.2 lb/MMBtu	0.2 lb/MMBtu	0.2 lb/MMBtu
PM_{10}	0.2 lb/MMBtu	0.2 lb/MMBtu	0.2 lb/MMBtu
VOCs (as carbon)	0.1 lb/MMBtu	0.1 lb/MMBtu	0.6 lb/MMBtu
NO_x	0.2 lb/MMBtu	0.2 lb/MMBtu	0.323 lb/MMBtu[2]
CO	0.7 lb/MMBtu	0.7 lb/MMBtu	6.5 lb/MMBtu
SO_2	0.075 lb/ton fuel[3]	0.075 lb/ton fuel[3]	0.075 lb/ton fuel[3]
Lead	3.5×10^{-4} lb/ton fuel[3]	3.5×10^{-4} lb/ton fuel[3]	3.5×10^{-4} lb/ton fuel[3]

[1] Note that all PM has been conservatively assumed to be PM_{10}.
[2] Based on a permit limit of 71.06 lb/hr and a maximum heat input rate of 220 MMBtu/hr.
[3] Tons of fuel on a wet basis, 4,500 Btu/lb.

All three boilers can reasonably be expected to supply steam to the proposed kiln because they feed into a common steam header. Because emission factors are not identical among the three boilers, the increase in steam use was apportioned among the boilers based on their contributions to mill steam demand in 1995 and 1996. Future steam production can reasonably be expected to follow the same distribution pattern among the three boilers as these two years. The average contributions to total mill steam production by the three boilers over 1995 and 1996 were as follows:

- No. 1 Boiler: 9%
- No. 2 Boiler: 9%
- No. 3 Boiler: 82%

Boiler Emission Calculations

The incremental increases in annual emissions from the boilers, resulting from operation of the new kiln and the existing kilns under the steam cap identified above, have been calculated. The calculation used the emission factor, the relevant annual fuel or heat input increase, and the percentage listed above for each boiler, as follows.

$$ER_{NP} = \frac{EF_{NP} \times FR \times \%SD_N}{2{,}000 \text{ lb/ton}}$$

Where:

ER_{NP}	=	Annual emission rate for boiler N, pollutant P
EF_{NP}	=	Emission factor for boiler N, pollutant P
FR	=	Annual fuel rate, MMBtu or tons (wet)
$\%SD_N$	=	Percent of annual steam demand, boiler N
2,000 lb/ton	=	Constant (conversion factor)

For example:

No. 1 Boiler NO_x:

$$\frac{0.2\ \text{lb } NO_x/\text{MMBtu} \times 107{,}600\ \text{MMBtu/yr} \times 0.09}{2{,}000\ \text{lb/ton}} = 0.97\ \text{ton/yr}$$

The total NO_x emissions increase attributable to the operation of the three kilns will be the sum of the increases from each of the three boilers. Emissions of the criteria pollutants have been calculated in this manner and are presented in Table 3-4.

TABLE 3-4
BOILER EMISSION INCREASES
(TONS PER YEAR)

POLLUTANT	NO. 1 BOILER	NO. 2 BOILER	NO. 3 BOILER	TOTAL
PM*	0.97	0.97	8.8	10.74
PM_{10}	0.97	0.97	8.8	10.74
VOCs (as C)	0.48	0.48	26.5	27.5
NO_x	0.97	0.97	14.2	16.1
CO	3.4	3.4	286.8	293.6
SO_2	0.04	0.04	0.37	0.45
Lead	1.9×10^{-4}	1.9×10^{-4}	1.7×10^{-3}	0.002

* Note that all PM has been conservatively assumed to be PM_{10}.

3.2.4 Planer Shavings Bin Cyclone Emissions

Dried lumber is finished in the planer building. Shavings from the planer are conveyed to the planer shavings bin before being loaded into trucks for sale. Planer throughput will increase upon start-up of the proposed new kiln, which will result in increased production of planer shavings and increased emissions from the planer shavings bin cyclone.

The magnitude of the increase has been calculated on the basis of permitted hourly emission rates and an increase in the hours of cyclone operation that is proportional to the increase in overall kiln capacity that will result from the installation of the new kiln.

Actual emissions for 1996, as reported in the mill's Emissions Inventory report to TNRCC, were calculated on the basis of the permitted hourly emission rate of 2.06 lb/hr and 4,660 operating hours per year. To determine the increase in operating hours that will result from the new kiln's production, 1996 planer throughput and annual hours of operation were used to calculate an average planer throughput per hour:

$$\frac{113{,}250\ \text{MBF/yr}}{4{,}660\ \text{hr/yr}} = 24.3\ \text{MBF/hr}$$

The highest feasible increase in overall kiln production that would result under the "steam cap" described in the previous subsection was back-calculated to be 34,876 MBF/yr. This calculation was based on the new kiln's annual throughput capacity of 64,896 MBF/yr and anticipated steam demand of 2.5 lb/BF.

64,896 MBF/yr x 2.5 lb steam/BF = 162,240 Mlb steam/yr used by new kiln

421,632 Mlb steam/yr - 162,240 Mlb steam/yr = 259,392 Mlb steam/yr available for existing kilns

$$\frac{259{,}392\ \text{Mlb steam/yr}}{3.0\ \text{lb steam/BF}} = 86{,}464\ \text{MBF/yr production in existing kilns}$$

Maximum production under the steam cap given the production rates used in the calculations above.

64,896 MBF/yr + 86,464 MBF/yr = 151,360 MBF/yr

Production increase over recent actual production:

151,360 MBF/yr - 116,484 MBF/yr ('96/'97 production average) = 34,876 MBF/yr

The average throughput factor of 24.3 MBF/hr and the maximum production increase of 34,876 MBF/yr were used to estimate the annual planer operating hours after installation of the new kiln, with the assumption that the planer operation is currently operating at its capacity on an hourly basis.

$$\frac{34{,}876\ \text{MBF/yr}}{24.3\ \text{MBF/hr}} = 1{,}435\ \text{hr/yr}$$

The annual emission increase resulting from this increase in annual operating hours is calculated using the permitted PM emission rate:

$$\frac{1{,}435\ \text{hr/yr} \times 2.06\ \text{lb/hr}}{2{,}000\ \text{lb/ton}} = 1.48\ \text{ton/yr}$$

A short-term emission increase is not expected because the short-term emission rate is based on outlet grain loading and flow rate, which are not expected to increase.

3.2.5 Emission Increase Summary

Emission increases from point sources must be compared with PSD significant increase levels to determine which, if any, pollutants must undergo PSD review. The previous subsections have detailed the maximum emission rate increases that are expected to occur as a result of the changes proposed in this application. The PSD significant increase levels are discussed and listed in Subsection 3.2.1. Table 3-5 lists emission increases by pollutant and compares the increases with the significant increase levels. This table shows that only VOCs and CO will increase by significant amounts. Therefore, these pollutants have been evaluated with respect to PSD permitting requirements.

TABLE 3-5
COMPARISON OF PROJECT-RELATED EMISSION INCREASES WITH PSD SIGNIFICANCE LEVELS
(TONS PER YEAR)

POLLUTANT	NEW KILN	BOILERS	PLANER SHAVINGS BIN	TOTALS	PSD SIGNIF. LEVELS	PSD SIGNIF?
PM*	2.66	10.74	1.48	14.88	25	No
PM_{10}	2.66	10.74	1.48	14.88	15	No
VOCs (as C)	92.15	27.5	—	119.65	40	**Yes**
NO_x	—	16.1	—	16.1	40	No
CO	—	293.6	—	293.6	100	**Yes**
SO_2	—	0.45	—	0.45	40	No
Lead	—	0.002	—	0.002	0.6	No

* Note that all PM has been conservatively assumed to be PM_{10}.

3.2.6 Fugitive Particulate Emissions

Fugitive particulate emissions related to an increase in kiln operations primarily include emissions from debarking of the logs prior to further processing in the mill, and potentially road dust from log and lumber trucks.

Most of the increase in logs brought to the mill will be of the "Small Sort Tree" (SST) variety discussed in Subsection 1.1. The SSTs are transported to the drum debarker by a log flume, which thoroughly wets each log, reducing the potential for fugitive emissions. An increase in hourly throughput is not expected, but a long-term throughput increase may result in increased fugitive emissions over the long term.

For the Camden Mill's March 1996 permit renewal application, emissions from the drum debarker were estimated on the basis of throughput, an emission factor of 0.024 lb PM/ton of wood, and an assumed control factor of 90% because of wet conditions (from the log flume). The particulate emissions were estimated to be 0.31 lb/hr and 0.97 ton/yr.

The potential increase in kiln production represented by the proposed new kiln project is up to 34,876 MBF/yr over the existing kilns' recent actual production). The amount of logs represented by this increase has been calculated using a mill-specific factor of 3.65 tons of logs per MBF produced. (Derivation of this factor is included in Appendix C).

$$34{,}876 \text{ MBF/yr} \times 3.65 \text{ tons/MBF} = 127{,}297 \text{ tons/yr}$$

From this annual increase in logs an annual emission increase has been calculated using the debarking emission factor of 0.024 lb PM/ton of wood.

$$\frac{127{,}297 \text{ tons/yr} \times 0.024 \text{ lb PM/ton} \times (1-0.9)}{2{,}000 \text{ lb PM/ton PM}} = 0.15 \text{ ton PM/yr}$$

Other processing steps such as sawing may produce very low amounts of particulate emissions. However any increase will not be appreciable, since the operations have a low emission potential and they are carried out within a 3-sided, roofed enclosure.

Traffic increases will consist of additional log, lumber, and planer shavings trucks. Estimates of these increases have been made using AP-42 estimating equations as documented in Appendix C. Traffic increases have been based on estimates of the new kiln's impact on mill traffic. Increases of 21.3 ton/yr in total particulate emissions and 4.2 ton/yr in PM_{10} emissions have been calculated.

3.3 REGULATORY APPLICABILITY

This subsection discusses the federal and State of Texas regulations potentially affecting the Camden mill kiln project.

3.3.1 Prevention of Significant Deterioration

Prevention of Significant Deterioration (PSD) regulations are established by Title 40 of the Code of Federal Regulations (40 CFR) §52.21. These regulations have been incorporated into TNRCC regulations at Title 30 of the Texas Administrative Code (30 TAC) §116.111, with certain specified exceptions. Applicability of the PSD program to a proposed new source or modification of an existing source is based on the magnitude of the emissions increases that will result from the new source or modification. Sources subject to the PSD program must address the following program components.

- Application of Best Available Control Technology (BACT).
- Determination of ambient air quality impacts.
- Analysis of additional impacts

Champion's Camden mill is an existing major stationary source of air emissions because it emits more than 250 tons of at least one regulated pollutant. Because it is an existing major source, any modification resulting in a significant increase in emissions of a regulated pollutant must receive

PSD preconstruction authorization. The amount of increase considered significant varies by pollutant, and is listed in Table 3-6.

TABLE 3-6
PSD SIGNIFICANT INCREASE LEVELS

POLLUTANT	SIGNIFICANT INCREASE LEVEL (tons per year)
Particulate Matter (total)	25
Particulate Matter (PM_{10})	15
Volatile Organic Compounds	40
Nitrogen Oxides	40
Sulfur Oxides	40
Carbon Monoxide	100
Lead	0.6

Subsection 3.2 of this document includes emissions estimates and an analysis of net emission rate changes over the contemporaneous period. This analysis indicates that the Camden mill kiln project is significant for VOCs and CO.

Once a project has been determined to be PSD-significant for one or more pollutants, BACT must be established for each pollutant subject to review. Subsection 3.4 of this document defines BACT and includes an analysis of BACT for the significant pollutants.

The emission levels resulting from the application of BACT are used with physical emission parameters, meteorological data, and other site-specific information to estimate the off-property impacts that will result from the project. Subsection 3.6 of this document describes the ambient air quality impacts analysis and the results of that analysis.

3.3.2 Other Federal Regulations

Other federal regulatory programs with potential applicability to the proposed new kiln include the following.

- New Source Performance Standards (NSPS) established in 40 CFR Part 60.
- National Emission Standards for Hazardous Air Pollutants (NESHAP) established in 40 CFR Part 61.
- National Emission Standards for Hazardous Air Pollutants for Source Categories (known as MACT standards for their requirement of Maximum Achievable Control Technology) established in 40 CFR Part 63.
- Federal operating permits program (Title V) established in 40 CFR Part 70.

- Compliance Assurance Monitoring (CAM) requirements established in 40 CFR Part 64.

EPA has not promulgated any NSPS, NESHAP, or MACT standards that apply to lumber drying kilns.

The Title V program has been incorporated into TNRCC regulations by 30 TAC Chapter 122. A full Title V permit application for the Camden mill will be due by 25 July 1998, and the permit will be issued by 25 July 2001. Requirements affecting the new kiln will be incorporated into the mill's Title V permit application after issuance of the kiln's new source review preconstruction permit.

The CAM program affects individual emission sources that use a control device to meet an emission limitation and that emit more than the major source threshold of the controlled pollutant. This program will not affect the proposed kiln because no control device has been proposed to control the VOCs or PM_{10} that will be emitted. In addition, the kiln project itself will not trigger the applicability of the CAM program for any other source affected by the project.

3.3.3 State of Texas Regulations

TNRCC has established preconstruction permitting requirements in 30 TAC Chapter 116. These requirements include state (minor source) new source review (NSR) as well as PSD program elements.

Under the NSR provisions, preconstruction review is required before any addition or change may be made to an air contaminant emitting facility or unit that may alter the nature or quantity of its emissions.

State regulations are addressed in more detail in Subsection 2.2.8, General Application Requirements.

3.4 BEST AVAILABLE CONTROL TECHNOLOGY

3.4.1 Introduction

The installation of the new lumber drying kiln at the Camden plywood mill will result in PSD significant net emission increases for VOC and CO, and non-significant increases of other pollutants. The emission increases will be due to emissions from the new kiln as well as increases from other mill sources which will experience production rate throughput increases due to the additional mill capacity provided by the new kiln. None of the existing emission sources which will experience increased throughput and increased emissions will be physically modified or undergo changes in the method of their operation. Therefore, only emissions from the new kiln must be reviewed for PSD BACT.

TNRCC rule §116.111 specifies that in order to be granted a new source review permit the applicant must demonstrate that a new facility will utilize best available control technology (BACT), with consideration given to the technical practicability and economic reasonableness of reducing or eliminating the emissions from the facility. TNRCC rule §116.160 incorporates most Federal PSD requirements, one exception being the Federal BACT requirements established by 40 CFR 52.21(j).

Although the federal BACT requirement is not incorporated into TNRCC's regulations, the federal definition of BACT can provide a perspective on how BACT may be determined. BACT is defined in the Federal PSD regulations at 40 CFR 52.21(b)(12) as:

> "An emissions limitation (including a visible emission standard) based on the maximum degree of reduction for each pollutant subject to regulation under the Act which would be emitted from any proposed major stationary source or major modification which the Administrator, on a case-by-case basis, taking into account energy, environmental and economic impacts and other costs, determines is achievable for such source or modification through application of production processes or available methods, systems, and techniques, including fuel cleaning or treatment or innovative fuel combustion techniques for control of such pollutant. In no event shall application of best available control technology result in emissions of any pollutant which would exceed the emissions allowed by any applicable standard under 40 CFR Parts 60 and 61. If the Administrator determines that technological or economic limitations on the application of measurement methodology to a particular emissions unit would make the imposition of an emissions standard infeasible, a design, equipment, work practice, operational standard, or combination thereof, may be prescribed instead to satisfy the requirement for the application of best available control technology. Such standard shall, to the degree possible, set forth the emissions reduction achievable by implementation of such design, equipment, work practice, or operation, and shall provide for compliance by means which achieve equivalent results".

In addition to this federal definition, TNRCC has issued a BACT Guidance Document which specifies that "a BACT review is accomplished using a three tiered approach. In each tier BACT is reviewed on a case-by-case basis for technical practicability and economic reasonableness." The Guidance Document goes on to further describe in more detail how the tiered approach BACT review is conducted:

> "In the first tier, controls accepted as BACT in a recent permit review for the same process/industry are approvable as BACT in a current review if no new technical developments have been made which would justify additional controls as economically or technically reasonable. The review of control technologies under the first tier is relatively straightforward in that technical practicability and economic reasonableness have already been demonstrated by use."

"The second tier takes into account controls which have been accepted as BACT in recent permits for similar streams in a different process/industry. The second tier is also fairly straightforward. It may require additional research to review cross technology, but an in-depth economic analysis is avoided since economic reasonableness has also already been demonstrated by use."

"The third tier of review is a detailed technical and economic analysis of all control options available for the process being reviewed. Technical practicability aspects include the demonstrated success of the control technology as determined by previous use, an assessment of the technical success of a new technology, and/or the availability and reliability of the proposed control system. Economic reasonableness is determined solely in the cost effectiveness of controlling emissions and does not take into account the effect of control cost on corporate economics. Economic reasonableness is evaluated on a $/ton basis considering both incremental and total tons controlled although the focus is primarily on the $/ton number."

Champion has followed the TNRCC guidance while at the same time satisfying the EPA's recommended approach for conducting a BACT demonstration for the control of VOC emissions from the proposed new kiln. In addition, BACT has been addressed for emissions of PM_{10} and air toxics from the proposed new kiln for state NSR purposes.

3.4.2 Kiln VOC BACT

Champion is not aware of any existing lumber drying kilns that have VOC emission controls. The most recently constructed new lumber drying kiln subject to the federal PSD rules with which Champion is familiar is a unit installed at the International Paper mill located in Riegelwood, North Carolina. This kiln has a capacity of 135,000 board feet per drying cycle. The kiln is similar in design to the kiln proposed for the Camden mill, and no add-on controls were required as BACT. North Carolina issued the PSD permit for this facility in mid-1997. In addition, based upon information from the lumber drying kiln manufacturer and other industry sources, no add-on VOC controls have ever been applied to lumber drying kilns, including new kilns constructed in Texas.

As a first step in the kiln VOC analysis, Champion conducted a thorough review of existing lumber kiln operations and concluded that no controls for VOC have been applied to kilns such as that proposed for the Camden mill.

This conclusion is based on the following:

- A review of the EPA RACT/BACT/LAER clearinghouse on the Technology Transfer Network (TTN) on EPA's electronic bulletin board.

- Discussion with TNRCC staff on similar projects in Texas and in EPA Region 6.

- Discussions with other lumber industry companies.

- Discussions with the lumber kiln manufacturer Wellons Inc., the likely kiln supplier for this project.

- Discussions with control technologies vendors.

- A review of NCASI publications and discussions with NCASI representatives responsible for lumber manufacturing operations.

- A review of recent PSD permit applications, including a recent evaluation in North Carolina for a similar lumber kiln in which the determination was made that BACT for VOC emissions consisted of no add-on controls.

All these data indicate that "no control" is considered BACT for VOC emissions from lumber kilns.

Although this review satisfies the TNRCC Tier 1 requirements in demonstrating that "no control" is BACT for the lumber drying kiln, Champion has conducted an analysis of control systems that could possibly be applied to lumber drying kilns (Tier 2 and Tier 3 analysis). This review evaluated the technical and economic feasibility of applying control systems that have been demonstrated in other industries but that have not been used on lumber kilns. The remainder of this section discusses the technical issues associated with the lumber drying process and potential VOC control technologies, and evaluates the technical and economic issues surrounding these technologies relative to the Camden mill kiln project. The results of this evaluation demonstrate that the emission control technologies used for similar source operations are not feasible for lumber drying kilns for technical and/or economic reasons.

3.4.2.1 Technical Background

Lumber is dried to a desired moisture content under controlled conditions in a drying kiln before being further processed. Heat is supplied to the drying kiln by steam circulated within steam coils. Air is circulated around the coils and throughout the kiln by fans located near the ceiling of the kiln. The fans move the air horizontally across the top of the kiln's interior, which sets up a circulation past the steam coils and through the stacked lumber. To ensure even drying throughout the stack, the fans periodically reverse direction, which reverses the air circulation within the kiln.

Fresh air is brought into the kiln, and moisture laden air is exhausted, through vents located on top of the kiln. When the fans are reversed, the function of the vents is also reversed, such that the vents that were exhaust vents now let in fresh air, and the vents that had been fresh are vents now exhaust wet air. These reversing cycles continue throughout the drying period, which typically lasts from 18 to 36 hours. In order to collect kiln gases for control, a complex system of dampers and ducts would be necessary to ensure that the air flow within the kiln is not restricted or altered.

As the wood in the kiln is heated, a large volume of water is released. The kiln exhaust air typically has a moisture content of more than 25%, which remains fairly constant over the duration of the drying cycle. In addition to the moisture, other wood constituents (primarily turpentine) are released as the wood is heated, resulting in VOC emissions.

Air flow through the kiln may entrain small amounts of dust from the stacked lumber. Additionally, heavier VOCs exiting the kiln may condense into small liquid or solid particles. As a result, minor amounts of PM_{10} may also be emitted in the kiln exhaust.

3.4.2.2 VOC Emission Control Technologies

As part of the Texas Tier 2 and Tier 3 BACT review, Champion evaluated available technologies for other types of VOC sources for potential applicability to the new kiln. The emission control technologies Champion has evaluated would all require that the exhaust gases from the kiln vents be collected in a common duct and vented to a control device. The following emission control technologies were evaluated for suitability for controlling the VOC emissions captured by such a system.

- Biofiltration.
- Combustion in an existing wood waste boiler.
- Combustion in a catalytic thermal oxidizer.
- Combustion in a regenerative thermal oxidizer.

The detailed review of these technologies, with the exception of biofiltration, constitute a Tier 3 TNRCC BACT review. The review of the biofiltration technology (Tier 2 review) indicates that this technology is not directly transferable to the Camden mill kiln. Each of the VOC control technologies identified above are discussed in the following subsections.

Biofiltration

Biofiltration systems involve natural biodegradation processes used to break down volatile constituents in waste gases. The gases are passed through a substrate bed which supports microorganisms. Contaminants within the gas stream are biodegraded into simpler compounds by the organisms as the gas passes through. The organisms receive energy and/or nutrients from this process.

Two companies that design biofiltration systems were contacted. Neither company has installed or designed a system for a lumber drying kiln or similar process. Because of this lack of experience a substantial amount of up-front work would be required before the biofiltration vendors could design a system and offer a reliable price quote. The information needed would include complete specification of the kiln emissions as well as temperature and air flow profiles over the course of a drying cycle. Even with this information it would be necessary to identify appropriate organisms that could degrade the waste constituents and not be adversely affected by any of the compounds present or by their changing concentrations.

Adequate degradation would require a relatively long contact time. The high exhaust flow rates from a lumber kiln (maximum of approximately 46,000 actual cubic feet per minute [acfm]) would require a large volume of substrate to ensure a low enough velocity and appropriate contact time. In addition, much of the volatile matter emitted from a kiln may condense at the temperature at which a biofiltration system would need to operate (approximately 95 - 100 °F) which could cause plugging of the substrate bed. Furthermore, the vendors indicated that pilot scale testing and operation of a system would be required to properly design and size a system suitable for the Camden kiln.

Because of the lack of experience with designing biofiltration systems for lumber kilns and the difficulties that would appear to be inherent in designing and operating such a system, Champion believes that this type of system has not been demonstrated and is not a feasible option as BACT for the proposed new Camden lumber drying kiln. Therefore, Champion has eliminated this technology from further consideration on the basis of technical infeasibility.

Combustion in an Existing Wood Waste Boiler

Combustion of VOCs in an existing boiler has the apparent benefit of avoiding the cost of purchasing and installing an add-on emission control device. Existing wood waste boilers have been used to burn emissions from plywood dryers and other sources but Champion is not aware of any wood waste boilers being used to control lumber kiln emissions. Although potentially feasible, there are drawbacks that would make it technically challenging and that would raise the cost to an unreasonable level. The challenges would include ducting the kiln vent gas stream a substantial distance (approximately 800 feet) to the existing boiler while maintaining a sufficiently high temperature to prevent condensation of moisture and organics. This would require steam heating the kiln effluent as it leaves the kiln and transporting it in heated or heavily-insulated ducting.

Additionally, the boiler's performance would be degraded because of the increased moisture input. This would result in higher fuel requirements to maintain a given level of steam production, and higher emissions of carbon monoxide. Currently Champion burns wood waste produced at the mill, but would need to supplement this "free" fuel with wood waste available on the market for approximately $15 per ton.

Cost estimates for the use of Champion's No. 3 wood waste boiler are presented in Tables 3-7 and 3-8. The estimates include a kiln manufacturer's estimate of the cost to develop and install ductwork on a new lumber kiln, and a wood waste boiler expert's estimate of the cost to modify the boiler to handle the new duty. The estimates of capital and operating costs were based on methodology recommended in the EPA's Control Cost Manual, including the use of 7% as the interest rate when calculating the capital recovery factor, as required by the most recent (5th) edition of the Manual. These estimates show a control effectiveness cost of $16,160 per ton of VOC controlled. This cost would be excessive and, therefore, combustion of the lumber kiln's exhaust in the wood waste boiler is economically infeasible and does not represent BACT.

Table 3-7
Capital Costs for Lumber Drying Kiln - Collection and Incineration System (Boiler)
Champion International - Camden, Texas

Cost Item	EPA Cost Factor			Cost, dollars	
Direct Costs					
Purchased Equipment Cost:					
Control Equipment (Boiler mods, Steam Engineering, Inc.)				$ 500,000	
Collection Hood and Ductwork to Boiler				$ 1,130,000	NOTE 1
Control device and auxillary equipment				$ 1,630,000	(A)
Instruments and controls	0.01 (A)			$16,300	
Taxes	0.03 (A)			$48,900	
Freight	0.05 (A)			$81,500	
Total purchased equipment cost :				$1,776,700	(B)
Direct Installation Cost:					
Foundations and supports	0.08 (B)			$142,140	
Erection and handling	0.14 (B)			$248,740	
Electrical	0.04 (B)			$71,070	
Piping	0.02 (B)			$35,530	
Insulation	0.01 (B)	x	10.0 (exceptionally long pipe run)	$177,670	
Painting	0.01 (B)			$17,770	
Total direct installation costs:				$692,920	
Architectural Modifications				$0	
Total direct costs:				$2,469,620	
Indirect Costs:					
Engineering and supervision (included in equipment cost estimates)	0.00 (B)	x	2.0 (custom, automated controls)	$0	
Construction and field expenses	0.05 (B)			$88,840	
Contractor fees	0.10 (B)			$177,670	
Startup	0.02 (B)			$35,530	
Performance test	0.01 (B)	x	4.0 (pre/post modification on boiler)	$71,070	
Contingencies	0.50 (A)	–	(first time application on lumber kiln)	$815,000	
Contingencies	0.03 (B)	x	5.0 (efficiency guarantee)	$266,510	
Total indirect costs:				$1,454,620	
Total installed capital costs :				$3,924,240	

NOTE 1: This cost includes the recommended stainless steel collection system and ductwork that would be necessary to avoid corrosion.

Table 3-8
Operating Costs for Lumber Drying Kiln - Collection and Incineration System (Boiler)
Champion International - Camden, Texas

Cost item	Computation method								Cost, dollars/year	
Direct operating costs										
Operating Labor										
Operator	15.00	, $/hr	x	2,190	h/yr	(2 hrs/shift each shift at kiln and at boiler			32,850	
Supervision	15%	of operator labor cost				because of complexity - never done before)			4,928	
Operating materials										
Caustic	1.63	, $/gal	x	0	gal/yr				0	
Chemicals	0	, $/ton	x	0	ton/yr				0	
Maintenance (general)										
Labor	18.00	, $/hr	x	2,190	h/yr	(1 hr/shift each shift at kiln and at boiler			39,420	
Materials	100%	of maintenance labor				because of complexity - never done before)			39,420	
Replacement parts										
Materials		As required (2.00% of capital costs)							78,485	
Labor		100% of replacement parts cost							78,485	
Utilities										
Electricity (including comp. air)	0.0370	, $/kWh	x	535,651	kWh/yr				19,819	
Fuel (wood)	15.000	, $/BDT	x	4,000	BDT/yr				60,000	NOTE 1
Gas	6.000	, $/M ft.^3	x	0	M cu.ft./yr				0	
Water	0.790	, $/M gal	x	0	M gal/yr				0	
Steam	7.120	, $/M lb	x	0	M lb/yr				0	
Ammonia	250	, $/ton	x	0.0	ton/yr				0	
Waste disposal	7.78	, $/cu. yd	x		cu. yd./yr				0	
Wastewater disposal	0.0027	, $/M gal	x	0	M gal/yr				0	
Total Direct Operating Costs (DC)		Subtotal of above								353,406 (DC)
Indirect operating (fixed) costs										
Overhead	60%	of operating and maintenance labor and materials.						$116,618	69,971	
Property Tax	1%	of total installed capital costs.						$3,924,240	39,242	
Insurance	1%	of total installed capital costs.						$3,924,240	39,242	
Administration	2%	of total installed capital costs.						$3,924,240	78,485	
Capital Recovery	CRF,	0.1424	x (total installed capital costs)					$3,924,240	558,723	
	(at	7%	interest and	10	years)					
Total Fixed Costs (IC)	Subtotal of above									785,664 (IC)
Total Annualized Costs	(DC+IC)									1,139,070
Tons Per Year of VOC Emitted:	92		2.84	lb/MBF	64,896	MBF/yr				

Cost Effectiveness at Emission Reduction, $/Ton Of VOC Reduced

76.5% = $16,160 at 85% capture and 90% control

NOTE 1: Fuel costs would be incurred by the increased fuel needed to offset reduced boiler efficiency, which would need to be purchased to supplement wood waste produced at the mill.

Combustion in a Catalytic Thermal Oxidizer

Catalytic thermal oxidizers use a catalyst bed in the gas stream to lower the temperature at which the contaminants will combust. This can result in substantial cost efficiencies because less auxiliary fuel may be required. However, catalyst beds are subject to plugging which would be a concern with the kiln exhaust stream under consideration. The catalytic system vendors contacted for this evaluation confirmed that a catalytic system would not be the best choice and suggested that a more appropriate device may be a regenerative thermal oxidizer.

Nonetheless, cost estimates were obtained for a catalytic unit and these costs are summarized in Tables 3-9 and 3-10. Again, the estimates of capital and operating costs were based on methodology recommended in the EPA's Control Cost Manual. These estimates show a control effectiveness cost of $17,380 per ton of VOC controlled. This cost would be excessive, such that combustion of the lumber kiln's exhaust in a catalytic thermal oxidizer is economically infeasible and does not represent BACT.

Combustion in a Regenerative Thermal Oxidizer

Regenerative thermal oxidizers use heat from the oxidation process to preheat incoming gases and, under suitable conditions, to raise the gas temperature to the auto-ignition temperature of the VOCs in the stream. This can result in cost-effective operation because auxiliary fuel may not be required after the system reaches operating temperature. However, the large volumes of air and water that would need to be accommodated by a system controlling lumber kiln exhaust would require a substantial input of auxiliary fuel to maintain combustion.

Cost estimates from a supplier of regenerative thermal oxidizers are presented in Tables 3-11 and 3-12, again using the EPA cost estimating template. These estimates show control cost efficiencies of $11,050 per ton of VOC controlled for these systems. These costs would be excessive. Therefore, combustion of the lumber kiln's exhaust in a regenerative thermal oxidizer is economically infeasible and does not represent BACT.

Proposed BACT for VOC

Champion believes that the technologies available for controlling VOC emissions from other source types are not applicable to a steam heated lumber drying kiln for the technological and economic reasons outlined in the previous subsections. Champion proposes that BACT for the control of VOC emissions from the new kiln is proper installation, operation, and maintenance of the kiln. This will minimize the steam requirements for the kiln and maximize the kiln efficiency, thereby reducing unnecessary emissions from ancillary equipment such as the wood-fired boilers which supply steam to the kiln.

Table 3-9
Capital Costs for Lumber Drying Kiln - Thermal Catalytic Oxidizer
Champion International - Camden, Texas

Cost Item	EPA Cost Factor			Cost, dollars
Direct Costs				
Purchased Equipment Cost:				
Control Equipment (Catalytic Products International)				$ 618,733
Collection Hood and Ductwork to CE				$ 150,000
Installation of new propane tank (Amerigas)				$ 22,000
Control device and auxiliary equipment				$ 790,733 (A)
Instruments and controls	0.01 (A)			$7,910
Taxes	0.03 (A)			$23,720
Freight	0.05 (A)			$39,540
Total purchased equipment cost :				$861,903 (B)
Direct Installation Cost:				
Foundations and supports	0.08 (B)			$68,950
Erection and handling	0.14 (B)			$120,670
Electrical	0.04 (B)			$34,480
Piping	0.02 (B)			$17,240
Insulation	0.01 (B)			$8,620
Painting	0.01 (B)			$8,620
Total direct installation costs:				$258,580
Architectural Modifications				$0
Total direct costs:				$1,120,483
Indirect Costs:				
Engineering and supervision	0.10 (B)	x	2.0 (custom, automated controls)	$172,380
Construction and field expenses	0.05 (B)			$43,100
Contractor fees	0.10 (B)			$86,190
Startup	0.02 (B)			$17,240
Performance test	0.01 (B)	x	4.0 (inlet/outlet, multiple scenarios)	$34,480
Contingencies	0.50 (A)	—	(first time application on lumber kiln)	$395,370
Contingencies	0.03 (B)	x	5.0 (efficiency guarantee)	$129,290
Total indirect costs:				$878,050
Total installed capital costs :				$1,998,533

Table 3-10
Operating Costs for Lumber Drying Kiln - Thermal Catalytic Oxidizer
Champion International - Camden, Texas

Cost item	Computation method							Cost, dollars/year	
Direct operating costs									
Operating Labor									
Operator	15.00	, $/hr	x	2,190	h/yr	(4x reference costs, complex system		32,850	
Supervision	15%	of operator labor cost				never done before)		4,928	
Operating materials									
Catalyst replacement	635.00	, $/cf	x	120	cf			76,200	
Chemicals	0	, $/ton	x	0	ton/yr			0	
Maintenance (general)									
Labor	18.00	, $/hr	x	2,190	h/yr	(4x reference costs, complex system		39,420	
Materials	100%	of maintenance labor				never done before)		39,420	
Replacement parts									
Materials		As required (2.00% of capital costs)						39,971	
Labor		100% of replacement parts cost						39,971	
Utilities									
Electricity (w/o comp. air)	0.0370	, $/kWh	x	1,401,600	kWh/yr			51,859	
Fuel (propane)	0.715	, $/gal	x	744,073	gal/yr			532,013	
Electricity (comp. air)	0.0370	, $/kWh	x	65,323	kWh/yr	(10 hp compressor)		2,417	
Water	0.790	, $/M gal	x	0	M gal/yr			0	
Steam	7.120	, $/M lb	x	0	M lb/yr			0	
Ammonia	250	, $/ton	x	0.0	ton/yr			0	
Waste disposal	7.78	, $/cu. yd.	x	0	cu. yd./yr			0	
Wastewater disposal	0.0027	, $/M gal	x	0	M gal/yr			0 ?	
Total Direct Operating Costs (DC)		Subtotal of above							859,047 (DC)
Indirect operating (fixed) costs									
Overhead	60%	of operating and maintenance labor and materials,					$116,618	69,971	
Property Tax	1%	of total installed capital costs,					$1,998,533	19,985	
Insurance	1%	of total installed capital costs,					$1,998,533	19,985	
Administration	2%	of total installed capital costs,					$1,998,533	39,971	
Capital Recovery	CRF,	0.1424 x (total installed capital costs)					$1,998,533	284,546	
	(at	7% interest and		10	years)				
Subtotal of above									434,458 (IC)
Total Annualized Costs	(DC+IC)								1,293,505

Tons Per Year of VOC Emitted: 92 2.84 lb/MBF 64,896 MBF/yr

Cost Effectiveness at Emission Reduction, $/Ton Of VOC Reduced

80.8% = $17,380 at 85% capture and 95% control

Table 3-11
Capital Costs for Lumber Drying Kiln - Regenerative Thermal Oxidizer
Champion International - Camden, Texas

Cost Item	EPA Cost Factor				Cost, dollars	
Direct Costs						
Purchased Equipment Cost:						
Control Equipment (REECO - RE-THERM RL Model R40-V3-95V RTO)					$ 715,000	
Collection Hood and Ductwork to CE					$ 150,000	
Installation of new propane tank (Amerigas)					$ 22,000	
Control device and auxillary equipment					$ 887,000	(A)
Instruments and controls	0.01 (A)				$8,870	
Taxes	0.03 (A)				$26,610	
Freight	0.02 (A)			(only covers hood and tank, included in CE costs)	$17,740	
Total purchased equipment cost :					$940,220	(B)
Direct Installation Cost:						
Foundations and supports	0.08 (B)				$75,220	
Erection and handling	0.14 (B)				$131,630	
Electrical	0.04 (B)				$37,610	
Piping	0.02 (B)				$18,800	
Insulation	0.01 (B)				$9,400	
Painting	0.01 (B)				$9,400	
Total direct installation costs:					$282,060	
Architectural Modifications					$0	
Total direct costs:					$1,222,280	
Indirect Costs:						
Engineering and supervision	0.10 (B)	x	2.0	(custom, automated controls)	$188,044	
Construction and field expenses	0.05 (B)				$47,010	
Contractor fees	0.10 (B)				$94,020	
Startup	0.02 (B)				$18,800	
Performance test	0.01 (B)	x	4.0	(inlet/outlet, multiple scenarios)	$37,610	
Contingencies	0.50 (A)	–		(first time application on lumber kiln)	$443,500	
Contingencies	0.03 (B)	x	5.0	(efficiency guarantee)	$141,030	
Total indirect costs:					$970,014	
Total installed capital costs :					$2,192,294	

Table 3-12
Operating Costs for Lumber Drying Kiln - Regenerative Thermal Oxidizer
Champion International - Camden, Texas

Cost item	Computation method							Cost, dollars/year	
Direct operating costs									
Operating Labor									
Operator	15.00	, $/hr	x	2,190	h/yr	(4x reference costs, complex system		32,850	
Supervision	15%	of operator labor cost				never done before)		4,928	
Operating materials									
Chemicals	0	, $/ton	x	0	ton/yr			0	
Maintenance (general)									
Labor	18.00	, $/hr	x	2,190	h/yr	(4x reference costs, complex system		39,420	
Materials	100%	of maintenance labor				never done before)		39,420	
Replacement parts									
Materials		As required (2.00% of capital costs)						43,846	
Labor		100% of replacement parts cost						43,846	
Utilities									
Electricity (w/o comp. air)	0.0370	, $/kWh	x	350,400	kWh/yr			12,965	
Fuel (propane)	0.715	, $/gal	x	186,018	gal/yr			133,003	
Electricity (comp. air)	0.0370	, $/kWh	x	65,323	kWh/yr	(10 hp compressor)		2,417	
Water	0.790	, $/M gal	x	0	M gal/yr			0	
Steam	7.120	, $/M lb	x	0	M lb/yr			0	
Ammonia	250	, $/ton	x	0.0	ton/yr			0	
Waste disposal	7.78	, $/cu. yd.	x	0	cu. yd./yr			0	
Wastewater disposal	0.0027	, $/M gal	x	0	M gal/yr			0	
Total Direct Operating Costs (DC)		Subtotal of above							352,694 (DC)
Indirect operating (fixed) costs									
Overhead	60%	of operating and maintenance labor and materials,					$116,618	69,971	
Property Tax	1%	of total installed capital costs,					$2,192,294	21,923	
Insurance	1%	of total installed capital costs,					$2,192,294	21,923	
Administration	2%	of total installed capital costs,					$2,192,294	43,846	
Capital Recovery	CRF,	0.1424 x (total installed capital costs)					$2,192,294	312,133	
	(at	7% interest and		10	years)				
Total Fixed Costs (IC)	Subtotal of above								469,796 (IC)
Total Annualized Costs	(DC+IC)								822,490

Tons Per Year of VOC Emitted: 92 2.84 lb/MBF 64,896 MBF/yr

Cost Effectiveness at Emission Reduction, $/Ton Of VOC Reduced

80.8% = $11,050 at 85% capture and 95% control

3.4.3 Kiln PM_{10} BACT

The proposed new lumber drying kiln may have minor amounts of PM_{10} present in the exhaust stream. The activities within a lumber drying kiln during the drying cycle do not include any mechanical operations that would result in the creation of particulate matter. However, PM_{10} may be present in the exhaust because of dust present on the surface of the lumber as it dries, or carried into the kiln as the lumber is loaded and unloaded. The air movement within the kiln is at a relatively low velocity. Therefore, only very fine particles would have the potential to be entrained and exhausted from the kiln. Alternatively, particulate matter may be formed as VOCs condense after cooling when released from the kiln. BACT for these emissions has been evaluated for Texas New Source Review only.

Champion is unaware of any PM_{10} controls applied to a lumber drying kiln. The exhaust volume from the new kiln will be relatively high, approximately 46,000 acfm maximum, with a high moisture content. Fabric filter type control devices would be the only type of device potentially applicable to such a source, although moisture levels and the corrosive nature of the exhaust gas could cause operating problems with such a system. The predicted uncontrolled PM_{10} outlet loading from the kiln is an average of 0.003 to 0.006 grains per dry standard cubic foot (gr/dscf). This level is consistent with typical levels guaranteed by fabric filter vendors at their system outlets. Therefore, applying such a control technology for PM_{10} emissions from a lumber dry kiln is not technically reasonable and does not represent BACT.

Champion proposes that BACT for PM_{10} emissions from the new kiln will be proper installation, operation, and maintenance. This will minimize steam requirements for the kiln and maximize the kiln efficiency, thereby reducing unnecessary emissions from ancillary equipment such as the wood-fired boilers which supply steam to the kiln.

3.4.4 Kiln Air Toxics BACT

The VOC emissions from the proposed lumber drying kiln will include potentially hazardous air pollutants. EPA has recently reviewed air toxics emissions associated with operations at lumber manufacturing facilities as part of their MACT study for this source category. While EPA is evaluating emissions from other emission units at lumber manufacturing facilities, they have not included lumber drying kilns in their planned studies. This is likely due to the nature and quantity of emissions associated with these units. That is, the concentrations and mass emission rates, coupled with the relatively low toxicity of the compounds emitted, do not warrant additional studies and/or controls on such sources.

The limited data available on emissions from lumber kilns suggest that the primary constituents emitted from these processes are the typical VOCs emitted from wood (e.g., turpentine, terpenes and pinenes). Based on the relatively low toxicity of these compounds, their low concentrations, and the apparent lack of a MACT standard for this source type, Champian proposes that BACT for air toxics emissions from the proposed new kiln will be proper installation, operation, and maintenance. This proposal is consistent with the proposed BACT for VOCs in general.

3.5 PROPOSED COMPLIANCE DEMONSTRATION METHODS

Champion currently has an annual production limit on the two existing kilns of 129,800,000 board feet per year. The proposed new kiln will be limited to 64,896,000 board feet of lumber per year. In addition, as noted in section 3.2, Champion has proposed a steam cap of 423,242,000 pounds of steam per year for the three kilns combined. It is proposed that compliance with all three of these limits be demonstrated as follows.

Champion proposes to demonstrate compliance with the production limit for the two existing kilns by adding the current month's production amount for the two kilns combined to the previous 11 months' production for the two kilns, and comparing this total with the permitted production limit for the existing kilns of 129,800,000 board feet. For the new kiln, the current month's production for the kiln will be added to the previous 11 months' production, and the sum will be compared with the proposed production limit for the new kiln of 64,896,000 board feet.

Champion proposes to demonstrate compliance with the steam cap on the three kilns by tracking lumber production and relating this production to steam usage. As noted in section 3.2, the new kiln is projected to use 2.5 pounds of steam per board foot of production, and the existing kilns have been determined to use 3 pounds of steam per board foot of production. Therefore, by tracking lumber production in the kilns it will be possible to determine the total steam used by the combined three kilns using the appropriate steam factor as listed above. Total steam usage will be calculated on a monthly basis using the actual production through each kiln and the applicable steam factor. The total monthly steam usage for each current month will be added to the usage for the previous 11 months, and the sum will be compared with the annual limit of 423,242,000 pounds of steam. This will allow Champion to use any of the kilns to produce dried lumber while maintaining compliance with the applicable steam cap.

The proposed compliance methodology will allow Champion to track lumber production as a surrogate for emissions. This methodology will allow the mill and TNRCC to determine the compliance status of the mill at any time by referring to appropriate records on lumber production.

3.6 AIR QUALITY MODELING ANALYSIS

3.6.1 Introduction

This section of the application addresses the air quality modeling requirements associated with the Camden mill project. As noted in section 3.2.1, the only pollutants that will be emitted in quantities greater than the PSD significant emissions increase levels are CO and VOC. In addition, the new kiln will emit pollutants that must be evaluated under the state's effects evaluation analysis for non-criteria pollutants. Based on the limited amount of speciation data available for lumber drying kiln emissions, three pollutants that have been identified as potentially being emitted from the new kiln are turpentine, terpenes, and pinenes. These compounds are included on the Effects Screening Level (ESL) list. The non-criteria pollutant evaluation included the air quality impacts associated with emissions of these pollutants.

While an annual increase in CO emissions is projected due to the proposed project, the short-term emissions of CO due to boiler operations are not projected to increase over historic short-term emissions. This is due to the fact that the boilers have routinely operated at their maximum potential steaming rates to meet short-term steam demands at the mill. For example, during startup of operations such as the existing kilns, or during periods when production through the kilns coupled with steam demands from the plywood facility are maximized, all three boilers have been operated for short periods (1 to 16 hours) at their maximum potential steaming rates. Hence, there will be no increase in short-term emissions due to the proposed project. Data supporting this assertion is presented in Appendix D. Since CO is only regulated on a short-term basis (1-hour and 8-hour ambient air quality standards), CO impacts on air quality in the area will not change as a result of the proposed project. Therefore, modeling for CO was not conducted.

In order to evaluate VOC emission increases resulting from the proposed project, a screening technique known as the Scheffe technique was used to calculate the impact that VOC emissions would have on ozone formation in the area. Appendix E includes a summary of the results of this analysis, which was conduced by the TNRCC based on information provided by Champion on emissions of VOC and NO_x.

The air quality dispersion models used in the effects evaluation analysis of the Camden mill project were U.S. EPA-approved models. The air quality modeling analysis included screening and refined air dispersion models. The procedures used in conducting the modeling analysis followed the requirements outlined in U.S. EPA's Guideline on Air Quality Models, 40 CFR Part 51, Appendix W; and in TNRCC's Air Quality Modeling Guidelines.

The potential for off-site cavity zone impacts associated with emissions of pinenes, terpenes, and turpentine resulting from the proposed kiln were evaluated using the EPA SCREEN3 model. Short-term and annual air quality impacts resulting from emissions of pinenes, terpenes, and turpentine from the proposed kiln were calculated using the ISCST3 model. The remainder of this section of the permit application addresses the models, modeling parameters, meteorological data, and receptor grid, presents a GEP stack height analysis, and reports the results of the analysis.

3.6.2 Screening Model Selection

The U.S. EPA SCREEN3 (version 96043) air dispersion model was used to determine the off-site cavity zone impacts. SCREEN3 is a computerized version of the modeling techniques described in the SCREEN3 Model User's Guide. The SCREEN3 regulatory mixing height option and an anemometer height of 10 meters were used.

The SCREEN3 air dispersion model contains cavity zone concentration algorithms to provide predictions of the impacts in the cavity recirculation zones of buildings. The cavity zone concentrations was determined using the Schulman-Scire cavity zone algorithms. The results from the Building Profile Input Program were used to determine which structures influence a source. The SCREEN3 model was used to predict the maximum cavity concentration for each of the four downwind recirculation cavities that would be formed by winds perpendicular to each building face. The model calculates the maximum cavity concentrations for wind speeds measured at a height of 10 meters at speeds up to 20 m/s. In addition, the model reports the predicted concentrations for each of the 20 wind speeds from 1 m/s to 20 m/s. Annual cavity zone concentrations were not calculated since cavity zone impacts are short-term phenomena and are not representative of long-term conditions.

The cavity zone for each structure or building at the facility was determined and compared with the location of the proposed new kiln. For cavity zones that could potentially affect the new kiln vents, the downwind length of the cavity zone was compared with the downwind distance to the fence line. Only the Planer Building with a 63 meter cavity zone both affects the new kiln and extends beyond the fence line. Furthermore, the portion of the cavity zone extending beyond the fence line is associated with the northern end of the Planer Building. The new kiln will be located at the southern end of the Planer Building. The minimum distance to the fence line at the southern end of the Planer Building is greater than 80 meters. Therefore, no cavity concentrations are projected to occur off-site.

3.6.3 Refined Model Selection

The U.S. EPA Industrial Source Complex Short-Term 3 (ISCST3, version 96113) model was used to perform the refined modeling analysis used to evaluate impacts associated with pinenes, terpenes and turpentine emitted by the proposed new kiln. The ISCST3 model can predict short-term and long-term (annual) concentrations from multiple emission points in rural or urban areas. The ISCST3 air dispersion model can also account for the effects of aerodynamic downwash of a stack's plume by nearby structures. The ISCST3 air dispersion model accepts hourly meteorological data to define the conditions for plume rise, transport, and dispersion. The model estimates the concentration for each source and receptor combination for each hour.

The ISCST3 air dispersion model has various options to simulate a variety of dispersion conditions for emissions from a stack or non-stack source. The U.S. EPA has recommended various default options to be used in dispersion modeling for regulatory purposes. The recommended regulatory default options were used in the air quality impact analysis as follows:

- Stack-tip downwash.
- Final plume rise.
- Buoyancy-induced dispersion (BID).
- Vertical potential temperature gradients of 0.0, 0.0, 0.0, 0.0, 0.02, and 0.035 for stability classes A through F, respectively.
- Automatic treatment of calms.
- Wind profile exponents of 0.07, 0.07, 0.010, 0.15, 0.35, and 0.55 for stability classes A through F, respectively.

- Infinite pollutant half-life.

- Upper bound value for "supersquat" buildings.

- Missing data processing not used.

3.6.4 Land Use and Topography

The land use classification for the area was based on a simplified review of land use patterns surrounding the Camden mill. For the qualitative review, the 7.5 minute United States Geological Survey (USGS) topographic maps were used. The USGS topographic maps are provisional maps dated 1984. Despite the date of the maps, the maps are still representative of the land use surrounding the mill. The land use analysis followed the procedures recommended by the TNRCC in Section 5.1.1 of the air quality modeling document. To evaluate the land use using USGS topographic maps an area is defined as rural if more than 70 percent of the surface within 3 kilometers of the source falls under a rural land use type. The TNRCC simplified land use analysis indicated that the area surrounding the mill is rural. Therefore, rural dispersion coefficients were used to assess the air quality impacts from the stacks.

3.6.5 Receptor Grid Selection

Receptor grids used in the refined air quality analysis were prepared for the ISCST3 model that conform with TNRCC recommendations. The receptor grids incorporated terrain elevations that were determined from USGS 7.5 topographic maps.

A Cartesian receptor grid was used as the main receptor grid, with additional receptors placed around the mill fence line. The Cartesian receptor grid was centered on a location near the central portion of the Champion facility. The Universal Transverse Mercator (UTM) coordinates of the grid center are 334,000 Easting 3,421,000 Northing. The following receptor spacing was used:

- 25 meters out to ± 0.5 kilometers;
- 100 meters out to ± 1 kilometer
- 200 meters out to ± 3 kilometers;
- 500 meters out to ± 10 kilometers.

Cartesian receptors that are inside the Champion fence line were excluded from the receptor grid. The fence line was represented by discrete receptors at 25 meter intervals. Terrain elevations were included in the modeling analysis. Terrain heights for all receptors were obtained from USGS 7.5 minute topographical maps. The maximum elevation falling within a rectangular area extending from each modeled receptor point to halfway to an adjoining receptor was assigned to the modeled receptor.

3.6.6 Meteorological Data

The meteorological database for the ISCST3 air dispersion model consisted of five years (1987-1991) of National Weather Services (NWS) surface data collected at Shreveport, Louisiana. Coincident mixing heights was derived by merging surface temperatures with concurrent twice-daily rawinsonde data obtained from Lake Charles, Louisiana. The processed meteorological data was obtained directly from the TNRCC. Shreveport is located approximately 122 miles northeast of the Champion facility. Due to the absence of significant terrain features between Camden and Shreveport, the NWS data can be considered representative of the Camden area.

3.6.7 Good Engineering Practice Stack Height Analysis

Following EPA guidance, a Good Engineering Practice (GEP) stack height analysis was performed to evaluate the potential for building downwash. The following procedure was used to analyze the kiln vents for downwash effects. The vents and influencing buildings were located on a plant map. The vent height and relevant building dimensions were evaluated using the U.S. EPA Building Profile Input Program (BPIP, Date 95086). BPIP determines, in each of the 36 wind directions (10° sectors), which building may cause downwash for a particular emission point. The building-specific dimensions produced by BPIP were included in the air quality modeling analysis. The direction-specific dimensions were also used for the cavity zone analysis.

3.6.8 Emissions Inventory for Modeling

As noted in subsection 3.6.1, NO_x and VOC emission estimates were provided to TNRCC for an ozone formation screening analysis. It is important to note that the data provided to TNRCC were based on initial estimates of the expected emissions of NO_x and VOC from the project. The refined analysis of project related emissions resulted in lower projected increases for these pollutants than those initially projected and reported to TNRCC. Therefore, it is anticipated that ozone impacts will be less than those projected by the initial screening analysis. Table 3-13 provides a comparison between the NO_x and VOC emissions used in the initial analysis and the refined projections contained in this application.

TABLE 3-13
COMPARISON OF
INITIAL NO_x AND VOC EMISSIONS USED IN AREA OZONE MODELING
WITH REVISED PROJECTED EMISSIONS

POLLUTANT	INITIAL PROJECTIONS[1]		CURRENT PROJECTION[2]	
	DAILY MAX.	ANNUAL	DAILY	ANNUAL
VOC	1,070 lbs	200 tons	842 lbs	119.7 tons
NO_x	---	50 tons	---	16.1 tons

[1] Initial projections used in the TNRCC screening modeling analysis.
[2] Based on estimates included in this permit application.

The VOC emissions from the proposed kiln can be speciated as turpentine, terpenes, and pinenes, compounds for which ESLs have been established. Turpentine is the general term used to describe the volatile oil contained in coniferous trees such as the southern yellow pine used at the Camden mill. Based on data for similar tree species, the composition of turpentine can be characterized as consisting of terpenes, most of which are alpha and beta pinenes.

The emission rates used in the health effects modeling for the kiln project are based on the following assumptions:

- All of the VOC emissions from the kiln will be turpentine.
- All of the turpentine will consist of various terpenes.
- 85% of the terpenes will be pinenes.

Research (Ingram, et al) indicates that approximately 85% of the turpentine will be alpha and beta pinenes. Additional research (Drew and Pylant) provides support for the VOC emission rates established in section 3.2. This research reports a turpentine content of approximately 6.3 lb/MBF for Loblolly pine, which makes up virtually all of Camden's log furnish. Of this turpentine content, the research indicates that approximately 40%, or 2.5 lb/MBF, is emitted to the atmosphere during the drying process. This is consistent with the use of 2.84 lb/MBF as a long-term emission factor in this application. The assumption that all VOCs are turpentine is conservative, and equivalent to assuming that 45% of the wood's turpentine content is released to the atmosphere during the drying process. References cited above are listed at the end of this section.

The turpentine, terpene, and pinene emission rates used in the health effects analysis are shown in Table 3-14. It has been conservatively assumed that all VOCs are turpentine, as discussed above. The emission rates are based on the VOC emission rates developed for the new kiln and discussed in Section 3.2. The short-term (1-hour) emission rates used in the analysis are based on the projected 1-hour emission rate for VOC emissions from the kiln (28.8 pounds per hour). The long-term (annual) emission rates used in the analysis are based on the annual VOC emission rate (92.15 tons per year or an average of 21.0 pounds per hour).

3.6.9 <u>Ozone Modeling Results</u>

The results of the ozone modeling study conducted by TNRCC based on data provided by Champion indicate that the predicted incremental impact due to the proposed project, when added to a conservative background ozone concentration, should not adversely affect ambient ozone concentrations in Polk County. The results of the analysis also suggest that data from Jasper County can be used to characterize background ozone concentrations. Therefore, pre-construction monitoring should not be required. A copy of the TNRCC analysis for this evaluation is included in Appendix E.

3.6.10 <u>Health Effects Modeling Results</u>

The health effects modeling results for the proposed project are included in Table 3-15. The results of the analysis of emissions of turpentine, terpenes, and pinenes from the new kiln are

TABLE 3-14
PHYSICAL VENT CHARACTERISTICS AND POLLUTANT EMISSION RATES FOR THE PROPOSED KILN
CHAMPION INTERNATIONAL CORPORATION
CAMDEN, TEXAS

Source	Vent Location UTM (m)	Base Elevation (m)	Vent Height (m)	Equivalent Vent Diameter* (m)	Vent Exit Velocity (m/sec)	Vent Temperature (°k)	Pollutant Emission Rate (g/sec)					
							Turpentine		Terpenes		Pinenes	
							1-hour	Annual	1-hour	Annual	1-hour	Annual
New Kiln (5 vents)	333896, 3421444	91.44	6.32	0.80	4.87	366.5	0.726	0.529	0.726	0.529	0.617	0.450
	333894, 3421438	91.44	6.32	0.80	4.87	366.5	0.726	0.529	0.726	0.529	0.617	0.450
	333893, 3421431	91.44	6.32	0.80	4.87	366.5	0.726	0.529	0.726	0.529	0.617	0.450
	333891, 3421425	91.44	6.32	0.80	4.87	366.5	0.726	0.529	0.726	0.529	0.617	0.450
	333889, 3421418	91.44	6.32	0.80	4.87	366.5	0.726	0.529	0.726	0.529	0.617	0.450

NA = Not applicable
* Equivalent diameter based on a 28" square opening

TABLE 3-15
COMPARISON OF KILN IMPACTS WITH ESL VALUES
CHAMPION INTERNATIONAL CORPORATION
CAMDEN, TEXAS

POLLUTANT	SHORT-TERM IMPACT[a], $\mu g/m^3$			ANNUAL IMPACT, $\mu g/m^3$		
	PEAK	NEAREST RESIDENCE	ESL	PEAK	NEAREST RESIDENCE	ESL
Turpentine	4,886	732	5,560	164	4.2	556
Terpenes	4,886	732	2,000	164	4.2	200
Pinenes[c]	4,153	622	64	[b]	[b]	[b]

[a] Based on peak 1-hour concentration
[b] No annual value for pinene—short-term value is more restrictive than long-term value
[c] Pinene values are odor based

compared with the applicable ESL values in the table. These values include the peak predicted off-property impact as well as impacts predicted for the nearest residence. For annual impacts, the peak off-property concentrations of turpentine and terpenes are below the annual ESLs. There is no annual ESL established for pinenes because the hourly value (based on odor) is more restrictive than the annual would be. The highest annual turpentine and terpene concentrations at the nearest residence are less than 1% and 2.1% of the ESLs for turpentine and terpenes, respectively.

For hourly impacts, the peak predicted off-property concentration of turpentine is below the ESL and the highest turpentine concentration predicted at the nearest residence is less than 15 per cent of the ESL. The peak predicted off-property concentration of terpene is greater than the ESL by a factor of 2.4, but at the nearest residence, where the potential for exposure is highest, the highest concentration is less than 40% of the relevant ESL.

The pinene impacts exceed the short-term ESL at the nearest residence as well as at the peak off-property location. However, the pinene ESL is based on the odor threshold for these compounds and is not related to health risk concerns. The mill has not experienced odor complaints due to the operation of their current kilns, which have similar emissions, so it is not anticipated that the new kiln will result in odor complaints or nuisance odors. In addition, the nuisance provision in the General Rules (30 TAC Chapter 101) provides a mechanism to address odor complaints should they arise due to emissions from the kiln.

3.7 IMPACT ON GROWTH, VISIBILITY, SOILS, AND VEGETATION

PSD regulations require that an analysis be conducted to determine whether any impairment to visibility or other adverse impacts on soils and vegetation in the vicinity of the source would occur. Specifically, five areas have been examined: associated growth, visibility, acidification of rainfall, soils, and vegetation. The proposed mill modifications should not cause adverse impacts in any of these areas; however, it is important to recognize their potential existence.

3.7.1 Associated Growth

It is not anticipated that the mill modifications will require any additional staff. Thus, there will be no perceptible negative growth impacts resulting from the project.

3.7.2 Visibility

Pollutants responsible for visibility reduction are classified into three major groups:

- Hygroscopic particles.
- Opaque agglomerates (e.g., carbon, metal particles).
- Transparent crystals (e.g., silicon, calcium).

The mill modifications are estimated to result in a less than significant increase in PM_{10} emissions and an increase of less than 1 ton per year of sulfur dioxide. Hence, it is not anticipated that any perceptible reduction in visibility will occur due to the emission of primary or secondary aerosols by the proposed mill modification.

Nitrogen dioxide absorbs light energy over the entire visible spectrum, although primarily in the shorter, blue wave length regions. Thus, nitrogen dioxide can by itself reduce visibility. In addition, visibility reducing aerosols are formed by photochemical processes involving oxides of nitrogen and hydrocarbons. However, no significant increase in NO_x emissions is projected for the proposed project. Hence, visibility impairment should not occur.

3.7.3 Acidification of Rainfall

Sulfuric acid may be formed in the natural atmospheric removal process associated with sulfur dioxide. Acidity levels of precipitation can be increased with this addition of hydrogen ions and potentially may have an adverse impact on biotic communities.

As previously indicated, the emission rate of SO_2 from the proposed project is estimated to be less than 1 ton per year. At this relatively low emission rate, no measurable increase in rainfall acidification is anticipated due to the proposed project.

3.7.4 Soils

Operation of the facility must be addressed to determine the impacts of its emissions on soils in the vicinity by mechanisms including the following.

- Dry deposition of emitted particulate matter.
- Washout deposition of particulate and water soluble gases.
- Dry reaction of gaseous compounds with the soil via metabolic incorporation into plant root systems
- Deposition of combustion particulate matter.

It is extremely difficult to quantify any of the potential impacts delineated above. However, at the low estimated emission rates for the proposed mill modifications, adverse impacts are unlikely.

Atmospheric washout will remove some particulate matter, SO_2, and NO_2. The amounts removed and initially deposited on the soil will be quite small in comparison with deposition due to emissions or sources in urban areas. It is doubtful that the pH of the rainfall in the region will be measurably lowered. Some field experiments at other locations using simulated rainfall with a pH as low as 4 have shown only small effects on soil chemical properties. These same studies have shown that forested areas absorbed much of the deposited nitrogen and benefited therefrom.

3.7.5 Vegetation

The emission of common atmospheric pollutants such as SO_2 and NO_2 has the potential to cause damage to vegetation. The proposed mill modification must be addressed to determine if it has a potential impact on vegetation.

The sensitivity of vegetation to air pollution injury varies greatly with such factors as plant species and variety, climatic and seasonal conditions, soil composition, and the nature or combinations of pollutants. In general, plants tend to be more susceptible to damage during spring and summer growing seasons and when exposed to short-term high concentrations as opposed to continuous lower levels of pollution.

A summary of research on air pollution effects on vegetation divides air pollution injuries to plants into three general categories: acute, chronic, and subtle. Acute injury is caused by exposure to a high concentration of a deleterious substance resulting in rapid visible death of some tissue. Chronic injury is caused by long-term exposure to low pollutant levels which gradually disrupts physiological processes and retards growth or yield.

Long-term subtle effects on vegetation are difficult to define and little is known to date as to the threshold concentrations and exposure times which may cause damage. The following paragraphs will, therefore, focus on acute injuries for which exposures and effects are known.

SO_2 will be emitted at extremely low levels, resulting in concentrations which will be below detection level in the atmosphere. Hence, increased emissions of SO_2 from the facility are not expected to have an adverse impact on vegetation.

Potential NO_2 damage to vegetation in the area is also unlikely. In general, acute NO_2 damage to vegetation is not likely to occur at levels found outdoors although some reduction in growth might occur at continuous levels of 200 - 500 $\mu g/m^3$. Sensitive species may be damaged by 4-hour concentrations of 3,800 - 13,3000 $\mu g/m^3$. Soybeans are considered to have intermediate sensitivity (4-hour injury threshold of 9,400 - 18,800 $\mu g/m^3$), while corn is rated as resistant (4-hour injury threshold of 16,900 $\mu g/m^3$). In view of the minor increase in NO_2 emissions anticipated as a result of operation of the proposed new kiln, no adverse effects on vegetation are expected to occur.

3.8 REFERENCES

NCASI Technical Bulletin #718, July 1996.

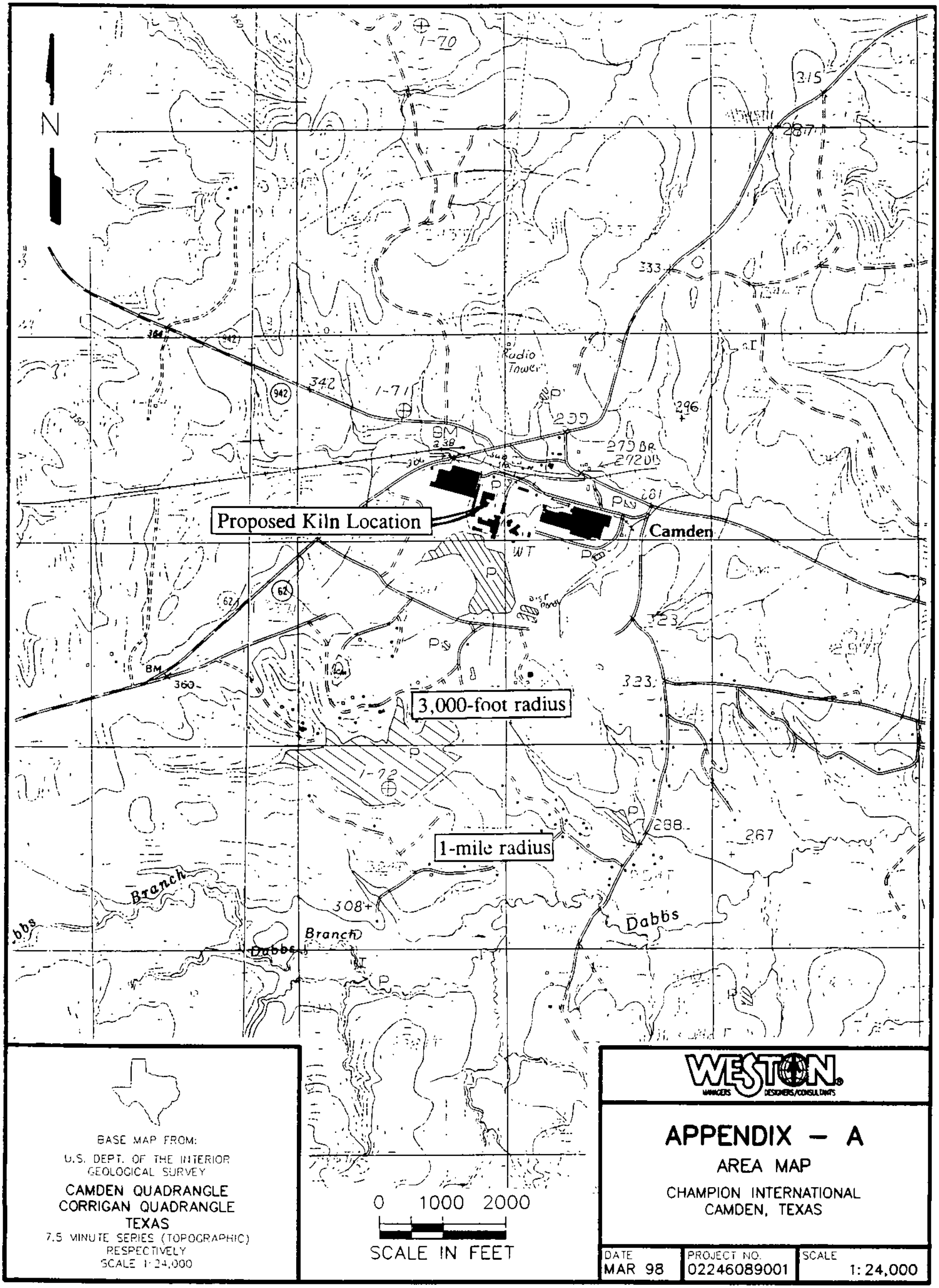
Ingram, Taylor, Punsavon, and Templeton, "Identification of volatile organic compounds emitted during the drying of southern pine in pilot and laboratory experiments," Internal Report, Forest Products Laboratory, Mississippi State University, 1994.

Drew and Pylant, "Turpentine from the Pulpwoods of the United States and Canada," Volume 49, No. 10, October 1966, pg. 430-438.

APPENDICES

APPENDIX A

FACILITY LOCATION (AREA) MAP



APPENDIX – A

AREA MAP

CHAMPION INTERNATIONAL
CAMDEN, TEXAS

H:\DWG\CHAMPIONS-INTL\APPENDIX-A.PB.GG 1=1 03-17-98 (NEWWEST.PCP)

APPENDIX B

FACILITY PLOT PLAN

APPENDIX C

DOCUMENTATION OF EMISSION CALCULATIONS

CHAMPION INTERNATIONAL
CAMDEN MILL
CALCULATION OF BOILER EMISSION INCREASES

Data:			Boiler 1	Boiler 2	Boiler 3
Btu requirement	107,600	MMBtu/yr	9,684	9,684	88,232
Fuel requirement	6,114	BD tons fuel			
	11,956	wet tons fuel	1,076	1,076	9,804

Pollutant	Emission Factor	Units	Annual Emissions
Boiler 1	**9**	**percent of steam supply**	
PM	0.2	lb/MMBtu	0.97
PM10	0.2	lb/MMBtu	0.97
VOCs (as carbon)	0.1	lb/MMBtu	0.48
NOx	0.2	lb/MMBtu	0.97
CO	0.7	lb/MMBtu	3.39
SO2	0.075	lb/wet ton fuel	0.04
Lead	3.50E-04	lb/wet ton fuel	1.9E-04
Boiler 2	**9**	**percent of steam supply**	
PM	0.2	lb/MMBtu	0.97
PM10	0.2	lb/MMBtu	0.97
VOCs (as carbon)	0.1	lb/MMBtu	0.48
NOx	0.2	lb/MMBtu	0.97
CO	0.7	lb/MMBtu	3.39
SO2	0.075	lb/wet ton fuel	0.04
Lead	3.50E-04	lb/wet ton fuel	1.9E-04
Boiler 3	**82**	**percent of steam supply**	
PM	0.2	lb/MMBtu	8.8
PM10	0.2	lb/MMBtu	8.8
VOCs (as carbon)	0.6	lb/MMBtu	26.5
NOx	0.323	lb/MMBtu	14.2
CO	6.5	lb/MMBtu	286.8
SO2	0.075	lb/wet ton fuel	0.37
Lead	3.50E-04	lb/wet ton fuel	1.7E-03
Summary			
PM			10.76
PM10			10.76
VOCs (as carbon)			27.4
NOx			16.2
CO			293.5
SO2			0.4
Lead			2.1E-03

CHAMPION INTERNATIONAL
CAMDEN MILL
PAVED ROADS EMISSIONS INCREASE ESTIMATE

	Particle Size Multiplier	Road Surface Silt Loading (sL) (g/m²)	Mean Vehicle Weight [a] (W) (ton)	Trips / Year	Trips / Hour [b]	Miles / Trip	Total Vehicle Miles/Year (VMT/yr)	Emission Factor [c] (E) (Lb/VMT)	Uncontrolled Emission Rate (lb/hr)	Uncontrolled Annual Emissions (ton/yr)	Control Efficiency (%)	Controlled Annual Emissions (ton/yr)
AP-42 Section 13.2.4 Paved Roads (01/95) (TSP <30um)												
Short Log Truck Increase (10,000 Trucks)	0.082	8.2	27.10	10,000	2.67	0.68	6,818	5.57	10.14	18.99		18.99
Lumber Truck Increase (750 Trucks)	0.082	8.2	26.38	750	0.20	0.91	682	5.35	0.97	1.82		1.82
Shavings Truck Increase (240 Trucks)	0.082	8.2	24.43	240	0.06	0.87	209	4.77	0.27	0.50		0.50
												21.31
AP-42 Section 13.2.4 Paved Roads (01/95) (PM10 <10um)												
Short Log Truck Increase (10,000 Trucks)	0.016	8.2	27.10	10,000	2.67	0.68	6,818	1.09	1.98	3.71		3.71
Lumber Truck Increase (750 Trucks)	0.016	8.2	26.38	750	0.20	0.91	682	1.04	0.19	0.36		0.36
Shavings Truck Increase (240 Trucks)	0.016	8.2	24.43	240	0.06	0.87	209	0.93	0.05	0.10		0.10
											TOTALS	4.16

General paved road fugitive emissions calculation is: $E = k\,(sL/2)^{0.65}\,(W/3)^{1.5}$.

Derivation of Log Weight/Lumber Production Factor

100 ft^3 logs results in production of 70 ft^3 of lumber (70/100 = 0.7 ft^3 lumber/ft^3 logs)
An average 100 cubic feet of logs as received weighs 6,133 pounds (61.33 lb/ft^3)
There are 12 BF of lumber per ft^3 of lumber (board foot = 1 ft x 1 ft x 1 inch)

0.7 ft^3 lumber/ft^3 logs x 12 BF/ft^3 lumber = 8.4 BF/ft^3logs

$$\frac{61.33 \text{ lb/ft}^3 \text{ logs} \times 1{,}000 \text{ BF/MBF}}{8.4 \text{ BF/ft}^3 \text{ logs} \times 2{,}000 \text{ lb logs/ton logs}} = 3.65 \text{ tons logs/MBF}$$

APPENDIX D

BOILER OPERATING DATA

CHAMPION INTERNATIONAL
CAMDEN MILL
ESTIMATION OF KILN STEAM DEMAND (EXISTING KILNS)

DATE	#1 DRY TIME[1]	#2 DRY TIME[1]	AVG. DRY TIME	BF DRIED[2]	AVG. PPH STEAM USAGE[3]	AVG. lb/BF[4],[5]
2/16/97	23.67	22.67	23.17	313200	36000	2.66
2/17/97	22.17	29.00	25.59	300000	36500	3.11
2/19/97	16.00	18.92	17.46	300000	34700	2.02
3/1/97	20.08	24.42	22.25	313200	34425	2.45
3/3/97	23.00	21.67	22.34	300000	37300	2.78
4/2/98	21.83	28.17	25.00	300000	34850	2.90
5/1/97	23.58	19.00	21.29	300000	33070	2.35
5/5/97	20.50	23.25	21.88	313200	34655	2.42
5/6/97	24.17	24.67	24.42	313200	33160	2.59
9/27/97	22.00	25.50	23.75	313200	29790	2.26
10/10/97	23.67	20.83	22.25	300000	33030	2.45
11/3/97	22.17	19.83	21.00	300000	40190	2.81
11/6/97	24.92	20.75	22.84	300000	40215	3.06
11/7/97	21.75	25.75	23.75	313200	41070	3.11
11/10/97	20.75	21.33	21.04	300000	39875	2.80

AVERAGE	2.65 [5]

[1] #1 and #2 kiln drying times from kiln log sheets.

[2] BF dried from kiln log sheets - 2x4's = 150,000 BF/charge, 4x4's = 163,200 BF/charge

[3] Steam usage from boiler log sheets.

[4] Avg. lb/BF = Avg. Dry Time x Avg. PPH steam usage/BF dried.

[5] Does not include steam supplied to kilns through boiler ID fan turbine. This additional steam is assumed to increase total steam supply to the existing kilns to 3.0 lbMBF.

1.9 Upgrade efficiency of small boilers to include flue gas oxygen trim to reduce the still very high levels of excess air.

1.10 Install air heaters and or feedwater economizers on boilers 1 and 2 to increase the efficiency.

1.11 Improve fuel sizing and mix of fuel to boilers; blend dry fuel and wet fuel to improve average fuel moisture content.

I have notes and flue gas data that indicate the efficiency of the boiler operations in April 1993, December 1994, July 1995, July 1996, and July 1997. Some of the data is incomplete, because we were emphasizing the testing of boiler #3, the boiler that was being improved.

Date	April 93	Dec. 94	July 95	July 96	July 97
Steam flow lbs/hr Boiler #1	10,000	10,000	12,000	18,000	15,000
Boiler #2	10,000	10,000	12,000	18,000	15,000
Boiler #3	129,000	129,000	125,000	134,000	140.000
Total Steam Flow	149,000	149,000	149,000	170,000	170,000
Boiler Efficiency % Boiler #1	46.6	46.6	50.5	57.0	54.3
Boiler #2	46.6	46.6	50.5	57.0	54.3
Boiler #3	60.2	66.0	60.5	59.8	68.1
Fuel Use BDT/hr Boiler #1	1.2	1.2	1.3	1.8	1.5
Boiler #2	1.2	1.2	1.3	1.8	1.5
Boiler #3	11.9	10.8	11.4	12.4	11.4
Total Fuel Use	14.3	13.2	14.0	16.0	14.4
Heat Input MM Btu/hr Boiler #1	21.2	21.2	23.2	30.8	26.9
Boiler #2	21.2	21.2	23.2	30.8	26.9
Boiler #3	208.6	190.3	201.3	218.5	200.4
Total Heat Input	251.0	232.7	247.7	280.1	254.2
Bone dry pounds of fuel per 1000 pounds of stm	191.9	177.2	187.9	188.2	169.4

MMBtu/Mlb steam 1.658 1.647 1.495

Champion

Champion International Corporation

Wednesday 2/19/97

HOUR	WATER LEVEL Boiler Drum #1	Boiler Drum #2	Boiler Drum #3	DA TANK	STORAGE TANK	PRESSURE DRUM	FEED WATER	DA TANK	DIESEL PUMP	DRAFT / PRESSURE UNDER GATE	FURNACE DRAFT	BOILER OUTLET	Boiler #3 ID Fan AMPS #1 MTR	#2 MTR	INSTRUMENT AIR	O_2 #3	TEMPERATURE DA TANK	BOILER OUTLET	F.W.P.	#3 FURNACE
7:00 A	.2	.4	.1	-3	✓	453	682	22	120		-.34		325	348	70	6.7	258			1377
8:00	.1	.8	.6	-2	✓	455	751	21	120		-.41		304	335	70	5.1	255			1401
9:00	.4	.9	.6	1	✓	452	701	30	130		-.56		218	341	70	8.3	259			1364
10:00	.5	.4	.2	4	✓	453	781	18	120		-.19		338	350	70	4.7	240			1360
11:00	.5	.6	.5	3	✓	452	756	22	120		-.26		301	349	70	6.6	255			1412
12:00	.6	-.1	.8	-1	✓	451	745	26	120		-.20		308	347	70	6.0	260			1392
1:00 P	.1	.1	.2	0	Low	453	754	20	120		-.15		316	359	70	8.1	252			1415
2:00	.2	.3	.4	3	✓	454	704	35	120		-.27		305	349	70	7.3	260			1412
3:00	.9	.7	.4	2	✓	457	798	29	120		-.23		321	338	70	2.3	248			1396
4:00	.4	0	.3	0	✓	455	741	20	120		-.36		304	351	70	2.6	250			1402
5:00	.9	-.3	.6	+3	✓	385	605	19	120		-.31		318	324	70	7.9	246			1306
6:00	.9	.3	.1	-.2	✓	449	711	21	120		-.01		259	315	70	5.6	251			1383
7:00																				
8:00																				
9:00																				
10:00																				
11:00																				
12:00																				
1:00 A																				
2:00																				
3:00																				
4:00																				
5:00	.1	.3	.3	-.2	✓	454	627	21	120		-.2		258	346	70	4.4	252			1422
6:00	.1	.4	.3	-.2	✓	410	633	21	120		-.2		320	354	70	4.9	255			1424

HOUR	MECHANICAL DRIVES R.S.V.'S	SAND CLASS	I.D. FANS	I.D. FAN BEARINGS	I.D. FAN	I.D. TURBINE	SCRUBBERS	EMERGENCY STACKS	[illegible] DRIVES	STEAM FLOWS PLY	KILNS	TURBINE	PSI	#1	#2	#3	TDS	A. UNIT PH		#1	#2
7:00 A	✓	✓	✓	✓	✓	✓	✓	✓		114	40	15	120	8	11	142				1145	1452
8:00	✓	✓	✓	✓	✓	✓	✓	✓		114	38	15	120	6	10	137				1180	1258
9:00	✓	✓	✓	✓	✓	✓	✓	✓		91	46	15	120	7	12	132				1228	1358
10:00	✓	✓	✓	✓	✓	✓	✓	✓		113	43	15	120	12	14	135				1255	1514
11:00	✓	✓	✓	✓	✓	✓	✓	✓		111	39	15	120	8	11	136				1186	1508
12:00	✓	✓	✓	✓	✓	✓	✓	✓		113	38	15	120	10	12	140				1266	1531
1:00 P	✓	✓	✓	✓	✓	✓	✓	✓		115	37	16	120	10	13	139				1187	1457
2:00	✓	✓	✓	✓	✓	✓	✓	✓		116	36	15	120	8	12	142				1129	1505
3:00	✓	✓	✓	✓	✓	✓	✓	✓		114	36	15	120	14	13	135				1229	1513
4:00	✓	✓	✓	✓	✓	✓	✓	✓		116	35	15	120	8	12	140				1153	1428
5:00	✓	✓	✓	✓	✓	✓	✓	✓		110	39	15	120	14	13	137				1246	1172
6:00	✓	✓	✓	✓	✓	✓	✓	✓		119	35	15	120	19	14	137				1214	1509
7:00																					
8:00																					
9:00																					
10:00																					
11:00																					
12:00																					
1:00 A																					
2:00													17	16	156	✓					
3:00	✓	✓	✓		✓	✓	✓	✓				15		20	19	153	✓				
4:00																					
5:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	134	40	15	120	21	22	141	✓			1505	1683
6:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	133	40	15	120	14	20	146	✓			1465	1572

DAYS 7A/M - 7P/M

OPERATOR Ware

	TIME
WATER COLUMN BLOWDOWN	2:00
BOILER BLOWDOWN	

NIGHTS 7P/M - 7A/M

OPERATOR

	TIME
WATER COLUMN BLOWDOWN	
BOILER BLOWDOWN	

Champion
Champion International Corporation

Monday 2/17/97

HOUR	WATER LEVEL Boiler Drum #1	Boiler Drum #2	Boiler Drum #3	DA TANK	STORAGE TANK	PRESSURE DRUM	FEED WATER	DA TANK	DIESEL PUMP	DRAFT / PRESSURE UNDER GATE	FURNACE DRAFT	BOILER OUTLET	Boiler #1 ID Fan AMPS #1 MTR	#2 MTR	INSTRUMENT AIR	O_2	TEMPERATURE DA TANK	BOILER OUTLET	F.W.P.	#3 FURNACE
7:00 A	.1	.2	.2	1	✓	450	815	38	120		.19		372	350	70	2.4	273	695		1365
8:00	.4	1.4	.2	-3	✓	449	651	25	120		.08		371	364	70	2.2	262	713		1402
9:00	.4	.2	.5	3	✓	438	623	30	130		.21		313	354	70	6.7	265	736		1363
10:00	-.3	.4	1.1	-3	✓	454	731	29	120		.17		314	312	70	6.7	268	758		1456
11:00	-.6	.3	-.4	-3	✓	410	623	21	120		.56		308	387	70	2.5	359	740		1343
12:00																				
1:00 P	.1	1.1	.5	-1	✓	426	572	26	120		.43		240	345	70	9.3	263	741		1446
2:00	-.1	.2	.3	3	✓	420	655	30	120	1	.18		294	383	70	6.3	245	748		1398
3:00	.1	-.1	.2	1	✓	448	611	32	120		.36		378	352	70	7.0	250	764		1423
4:00	.2	.2	.8	0	✓	437	645	30	130		.25		264	373	70	6.1	355			1440
5:00	.1	.2	.2	3	LOW	454	731	38	120		.35		256	376	70	8.5	268			1417
6:00	.2	.4	.2	4	✓	452	658	34	120		.54		279	387	70	8.1	265			1408
7:00	.5	.1	.2	1	✓	418	638	25	120		.30		275	388	70	7.8	263			1369
8:00	.1	.1	.2	1	✓	454	620	33	120		.32		229	360	70	7.3	266			1327
9:00	.1	.1	.1	1	✓	453	699	27	120		.21		278	405	70	7.5	266			1377
10:00	.2	.4	.7	1	✓	464	743	39	120		.43		276	388	70	9.0	270			1356
11:00	.4	.4	.2	2	✓	453	704	35	120		.33		252	414	70	2.6	262			1311
12:00	.1	.7	.5	0	✓	450	710	37	120		.14		288	348	70	10.0	260			1365
1:00 A	.2	.1	.2	1	✓	461	712	35	120		.21		305	316	70	11.1	268			1365
2:00	.1	.1	.0	1	✓	460	675	34	120		.12		253	427	70		268			1423
3:00	.1	.6	.5	3	✓	453	721	21	120		.41		313	323	70	10.9	264			1393
4:00	.3	.6	.3	1	✓	454	721	27	120		.05		323	352	70	6.9	265			1446
5:00																				
6:00	.3	.6	.4	2	✓	454	735	27	120		.09		344	366	70	2.6	265			1394

HOUR	MECHANICAL DRIVES R.S.V.S.	SAND CLASS.	I.D. FANS	I.D. FAN BEARINGS	F.D. FAN	F.D. TURBINE	SCRUBBERS	EMERGENCY STACKS	HYD. CONVEYOR DRIVES	STEAM FLOWS PLY	KILNS	TURBINE	PSI	#1	#2	#3	T.D.S.	A-UNIT PH		Furnace Temp #1	Furnace Temp #2
7:00 A	✓	✓	✓	✓	✓	✓	✓	✓		90	39	16	120	1	6	131				1152	1270
8:00	✓	✓	✓	✓	✓	✓	✓	✓		117	37	16	120	10	14	140				1131	1308
9:00	✓	✓	✓	✓	✓	✓	✓	✓		130	36	16	120	15	11	148				1327	1396
10:00	✓	✓	✓	✓	✓	✓	✓	✓		135	30	15	120	7	12	157				1214	1360
11:00	✓	✓	✓	✓	✓	✓	✓	✓		112	50	16	130	17	14	143				1366	1498
12:00																					
1:00 P	✓	✓	✓	✓	✓	✓	✓	✓		134	43	15	120	20	19	142				1517	1525
2:00	✓	✓	✓	✓	✓	✓	✓	✓		129	42	16	120	19	17	144				1482	1619
3:00	✓	✓	✓	✓	✓	✓	✓	✓		134	40	15	120	15	17	146				1495	1660
4:00	✓	✓	✓	✓	✓	✓	✓	✓		132	40	15	120	30	19	148				1524	1625
5:00	✓	✓	✓	✓	✓	✓	✓	✓		135	39	15	120	11	16	155	✓			1359	1596
6:00	✓	✓	✓	✓	✓	✓	✓	✓		133	38	15	120	15	17	157	✓			1320	1616
7:00	✓	✓	✓	✓	✓	✓	✓	✓		128	37	15	120	18	17	142				1365	1503
8:00	✓	✓	✓	✓	✓	✓	✓	✓		125	37	15	120	18	14	139				1437	1549
9:00	✓	✓	✓	✓	✓	✓	✓	✓		131	36	15	120	19	15	144				1560	1513
10:00	✓	✓	✓	✓	✓	✓	✓	✓		132	37	15	120	21	14	141				1513	1424
11:00	✓	✓	✓	✓	✓	✓	✓	✓		117	36	15	120	20	12	140				1423	1315
12:00	✓	✓	✓	✓	✓	✓	✓	✓		117	35	15	120	20	9	140					
1:00 A	✓	✓	✓	✓	✓	✓	✓	✓		118	35	15	120	15	12	138				1463	1222
2:00	✓	✓	✓	✓	✓	✓	✓	✓		113	35	15	120	12	15	132				1370	1516
3:00	✓	✓	✓	✓	✓	✓	✓	✓		113	35	15	120	17	15	127				1392	1416
4:00	✓	✓	✓	✓	✓	✓		✓		114	33	15	120	12	12	135				1323	1330
5:00																					
6:00	✓	✓	✓	✓	✓	✓	✓	✓		126	27	15	120	15	13	141				1458	1452

DAYS 7A/M - 7P/M

OPERATOR *ATP / Wans*

	TIME
WATER COLUMN BLOWDOWN	7:25
BOILER BLOWDOWN	

NIGHTS 7P/M - 7A/M

OPERATOR *Morris*

	TIME
WATER COLUMN BLOWDOWN	
BOILER BLOWDOWN	

Champion
Champion International Corporation

Sunday 2/16/97

HOUR	WATER LEVEL: Boiler Drum #1	Boiler Drum #2	Boiler Drum #3	DA Tank	Storage Tank	PRESSURE: Drum	Feed Water	DA Tank	Diesel Pump	DRAFT / PRESSURE: Under Gate	Furnace Draft	Boiler Outlet	Boiler #3 ID Fan AMPS #1 MTR	#2 MTR	Instrument Air	O_2 %	TEMPERATURE: DA Tank	Boiler Outlet	F.W.P.	#1 Furnace
7:00 A	0	.1	0	-.1	✓	415	710	31	120		.01		328	344	70	8.4	268	708		1379
8:00	.7	.6	.4	-2	✓	416	691	28	120		-.14		302	365	70	8.2	266	718		1415
9:00	-.2	-.2	.6	-1	Low	419	722	34	120		-.35		282	287	70	8.9	275	691		1410
10:00	.9	.9	.5	-1	Low	418	654	26	120		-.13		300	309	70	5.2	265	709		1424
11:00	0	.2	.5	-2	✓	420	734	27	120		-.11		295	304	70	7.2	264	729		1467
12:00	0	.6	.5	-1	✓	419	781	30	120		-.15		315	328	70	7.6	268	724		1390
1:00 P	-.4	-.4	.5	-1	✓	419	727	35	120		-.17		308	321	70	4.9	276	738		1404
2:00	.9	-.1	.2	-1	✓	420	735	24	120	)	-.12		293	300	70	6.7	256	724		1391
3:00	.3	.3	.4	-2	✓	422	788	21	120		-.15		319	329	70	5.7	254	727		1392
4:00	-.1	.1	.1	-1	✓	420	759	29	120		-.25		294	302	70	7.3	267	703		1400
5:00	.4	.3	.4	3	✓	424	669	23	120		-.16		313	318	70	7.6	262	700		1409
6:00	.2	0	.2	-1	✓	453	707	38	120		-.11		307	337	70	6.6	280	738		1429
7:00	.1	.1	.7	-1	✓	454	764	27	120		-.1		308	357	70	8.0	262	731		1426
8:00	-.4	.1	.6	-1	✓	452	610	32	120		-.09		324	379	70	7.7	270	731		1447
9:00																				
10:00																				
11:00	.1	.2	.5	1	✓	451	750	28	120		-.2		324	361	70	2.3	262	[illegible]		
12:00	.7	.4	.2	-1	✓	445	760	25	120		-.1		[illegible]	365	70	7.6	260	703		
1:00 A																				
2:00	.5	-.7	.3	-.1	✓	450	611	26	[illegible]		-.1		30[illegible]	316	70	6.9	260	727		1429
3:00	-.1	-.3	.3	-2	✓	450	650	30	120		-.08		323	353	70	6.2	273	714		1424
4:00	.5	-.3	.1	-2	✓	45[illegible]	728	31	120		-.1		271	453	70	7.9	283	721		1346
5:00																				
6:00	-.1	0	.15	-2	✓	354	716	25	120		.1		264	451	70	10.2	251	682		1311

HOUR	MECHANICAL DRIVES: RSVS	Sand Class	ID Fans	ID Fan Bearings	FD Fan	FD Turbine	Scrubbers	Emergency Stacks	Drives	STEAM FLOWS: PLT	Kilns	Turbine	PSI	#1	#2	#3	TDS	Unit PH		Furnace Temp #1	Furnace Temp #2
7:00 A	✓	✓	✓	✓	✓	✓	✓	✓		113	26	16	120	6	12	135				1083	1149
8:00	✓	✓	✓	✓	✓	✓	✓	✓		124	38	16	120	13	15	144				1128	1331
9:00	✓	✓	✓	✓	✓	✓	✓	✓		85	35	16	120	0	0	144				957	988
10:00	✓	✓	✓	✓	✓	✓	✓	✓		123	49	16	120	12	18	153	✓			1030	1079
11:00	✓	✓	✓	✓	✓	✓	✓	✓		126	45	16	120	14	15	149	✓			1362	1370
12:00	✓	✓	✓	✓	✓	✓	✓	✓		100	43	16	120	1	7	149				1042	1125
1:00 P	✓	✓	✓	✓	✓	✓	✓	✓		101	41	16	120	2	6	143				1019	1165
2:00	✓	✓	✓	✓	✓	✓	✓	✓		101	38	16	120	0	0	151				909	857
3:00	✓	✓	✓	✓	✓	✓	✓	✓		102	37	16	120	0	2	147				811	845
4:00	✓	✓	✓	✓	✓	✓	✓	✓		100	37	16	120	0	2	142				862	920
5:00	✓	✓	✓	✓	✓	✓	✓	✓		103	37	16	120	0	0	159				836	702
6:00	✓	✓	✓	✓	✓	✓	✓	✓		108	35	15	120	1	6	147				901	1080
7:00	✓	✓	✓	✓	✓	✓	✓	✓		110	34	15	120	0	7	147				851	1074
8:00	✓	✓	✓	✓	✓	✓	✓	✓		124	34	15	120	8	13	153				1076	1360
9:00																					
10:00																					
11:00	✓	✓	✓	✓	✓	✓	✓	✓		120	32	15	110	0	10	129				1136	1346
12:00	✓	✓	✓	✓	✓	✓	✓	✓		122	34	15	[illegible]	19	14	134				1100	1404
1:00 A																					
2:00	✓	✓	✓	✓	✓	✓	✓	✓		121	32	15	120	7	12	141				1137	1349
3:00	✓	✓	✓	✓	✓	✓	✓	✓		121	32	15	120	6	9	110				1132	1341
4:00	✓	✓	✓	✓	✓	✓	✓	✓		126	30	15	120	1	11	137				1370	1313
5:00																					
6:00	✓	✓	✓	✓	✓	✓	✓	✓		117	27	15	120	18	7	128				1300	1031

DAYS 7A/M - 7P/M

OPERATOR SRP

	TIME
WATER COLUMN BLOWDOWN	2:15
BOILER BLOWDOWN	

NIGHTS 7P/M - 7A/M

OPERATOR KCS

	TIME
WATER COLUMN BLOWDOWN	
BOILER BLOWDOWN	

D-5

Champion
Champion International Corporation

Saturday 3/1/97

HOUR	WATER LEVEL: Boiler Drum #1	Boiler Drum #2	Boiler Drum #3	DA TANK	STORAGE TANK	PRESSURE: DRUM	FEED WATER	DA TANK	DIESEL PUMP	DRAFT / PRESSURE: UNDER GATE	FURNACE DRAFT	BOILER OUTLET	Boiler #3 ID Fan AMPS #1 MTR	#2 MTR	INSTRUMENT AIR	O_2	TEMPERATURE: DA TANK	BOILER OUTLET	F.W.P.	#3 FURNACE	MECHANICAL DRIVES: R S V S	SAND CLASS	I D FANS	I D FAN BEARINGS	F D FAN	F D TURBINE	SCRUBBERS	EMERGENCY STACKS	FUEL CONVEYOR DRIVES	STEAM FLOWS: PLY	KILNS	TURBINE	PSI	#1	#2	#3	T D S	A. UNIT P H		Furnace Temp #1	#2
7:00 A																																									
8:00																																									
9:00											2																							12	14	14					
10:00																																									
11:00																																									
12:00																																									
1:00 P																																									
2:00																																									
3:00																																									
4:00																																									
5:00																																									
6:00																																									
7:00	-.3	-.1	.4	.5	✓	452	681	43	120		-.27		350	318	70	6.8	278	760		1386	✓	✓	✓	✓	✓	✓	✓	✓		125	28	15	120	10	14	139				1118	1423
8:00	0	-.3	.6	-1	✓	485	655	46	120		-1.78		308	299	70	6.3	282	727		1309	✓	✓	✓	✓	✓	✓	✓	✓		119	27	15	120	16	18	127				1333	1450
9:00	.1	.4	.3	-2	✓	425	691	40	120		-.15		336	296	70	4.1	283	736		1360	✓	✓	✓	✓	✓	✓	✓	✓		122	36	.15	120	18	16	124				1463	1465
10:00	.1	.1	.5	-1	✓	455	781	43	120		-.28		328	294	70	2.0	285	746		1449	✓	✓	✓	✓	✓	✓	✓	✓		121	25	15	120	3	11	142				1967	1322
11:00	-.2	.5	.4	.3	✓	450	750	33	120		-.31		326	295	70	4.9	269	739		1458	✓	✓	✓	✓	✓	✓	✓	✓		121	26	15	120	9	12	138				1264	1400
12:00	-.2	1.0	.5	-1	✓	454	623	32	120		-.30		320	289	70	6.1	271	729		1431	✓	✓	✓	✓	✓	✓	✓	✓		118	44	15	120	9	17	147	✓			1385	1371
1:00 A	.2	.4	.3	-1	✓	450	728	33	120		-.22		346	306	70	4.9	271	735		1461	✓	✓	✓	✓	✓	✓	✓	✓		125	42	15	120	14	15	145	✓			1536	1487
2:00	.2	.5	.4	-1	✓	444	749	45	120		-.29		345	300	70	3.9	286	732		1472	✓	✓	✓	✓	✓	✓	✓	✓		124	43	15	120	18	13	145				1501	1507
3:00	-.2	.2	.2	.3	✓	450	679	35	120		-.32		327	301	70	5.0	266	741		1442	✓	✓	✓	✓	✓	✓	✓	✓		120	37	15	120	13	13	141				1384	1459
4:00	-.1	.4	.8	-1	✓	453	718	41	120		-.37		313	298	70	2.0	281	700		1462	✓	✓	✓	✓	✓	✓	✓	✓		115	36	15	120	4	12	144				1234	1414
5:00	0	.2	.5	-2	✓	455	754	37	120		-.26		315	297	70	2.8	281	709		1421	✓	✓	✓	✓	✓	✓	✓	✓		112	37	15	120	6	11	142				1219	1397
6:00	-.2	-.4	.5	-1	✓	456	697	38	120		-.50		297	285	70	5.8	282	716		1459	✓	✓	✓	✓	✓	✓	✓	✓		113	36	15	120	10	10	151				1334	1431

DAYS 7A/M - 7P/M

OPERATOR KCS

	TIME
WATER COLUMN BLOWDOWN	
BOILER BLOWDOWN	

NIGHTS 7P/M - 7A/M

OPERATOR JP

	TIME
WATER COLUMN BLOWDOWN	
BOILER BLOWDOWN	

Champion
Champion International Corporation

Monday 3/3/92

HOUR	WATER LEVEL Boiler Drum #1	#2	#3	DA TANK	STORAGE TANK	PRESSURE DRUM	FEED WATER	DA TANK	DIESEL PUMP	DRAFT / PRESSURE UNDER GATE	FURNACE DRAFT	BOILER OUTLET	Boiler #1 ID Fan AMPS #1 MTR	#2 MTR	INSTRUMENT AIR	O_2	TEMPERATURE DA TANK	BOILER OUTLET	F.W.P.	#3 FURNACE
7:00 A	.1	.2	.1			423														136
8:00	.2	0	.1	-.2	/	447	748	24	120		-.3		354	311	70	3.1	262	238		1381
9:00	.2	.1	.3	-.3	/	407	640	.30	120		-.3		345	317	70	5.1	255	725		1394
10:00																				
11:00																				
12:00	.4	.3	.8	2	✓	421	640	32	120		-.3		311	305	70	5.3	267	236		1433
1:00 P	.2	.3	0	2	/	446	640	37	120		-.3		354	341	70	5.7	267	260		1448
2.00																				
3:00																				
4:00																				
5:00																				
6.00																				
7.00	.2	.4	.2	0	/	436	750	36	120		.20		355	363	70	4.7	260	263		1397
8:00	.1	.1	.2	0	✓	452	724	17	120		.24		321	339	70	4.5	245	709		1418
9:00	.2	.2	.9	1	.	453	664	34	120		.39		349	331	70	4.5	246	701		1468
10:00	.2	.1	.5	0	✓	441	652	30	130		.14		350	320	70	5.2	240	718		1425
11:00	.1	.2	.9	.2	✓	415	681	20	130		.19		331	304	70	4.4	254	726		1435
12:00	.2	.1	.1	.2	✓	436	677	25	120		.42		300	350	70	5.6	253	759		1449
1:00 A	.3	.2	.9	.1	✓	455	705	32	110		.22		344	339	70	4.7	256	739		1431
2:00	.4	.3	.3	.3	✓	444	712	27	120		.18		306	511	70	5.5	261	743		1406
3:00	.2	.1	0	.2		452	705	23	130		.21		362	301	70	4.2	240	771		1417
4:00	.3	.2	.1	.2	✓	451	703	32	120		.39		356	320	70	4.6	255	755		1395
5:00	.4	.5	.6	.2	/	384	711	21	120		.20		315	317	70	5.0	253	726		1421
6:00																				

HOUR	MECHANICAL DRIVES R.S.V.S.	SAND CLASS	I.D. FANS	I.D. FAN BEARINGS	F.D. FANS	F.D. TURBINE	SCRUBBERS	EMERGENCY STACKS	...	STEAM FLOWS PLY	KILNS	TURBINE	PSI	#1	#2	#3	TDS	A-UNIT PH			
7:00 A	/	/	/	/	/	/	/	/	/	–	36	15	120								
8:00	/	/	/	/	/	/	/	/	/	120	35	15	120	12	14	137				1269	1521
9:00	/	/	/	/	/	/	/	/	/	133	37	15	120	14	15	147				1471	1640
10:00																					
11:00																					
12:00	/	/	/	/	/	/	/	/	/	139	33	15	120	16	17	146				1402	1650
1:00 P	/	/	/	/	/	/	/	/	/	140	32	15	120	20	17	139				1421	1653
2.00																					
3:00																					
4:00																					
5:00																					
6.00																					
7.00	/	/	/							131	32	10	120	13	14	145				1197	14
8:00	/	/	/	/	/	/	/	/	/	109	27	11	120	10	11	149				1197	1269
9:00	/	/	/	/	/	/	/	/	/	123	32	11	120	9	9	145				1231	1459
10:00	/	/	/	/	/	/	/	/	/	117	47	15	120	15	12	144				1415	1572
11:00	/	/	/	/	/	/	/	/	/	125	43	11	120	20	18	153	✓			1597	1658
12:00	/	/	/	/	/	/	/	/	/	133	42	11	120	20	19	155	✓			1564	1560
1:00 A	/	/	/	/	/	/	/	/	/	116	37	10	120	6	8	150				1179	1369
2:00	/	/	/	/	/	/	/	/	/	129	40	10	120	19	20	155	✓			1524	1651
3:00	/	/	/	/	/	/	/	/	/	110	39	15	130	4	11	146				1344	1497
4:00	/	/	/	/	/	/	/	/	/	110	39	15	130	3	9	144				1029	1301
5:00	/	/	/	/	/	/	/	/	/	134	42	10	120	18	16	147	✓			1331	1553
6:00																					

6:30

DAYS 7A/M - 7P/M

OPERATOR KCS

TIME

WATER COLUMN BLOWDOWN ______

BOILER BLOWDOWN ______

NIGHTS 7P/M - 7A/M

OPERATOR W Dun

TIME

WATER COLUMN BLOWDOWN ______

BOILER BLOWDOWN ______

D-7

Champion
Champion International Corporation

Tuesday 4/8/97

WATER LEVEL / PRESSURE

HOUR	Boiler Drum #1	Boiler Drum #2	Boiler Drum #3	DA TANK	STORAGE TANK	DRUM	FEED WATER	DA TANK	DIESEL PUMP
7:00 A	0	-.6	0	4	✓	453	549	36	125
8:00	.1	0	.2	3	✓	453	593	32	125
9:00	.6	-.1	-.4	2	Bw	453	607	29	125
10:00	-.1	.1	-.1	1	✓	430	505	15	125
11:00	.2	.4	.2	0	✓	405	811	16	125
12:00	.2	.5	-.2	-1	✓	445	704	26	125
1:00 P	0	-.1	-.2	2	✓	400	599	24	125
2:00	-.2	.5	.4	-2	✓	447	740	25	125
3:00	-.2	-.5	.1	0	✓	452	575	26	125
4:00	.6	.6	-.4	-1	✓	453	717	30	125
5:00	0	-.3	.2	-1	✓	442	757	27	125
6:00	.1	.1	0	-2	✓	440	767	23	125
7:00									
8:00									
9:00									
10:00									
11:00									
12:00									
1:00 A									
2:00									
3:00									
4:00									
5:00									
6:00									

DRAFT / PRESSURE / O_2 / TEMPERATURE

HOUR	UNDER GATE	FURNACE DRAFT	BOILER OUTLET	Boiler #3 ID Fan AMPS #1 INTR	Boiler #3 ID Fan AMPS #2 INTR	INSTRUMENT AIR	O_2 #3	DA TANK	BOILER OUTLET	F.W.P.	#3 FURNACE
7:00 A		-.25		360	334	70	9.2	266	725		1474
8:00		-.55		320	348	70	9.1	271	750		1427
9:00		-.25		351	335	70	8.2	268	744		1416
10:00		-.30		341	307	70	5.7	241	730		1450
11:00		-.22		317	313	70	2.8	245	724		1584
12:00		-.19		338	342	70	5.7	258	757		1408
1:00 P		-.27		335	321	70	3.7	247	740		1450
2:00		-.40		344	342	70	4.9	262	761		1425
3:00		-.27		350	340	70	6.3	265	797		1440
4:00		-.46		350	331	70	8.9	270	751		1426
5:00		-.72		345	321	70	9.3	267	700		1362
6:00		-.47		361	337	70	7.2	263	673		1498
7:00											
8:00											
9:00											
10:00											
11:00											
12:00											
1:00 A											
2:00											
3:00											
4:00											
5:00											
6:00											

MECHANICAL DRIVES

HOUR	R.S.V.S.	SAND CLASS	I.D. FANS	I.D. FAN BEARINGS	F.D. FAN	F.D. TURBINE	SCRUBBERS	EMERGENCY STACKS	[illegible] DRIVES
7:00 A	✓	✓	✓	✓	✓	✓	✓	✓	
8:00	✓	✓	✓	✓	✓	✓	✓	✓	
9:00	✓	✓	✓	✓	✓	✓	✓	✓	
10:00	✓	✓	✓	✓	✓	✓	✓	✓	
11:00	✓	✓	✓	✓	✓	✓	✓	✓	
12:00	✓	✓	✓	✓	✓	✓	✓	✓	
1:00 P	✓	✓	✓	✓	✓	✓	✓	✓	
2:00	✓	✓	✓	✓	✓	✓	✓	✓	
3:00	✓	✓	✓	✓	✓	✓	✓	✓	
4:00	✓	✓	✓	✓	✓	✓	✓	✓	
5:00	✓	✓	✓	✓	✓	✓	✓	✓	
6:00	✓	✓	✓	✓	✓	✓	✓	✓	
7:00									
8:00									
9:00									
10:00									
11:00									
12:00									
1:00 A									
2:00									
3:00									
4:00									
5:00									
6:00									

STEAM FLOWS

HOUR	PLY	KILNS	TURBINE	PSI	#1	#2	#3	TDS	A UNIT PH		Furnace Temp #1	Furnace Temp #2
7:00 A	123	34	16	120	2	12	156	✓			1323	1325
8:00	132	33	16	120	11	14	127	✓			1221	1333
9:00	123	32	16	120	7	14	143				1400	1329
10:00	131	33	16	120	19	15	148	✓			1458	1320
11:00	123	31	16	120	20	16	133				1432	1325
12:00	125	25	16	120	9	19	134				1203	1322
1:00 P	132	34	16	120	2	18	152				1175	1364
2:00	155	29	16	120	12	12	157				1404	1358
3:00	135	28	16	120	10	12	146				1289	1325
4:00	131	27	16	120	7	13	149				1175	1298
5:00	117	27	16	120	17	18	133				1217	1361
6:00	132	41	16	120	12	16	136	✓			1145	1344
7:00												
8:00												
9:00												
10:00												
11:00												
12:00												
1:00 A												
2:00												
3:00												
4:00												
5:00												
6:00												

DAYS 7A/M - 7P/M

OPERATOR *[illegible]*

TIME

WATER COLUMN BLOWDOWN ______

BOILER BLOWDOWN ______

Tinisha
1 800 777 3167
ext 334

NIGHTS 7P/M - 7A/M

OPERATOR ______

TIME

WATER COLUMN BLOWDOWN ______

BOILER BLOWDOWN ______

D-8

322
4/16

![Champion International Corporation]

Champion
Champion International Corporation

Wednesday 1-2-9[illegible]

WATER LEVEL / PRESSURE / DRAFT / PRESSURE / O2 / TEMPERATURE

HOUR	Boiler Drum #1	Boiler Drum #2	Boiler Drum #3	DA Tank	Storage Tank	Pressure: Drum	Feed Water	DA Tank	Diesel Pump	Under Gate	Furnace Draft	Boiler Outlet	Boiler #1 ID Fan AMPS #1 MTR	#2 MTR	Instrument Air	O_2	Temp: DA Tank	Boiler Outlet	F.W.P.	#3 Furnace
7:00 A	2.5	.1	.0	1	✓	163	735	28	120		.61		350	353	70	9.1	248	729		1441
8:00	2.1	.2	.2	-1	✓	163	710	27	120		.10		352	350	70	5.6	251	744		1444
9:00	.55	.1	.3	.3	✓	164	651	26	120		.32		352	328	70	6.5	251	710		1446
10:00	1.9	.1	.1	.1		153	714	26	120		.43		337	322	70	9.4	259	727		1422
11:00	1.7		.2	.1	✓	161	710	30	120		.79		339	317	70	10.4	259	683		1412
12:00	.1	.2	.1	-1	✓	155	813	23	120		.73		351	331	70	11.4	255	710		1313
1:00 P	.6	.1	.1	.2	✓	123	715	19	120		.05		337	323	70	2.6	248	722		1413
2:00	.7	.6	.5	.2	✓	155	705	21	122		.02		335	326	70	[illegible]	257	712		1375
3:00	.6	.1	.3	.2		135	665	17	122		.04		337	323	70	2.3	242	703		1412
4:00	.6	.0	.2	2	✓	125	623	21	120		.19		338	316	70	6.3	253			1436
5:00	.2	.6	.2	1	✓	118	711	26	120		.10		338	321	70	6.8	262	710		1419
6:00	.2	.1	.3	1	✓	166	700	35	120		.10		345	322	70	4.1	266	724		1436
7:00	.2	.9	.5	0		401	652	34	125		.07		340	318	70	5.8	262	696		1417
8:00	.1	.1	.6	-1	✓	451	633	35	125		.50		337	330	70	4.8	274	721		1500
9:00	.2	.2	.5	-1	✓	456	746	39	125		.45		328	312	70	9.2	279	717		1454
10:00	.5	.8	.3	2	✓	452	599	33	125		.41		363	334	70	6.2	272	748		1452
11:00	.2	.3	.5	5	✓	451	700	35	125		.39		354	343	70	8.1	273	773		1433
12:00	.6	.4	.9	-2		453	232	22	125		.40		352	349	70	8.6	259	248		1410
1:00 A	.1	.5	.8	-3	✓	454	727	25	125		.35		351	341	70	2.6	265	259		1475
2:00	.4	.7	0	.2	✓	390	719	20	125		.12		314	299	70	11.0	252	702		1460
3:00	.4	.4	.7	.1	✓	454	676	26	125		.21		351	317	70	6.7	266	740		1477
4:00	.3	.4	.4	4	✓	400	778	34	125		.46		354	337	70	11.6	274	678		1364
5:00																				
6:00																				

MECHANICAL DRIVES

HOUR	R.S.V.S	Sand Class	I.D. Fans	I.D. Fan Bearings	F.D. Fan	F.D. Turbine	Scrubbers	Emergency Stacks	Fuel Conveyor Drives
7:00 A	✓	✓	✓	✓	✓	✓		✓	
8:00	✓	✓	✓	✓	✓	✓	✓	✓	
9:00	✓	✓	✓	✓	✓	✓	✓	✓	
10:00	✓	✓	✓	✓	✓	✓	✓	✓	
11:00	✓	✓	✓	✓	✓	✓	✓	✓	
12:00	✓	✓	✓	✓	✓	✓	✓	✓	
1:00 P	✓	✓	✓	✓	✓	✓	✓	✓	
2:00	✓	✓	✓	✓	✓	✓	✓	✓	
3:00	✓	✓	✓	✓	✓	✓	✓	✓	
4:00	✓	✓	✓	✓	✓	✓	✓	✓	
5:00	✓	✓	✓	✓	✓	✓	✓	✓	
6:00	✓	✓	✓	✓	✓	✓	✓	✓	
7:00	✓	✓	✓	✓	✓	✓	✓	✓	
8:00	✓	✓	✓	✓	✓	✓	✓	✓	
9:00	✓	✓	✓	✓	✓	✓	✓	✓	
10:00	✓	✓	✓	✓	✓	✓	✓	✓	
11:00	✓	✓	✓	✓	✓	✓	✓	✓	
12:00	✓	✓	✓	✓	✓	✓	✓	✓	
1:00 A	✓	✓	✓	✓	✓	✓	✓	✓	
2:00	✓	✓	✓	✓	✓	✓	✓	✓	
3:00	✓	✓	✓	✓	✓	✓	✓	✓	
4:00	✓	✓	✓	✓	✓	✓	✓	✓	
5:00									
6:00									

STEAM FLOWS

HOUR	P.M.	Kilns	Turbine	PSI	#1	#2	#3	T.D.S.	A. Unit PH		Furnace Temp #1	Furnace Temp #2
7:00 A	104	24	16	120	0	5	141				574	1024
8:00	105	41	16	120	0	19	143				544	1495
9:00	101	35	19	120	0	16	141				494	1293
10:00	102	33	16	120	0	17					473	1314
11:00	82	32	16	120	0	2	126				446	1126
12:00	81	35	15	120	0	16	131				424	1304
1:00 P	102	42	16	120	0	20	140				468	[illegible]
2:00	20	38	15	120	0	20	132				402	1411
3:00	93	39	16	120	0	19	132				401	1329
4:00	105	20	16	120	0	13	104				1235	1462
5:00	120	39	16	120	16	16	146	✓			1376	1521
6:00	133	40	16	120	19	19	146	✓			1439	1410
7:00	130	38	16	120	20	21	144	✓			1504	1506
8:00	131	38	16	120	17	12	154	✓			1443	1424
9:00	118	32	16	120	9	9	147				1345	1388
10:00	132	36	16	120	11	13	153	✓			1277	1351
11:00	132	35	16	120	13	15	150	✓			1323	1317
12:00	111	35	16	120	6	8	144				1043	1186
1:00 A	109	34	16	120	1	4	147				947	1105
2:00	109	36	16	120	12	20	126				1067	1294
3:00	212	33	16	120	0	3	150				999	1076
4:00	127	26	16	120	17	12	134				1335	1341
5:00												
6:00												

DAYS 7A/M - 7P/M

OPERATOR [illegible]

TIME

WATER COLUMN BLOWDOWN

BOILER BLOWDOWN

NIGHTS 7P/M - 7A/M

OPERATOR

TIME

WATER COLUMN BLOWDOWN

BOILER BLOWDOWN

Tuesday 5/6/97

HOUR	WATER LEVEL: Boiler Drum #1	#2	#3	DA TANK	STORAGE TANK	PRESSURE: DRUM	FEED WATER	DA TANK	DIESEL PUMP	DRAFT / PRESSURE: UNDER GATE	FURNACE DRAFT	BOILER OUTLET	Boiler #3 ID Fan AMPS #1 MTR	#2 MTR	INSTRUMENT AIR	O_2	TEMPERATURE: DA TANK	BOILER OUTLET	F.W.P.	#3 FURNACE
7:00 A	.1	.5	0	-2	✓	453	654	24	130	[illegible]	-.13	[illegible]	327	321	70	8.7	264	723		1448
8:00	.2	.8	-.1	5	✓	448	694	20	130		-.30		338	332	70	6.4	254	724		1455
9:00	-.2	.1	-.2	3	✓	450	527	25	130		-.48		343	338	70	5.9	260	739		1467
10:00	-.1	-.1	-.1	2	✓	420	592	28	130		-.29		341	339	70	6.1	261	737		1439
11:00	-.1	.4	0	4	✓	442	578	32	130		-.37		337	329	70	6.4	265	732		1454
12:00	-.2	-.2	-.1	-2	✓	453	556	26	130		-.43		333	327	70	6.6	264	729		1447
1:00 P	-.3	.3	-.2	5	✓	435	687	31	130		-.08		331	326	70	6.5	263	718		1397
2:00	-.3	.5	.1	-2	✓	452	619	25	130		-.25		330	328	70	7.0	263	728		1418
3:00	.2	.6	.2	2	✓	450	718	32	130		-.27		332	326	70	8.1	267	731		1396
4:00	-.2	0	0	-1	✓	438	573	35	130		-.32		330	321	70	5.7	273	732		1421
5:00	-.1	-.5	-.1	0	✓	420	619	27	130		-.10		324	319	70	5.9	262	702		1411
6:00	-.1	.2	-.3	0	✓	453	671	34	130		-.52		336	330	70	8.5	272	731		1413
7:00																				
8:00																				
9:00																				
10:00																				
11:00	.3	-.2	.4	3	✓	446	546	27	130		-.4		344	337	72	6.1	263	756		1446
12:00	[illegible]				✓	[illegible]														
1:00 A	-.3				✓															
2:00																				
3:00																				
4:00																				
5:00																				
6:00																				

HOUR	MECHANICAL DRIVES: R.S.V.'S	SAND CLASS	I.D. FANS	I.D. FAN BEARINGS	F.D. FAN	I.D. TURBINE	[illegible]	EMERGENCY STACKS	[illegible]	STEAM FLOWS: [illegible]	KILNS	TURBINE	PSI	#1	#2	#3	[illegible]	UNIT PH	Furnace Temp #1	#2
7:00 A	✓	✓	✓	✓	✓	✓	✓	✓	✓	126	23	15	120	6	13	140			1088	1265
8:00	✓	✓	✓	✓	✓	✓	✓	✓		126	41	15	120	17	17	145			1481	1248
9:00	✓	✓	✓	✓	✓	✓	✓	✓		125	39	15	120	12	16	146	✓		1213	1247
10:00	✓	✓	✓	✓	✓	✓	✓	✓		143	40	15	120	17	18	154			1308	1253
11:00	✓	✓	✓	✓	✓	✓	✓	✓		134	35	15	120	16	16	147	✓		1457	1295
12:00	✓	✓	✓	✓	✓	✓	✓	✓		130	34	15	120	9	16	150			1379	1257
1:00 P	✓	✓	✓	✓	✓	✓	✓	✓		128	35	15	120	15	21	136			1489	1229
2:00	✓	✓	✓	✓	✓	✓	✓	✓		132	33	15	120	10	20	143			1399	1335
3:00	✓	✓	✓	✓	✓	✓	✓	✓		108	33	15	120	1	16	133			910	1282
4:00	✓	✓	✓	✓	✓	✓	✓	✓		126	32	15	120	15	16	139			1262	010
5:00	✓	✓	✓	✓	✓	✓	✓	✓		127	33	15	120	8	18	143			1367	1311
6:00	✓	✓	✓	✓	✓	✓	✓	✓		130	31	15	120	8	18	142				
7:00																				
8:00																				
9:00																				
10:00																				
11:00	✓	✓	✓	✓	✓	✓	✓	✓		130	36	15	120	16	16	148	✓		1197	1245
12:00																				
1:00 A														7						
2:00										133	33									
3:00																				
4:00																				
5:00										135	31				19					
6:00																				

DAYS 7A/M - 7P/M

OPERATOR [signature]

	TIME
WATER COLUMN BLOWDOWN	
BOILER BLOWDOWN	

NIGHTS 7P/M - 7A/M

OPERATOR

	TIME
WATER COLUMN BLOWDOWN	
BOILER BLOWDOWN	

2054

Champion
Champion International Corporation

Monday 5-5-97

HOUR	WATER LEVEL: Boiler Drum #1	#2	#3	DA TANK	STORAGE TANK	PRESSURE: DRUM	FEED WATER	DA TANK	DIESEL PUMP	DRAFT / PRESSURE: UNDER GATE	FURNACE DRAFT	BOILER OUTLET	Boiler #1 ID Fan AMPS: #1 MTR	#2 MTR	INSTRUMENT AIR	O2	TEMPERATURE: DA TANK	BOILER OUTLET	F.W.P.	#3 FURNACE
7:00 A	0	.2	.1	2	✓	447	551	24	130		.5		320	316	70	4.3	241	232		1463
8:00	.2	.2	.1	0	✓	442	612	28	130		.12		324	325	70	5.8	262	212		1446
9:00	.3	.5	.1	1	✓	456	622	35	130		.15		320	314	70	4.4	222	212		1425
10:00	.1	.1	.2	2	✓	455	455	35	130		.10		321	314	70	5.2	267	237		1413
11:00	.6	1.6	.1	1	✓	428	521	29	130		.12		323	318	70	5.9	259	203		1436
12:00	.3	1.1	.1	2	✓	420	514	24	130		.21		328	318	70	6.7	249	214		1433
1:00 P																				
2:00	.1	.0	.5	1	✓	437	645	23	130		.14		326	319	70	4.4	257	209		1398
3:00	.2	.4	.1	1	✓	430	513	13	130		.01		319	308	70	4.2	243	195		1393
4:00	.2	.2	.1	3	✓	449	643	32	130		.5		315	309	70	5.5	266	224		1415
5:00	.4	.3	.1	5	✓	449	612	31	130		.1		322	304	70	5.5	262	240		1427
6:00	.1	.4	.2	1	✓	446	710	30	130		.37		355	326	70	9.3	261	227		1394
7:00																				
8:00																				
9:00																				
10:00																				
11:00																				
12:00																				
1:00 A																				
2:00																				
3:00																				
4:00																				
5:00																				
6:00																				

HOUR	MECHANICAL DRIVES: [illegible]	SAW CLASS	F.D. FANS	I.D. FAN BEARINGS	F.D. FAN	F.D. TURBINE	SCRUBBERS	EMERGENCY STACKS	[illegible]	STEAM FLOWS: PM	KILNS	TURBINE	PM	#1	#2	#3	[illegible]	UNIT PH		Furnace Temp #1	#2
7:00 A	✓	✓	✓	✓	✓	✓	✓	✓		122	33	15	120	15	11	146				1421	1128
8:00	✓	✓	✓	✓	✓	✓	✓	✓		125	32	15	120	14	11	147				1496	1196
9:00	✓	✓	✓	✓	✓	✓	✓	✓		129	32	15	120	14	14	148				1363	1219
10:00	✓	✓	✓	✓	✓	✓	✓	✓		124	44	15	120	17	19	151	✓			1386	1223
11:00	✓	✓	✓	✓	✓	✓	✓	✓		121	41	15	120	18	21	135				1500	1343
12:00	✓	✓	✓	✓	✓	✓	✓	✓		122	38	15	120	20	21	132				1622	1325
1:00 P																					
2:00	✓	✓	✓	✓	✓	✓	✓	✓		126	36	15	120	17	27	131				1555	1439
3:00	✓	✓	✓	✓	✓	✓	✓	✓		121	35	15	120	20	26	132				1556	1413
4:00	✓	✓	✓	✓	✓	✓	✓	✓		116	34	15	120	2	10	143				1131	1357
5:00	✓	✓	✓	✓	✓	✓	✓	✓		130	34	15	120	15	22	137				1449	1422
6:00	✓	✓	✓	✓	✓	✓	✓	✓		107	33	15	120	7	7	140				1388	1413
7:00																					
8:00																					
9:00																					
10:00																					
11:00																					
12:00																					
1:00 A																					
2:00																					
3:00																					
4:00																					
5:00																					
6:00																					

DAYS 7A/M - 7P/M

OPERATOR Morris

TIME

WATER COLUMN BLOWDOWN
BOILER BLOWDOWN

NIGHTS 7P/M - 7A/M

OPERATOR

TIME

WATER COLUMN BLOWDOWN
BOILER BLOWDOWN

Champion
Champion International Corporation

Thursday 5/1/97

HOUR	WATER LEVEL Boiler Drum #1	#2	#3	DA TANK	STORAGE TANK	PRESSURE DRUM	FEED WATER	DA TANK	DIESEL PUMP	DRAFT / PRESSURE UNDER GATE	FURNACE DRAFT	BOILER OUTLET	Boiler #3 ID Fan AMPS #1 MTR	#2 MTR	INSTRUMENT AIR	O_2 #3	TEMPERATURE DA TANK	BOILER OUTLET	F.W.P	#3 FURNACE
7:00 A	[illegible]	[illegible]				[illegible]	[illegible]						[illegible]	[illegible]				[illegible]	[illegible]	[illegible]
8:00						[illegible]	[illegible]											[illegible]	[illegible]	[illegible]
9:00	-.4	.3	-.2	2	✓	438	661	21	125		-.26		317	313	70	6.7	261	724	130	1316
10:00																				
11:00	[illegible]	[illegible]	[illegible]		✓	[illegible]	[illegible]	[illegible]					[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]
12:00	[illegible]			[illegible]		[illegible]	[illegible]						[illegible]							
1:00 P	.2	-.1	.3	2		441	5?7	34	[illegible]		-.24		341	341		5.9	270	730	130	1401
2:00	[illegible]					[illegible]					[illegible]									[illegible]
3:00																				
4:00	[illegible]	.1	[illegible]	1	✓	446	659	31	125		-.22		306	[illegible]	[illegible]	6.1	264	704	130	1461
5:00	.1	.2	.2	-1	✓	45?	723	21	125		.14		301	316	[illegible]	6.5	261	720	130	1453
6:00	0	-.1	0	0	✓	448	555	23	125		-.52		312	336	70	7.6	261	717	130	1453
7:00	.7	0	.3	2	✓	454	702	33	150		-.51		312	340	70	8.1	270	745	130	1475
8:00	-.2	.7	0	3	✓	450	566	32	130		-.20		285	298	70	9.2	267	727	130	1466
9:00	-.4	.5	-.3	-2	✓	451	539	25	130		-.18		295	322	70	7.0	263	711	130	1452
10:00	-.1	.1	0	-1	✓	450	594	30	130		-.20		301	319	70	7.9	270	737	130	1469
11:00	-.3	.3	0	2	✓	452	644	32	130		-.11		310	323	70	4.0	271	756	130	1447
12:00	-.2	.1	-.3	-2	✓	453	693	23	130		-.24		291	302	70	8.3	261	734	130	1503
1:00 A	-.4	.5	.2	-2	✓	445	621	24	130		-.31		308	335	70	5.4	263	692	130	1428
2:00	-.1	-.1	0	4	✓	448	514	30	130		-.31		295	324	70	5.2	267	738	130	1410
3:00	-.3	.7	0	3	✓	450	619	30	130		-.49		311	337	70	6.6	268	742	130	1420
4:00	-.1	.6	.4	-2	✓	447	657	29	130		-.35		308	328	70	4.5	269	764	130	1386
5:00	-.2	-.6	0	5	✓	435	550	28	130		-.27		310	338	70	7.9	265	733	130	1354
6:00	-.4	-.1	.1	1	✓	455	612	31	130		-.66		297	325	70	9.4	269	741	130	1440

HOUR	MECHANICAL DRIVES R.S.V.S	SAND CLASS	I.D. FANS	I.D. FAN BEARINGS	F.D. FAN	F.D. TURBINE	SCRUBBERS	EMERGENCY STACKS	[illegible] DRIVES	STEAM FLOWS PLY	KILNS	TURBINE	PSI	#1	#2	#3	TDS	A UNIT PH		Furnace Temp #1	#2
7:00 A										[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	✓			[illegible]	[illegible]
8:00																				[illegible]	[illegible]
9:00		✓	✓		✓	✓	✓	✓		133	35	16	120	13	23	136				1356	1595
10:00																					
11:00										[illegible]	[illegible]					[illegible]					[illegible]
12:00											[illegible]										[illegible]
1:00 P		✓	✓	✓		✓	✓	✓	✓	126	35	[illegible]	[illegible]	12	16	138				1341	1537
2:00										[illegible]					[illegible]	[illegible]				[illegible]	[illegible]
3:00																					
4:00		✓								120	32	15	120	17	2?	143				1104	1321
5:00		✓	✓					✓		123	37	[illegible]	120	7	16	142				1101	1281
6:00		✓	✓	✓	✓	✓				125	37	16	120	8	16	149				1386	1384
7:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	105	35	16	120	1	6	145				807	1244
8:00	✓	✓	✓	✓	✓	✓	✓	✓		128	33	16	120	11	17	144				1057	1357
9:00	✓	✓	✓	✓	✓	✓	✓	✓		123	31	15	120	6	17	141				1033	1298
10:00	✓	✓	✓	✓	✓	✓	✓	✓		126	31	15	120	10	16	141				1228	1297
11:00	✓	✓	✓	✓	✓	✓	✓	✓		121	26	15	120	3	10	145				1064	1155
12:00	✓	✓	✓	✓	✓	✓	✓	✓		125	40	15	120	14	14	150	✓			1476	1204
1:00 A	✓	✓	✓	✓	✓	✓	✓	✓		127	38	15	120	16	19	143				1453	1358
2:00	✓	✓	✓	✓	✓	✓	✓	✓		122	37	15	120	9	14	144				1251	1356
3:00	✓	✓	✓	✓	✓	✓	✓	✓		131	37	15	120	14	20	140				1413	1372
4:00	✓	✓	✓	✓	✓	✓	✓	✓		129	35	15	120	12	17	147				1446	1367
5:00	✓	✓	✓	✓	✓	✓	✓	✓		125	35	15	120	18	18	133				1434	1294
6:00	✓	✓	✓	✓	✓	✓	✓	✓		129	36	15	120	15	20	138				1523	1261

DAYS 7A/M - 7P/M

OPERATOR ____________

TIME

WATER COLUMN BLOWDOWN ______

BOILER BLOWDOWN ______

NIGHTS 7P/M - 7A/M

OPERATOR [signature]

TIME

WATER COLUMN BLOWDOWN ______

BOILER BLOWDOWN ______

D-12

Champion
Champion International Corporation

Saturday 9/27/97

HOUR	Water Level: Boiler Drum #1	Boiler Drum #2	Boiler Drum #3	DA Tank	Storage Tank	Pressure: Drum	Feed Water	DA Tank	Diesel Pump	Draft/Pressure: Under Gate	Furnace Draft	Boiler Outlet	Boiler #3 ID Fan AMPS (a)	Boiler #3 ID Fan AMPS (b)	Instrument Air	O_2	Temperature: DA Tank	Boiler Outlet	F.W.P.	#1 Furnace
7:00 A	-.1	.3	0	-2	✓	459	533	31	125		-.22		205	–	70	9.5	260	707		1500
8:00	-.2	.5	0	-7	✓	450	551	25	125		-.27		205	–	70	11.2	265	703		1379
9:00	-.3	0	-.4	-4	✓	448	543	30	125		-.22		214	–	70	10.3	266	702		1407
10:00	-.3	.1	-.1	-3	✓	441	559	35	125		-.20		194	–	70	9.5	270	677		1408
11:00	-.1	.5	0	-4	✓	452	577	23	125		-.09		201	–	70	9.9	263	714		1476
12:00	-.3	.2	-.4	-3	✓	455	526	34	125		-.17		195	–	70	10.2	273	693		1436
1:00 P	-.2	-.1	-.1	-4	✓	440	552	33	125		-.24		205	–	70	10.3	272	687		1484
2:00	-.3	.2	-.3	-4	✓	454	542	32	125		-.42		207	–	70	9.6	266	712		1488
3:00	-.2	0	0	-7	✓	451	599	30	125		-.22		201	–	70	9.7	264	702		1482
4:00	-.2	.3	-.2	-3	✓	463	536	28	125		-.29		192	–	70	7.4	260	716		1506
5:00	0	.4	.4	0	✓	450	614	27	125		-.11		205	–	70	8.3	257	709		1438
6:00	-.2	.2	-.4	-6	✓	460	538	29	125		-.28		169	–	70	7.9	269	715		1434
7:00	-.2	.1	+.2	-7	✓	446	550	20	125		-.2		214	–	70	8.5	256	740		1444
8:00	-.3																			
9:00	-.2	.2	-.1	-6	✓	451	530	19	125		-.1		212		70	6.5	261	670		1396
10:00	-.4	.8	-.2	-6	✓	461	537	20	125		-.19		196	–	70	6.2	254	698		1413
11:00																				
12:00	0	.8	-.1	-6	✓	452	595	22	125		-.2		217		70	7.8	258	746		1467
1:00 A	-.3	.3	0	-5	✓	419	595	27	125		-.2		212		70	11.2	268	711		1294
2:00	-.2	.7	-.1	-6	✓	456	545	39	125		-.2		187		70	9.7	282	681		1363
3:00	-.2	3.5	.1	-.6	✓	447	540	21	125		-.3		192		70	9.9	254	690		1274
4:00	-.1	3.7	.2	-6	✓	451	565	23	115		-.3		219		70	10.7	263	691		1269
5:00	-.14	-5.8	.1	0	✓	457	600	34	115		-.3		198		70	8.2	270	689		1317
6:00																				

HOUR	Mechanical Drives: [illegible]	Sand Class	I.D. Fans	I.D. Fan Bearings	F.D. Fan	I.D. Turbine	Scrubbers	Emergency Stacks	[illegible]	Steam Flows: [illegible]	Kilns	Turbine	PSI	#1	#2	#3	TDS	Unit pH	Furnace Temps #1	Furnace Temps #2
7:00 A	✓	✓	✓	✓	✓	✓	✓	✓		118	23	19	120	12	8	137			1435	1361
8:00	✓	✓	✓	✓	✓	✓	✓	✓		131	25	19	120	11	9	146			1140	1162
9:00	✓	✓	✓	✓	✓	✓	✓	✓		117	23	20	120	9	9	136			1325	1233
10:00	✓	✓	✓	✓	✓	✓	✓	✓		124	22	20	120	10	12	135			1298	1203
11:00	✓	✓	✓	✓	✓	✓	✓	✓		141	21	20	120	12	9	154			1398	1359
12:00	✓	✓	✓	✓	✓	✓	✓	✓		121	35	19	120	9	9	149			1276	1137
1:00 P	✓	✓	✓	✓	✓	✓	✓	✓		117	32	20	120	9	7	146			1273	1132
2:00	✓	✓	✓	✓	✓	✓	✓	✓		118	28	20	120	10	10	147			1328	1169
3:00	✓	✓	✓	✓	✓	✓	✓	✓		119	35	19	120	13	8	145			1398	1210
4:00	✓	✓	✓	✓	✓	✓	✓	✓		124	34	18	120	8	8	152			1229	1234
5:00	✓	✓	✓	✓	✓	✓	✓	✓		121	33	18	120	6	14	145			1178	1186
6:00	✓	✓	✓	✓	✓	✓	✓	✓		123	34	17	120	8	9	150			1232	1234
7:00	✓	✓	✓	✓	✓	✓	✓	✓		126	32	20	120	6	10	152			1171	1196
8:00																				
9:00	✓	✓	✓	✓	✓	✓	✓	✓		119	32	19	120	8	13	141			1184	1170
10:00	✓	✓	✓	✓	✓	✓	✓	✓		115	33	17	120	8	4	146			1182	1177
11:00																				
12:00	✓	✓	✓	✓	✓	✓	✓	✓		121	30	19	120	3	11	152			1215	1278
1:00 A	✓	✓	✓	✓	✓	✓	✓	✓		107	31	19	120	9	11	133			1145	1207
2:00	✓	✓	✓	✓	✓	✓	✓	✓		114	30	19	120	7	5	142			1191	1182
3:00	✓	✓	✓	✓	✓	✓	✓	✓		67	26	19	120	8	1	119			1066	932
4:00	✓	✓	✓	✓	✓	✓	✓	✓		85	27	20	120	9	—	127			1198	—
5:00	✓	✓	✓	✓	✓	✓	✓	✓		104	27	18	120	9	—	136			1192	
6:00																				

DAYS 7A/M - 7P/M

OPERATOR [illegible]

TIME

WATER COLUMN BLOWDOWN ______

BOILER BLOWDOWN ______

NIGHTS 7P/M - 7A/M

OPERATOR KLS

TIME

WATER COLUMN BLOWDOWN ______

BOILER BLOWDOWN ______

Tenisha 1800-777-3167 ext 334

D-13

Champion
Champion International Corporation

Friday 11/10/??

HOUR	WATER LEVEL Boiler Drum #1	#2	#3	DA TANK	STORAGE TANK	PRESSURE DRUM	FEED WATER	DA TANK	DIESEL PUMP	DRAFT / PRESSURE UNDER GATE	FURNACE DRAFT	BOILER OUTLET	Boiler #1 ID Fan AMPS #1 INTR	#2 INTR	INSTRUMENT AIR	O2 #3	TEMPERATURE DA TANK	BOILER OUTLET	F.W.T.	#3 FURNACE
7:00 A	-.4	.1	2.2	-.3	✓	390	624	24	125		-.30		235		70	8.1	252	628		1499
8:00	-.3	0	.9	-.8	low	443	602	12	125		-.26		239		70	6.2	248	669		1463
9:00	-.1	-.4	.6	-.3	low	408	564	28	125		-.12		[illegible]		70	5.5	250	652		1377
10:00	.4	.1	.7	.6	✓	332	582	15	135		-.23		238		70	2.6	246	713		1332
11:00	Raking Grates																			
12:00	Raking Grates																			
1:00 P																				
2:00	Raking Grates																			
3:00	-.2	.1	.2	.0	✓	452	542	22	125		-.21		235		70	6.6	249	711		1496
4:00	-.2	.1	1.2	-.2	✓	429	646	16	125		-.24		223		70	6.8	243	706		1432
5:00	Raking Grates																			
6:00																				
7:00	-.1	.8	1.2	-.7	.	450	610	14	125		-.28		230		70	9.0	245	725		1480
8:00	-.2	.5	1.2	-.5	✓	457	552	16	125		-.22		223		70	9.4	250	672		1427
9:00	-.1	.3	.1	-.6	✓	452	593	25	125		-.09		223		70	7.2	259	714		1449
10:00	-.5	.7	0	-.5	✓	425	614	21	125		-.07		217		70	5.3	255	733		1470
11:00	-.2	.6	.1	-.4	.	420	611	11	125		-.08		214		70	6.5	235	704		1469
12:00	-.3	.1	0	-.3	✓	435	557	29	125		-.27		214		70	6.0	258	714		1478
1:00 A	-.5	-.1	.1	0	✓	400	579	25	125		-.24		217		70	5.5	254	710		1452
2:00	-.4	.2	-.3	-4	✓	444	544	32	125		-.20		223		70	6.3	265	726		1457
3:00	-.1	.1	0	0	✓	432	520	26	125		-.23		223		70	8.0	256	707		1386
4:00	-.2	-.3	.3	-.5	✓	446	604	25	125		-.21		214		70	5.7	245	726		1411
5:00	-.2	.3	.3	-.4	✓	456	537	35	125		-.26		217		70	7.0	267	720		1413
6:00	-.2	-.2	.1	-.6	✓	452	643	21	125		-.18		216		70	6.7	261	709		1444

HOUR	MECHANICAL DRIVES R.S.V.'S	SAND CLASS	I.D. FANS	I.D. FAN BEARINGS	F.D. FAN	F.D. TURBINE	SCRUBBERS	EMERGENCY STACKS	HOT ... DRIVES	STEAM FLOWS FLY	KILNS	TURBINE	PSI	#1	#2	#3	TDS	#3 UNIT PH	Furnace Temp #1	#2
7:00 A	✓	✓	✓	✓	✓	✓	✓	✓		126	30	21	110	9	11	144			1316	1359
8:00	✓	✓	✓	✓	✓	✓	✓	✓		123	26	18	110	11	16	132			1330	1405
9:00	✓	✓	✓	✓	✓	✓	✓	✓		103	38	17	110	13	19	133			1240	1345
10:00	✓	✓	✓	✓	✓	✓	✓	✓		128	37	19	110	19	21	149			1334	1355
11:00																				
12:00																				
1:00 P																				
2:00																				
3:00	✓	✓	✓	✓	✓	✓	✓	✓		129	30	17	100	16	17	143			1434	1340
4:00	✓	✓	✓	✓	✓	✓	✓	✓		128	31	19	100	15	20	134	✓		1440	1356
5:00																				
6:00																				
7:00	✓	✓	✓	✓	✓	✓	✓	✓		129	29	18	100	16	12	147			1400	1277
8:00	✓	✓	✓	✓	✓	✓	✓	✓		121	28	18	100	16	14	148	✓		1354	1222
9:00	✓	✓	✓	✓	✓	✓	✓	✓		124	29	20	120	17	11	144			1320	1212
10:00	✓	✓	✓	✓	✓	✓	✓	✓		127	30	21	120	15	7	156	✓		1396	1210
11:00	✓	✓	✓	✓	✓	✓	✓	✓		127	25	20	120	15	21	130			1364	1293
12:00	✓	✓	✓	✓	✓	✓	✓	✓		120	36	20	120	13	15	148			1416	1141
1:00 A	✓	✓	✓	✓	✓	✓	✓	✓		124	37	22	120	13	18	149	✓		1314	1286
2:00	✓	✓	✓	✓	✓	✓	✓	✓		125	34	20	120	13	16	145			1383	1343
3:00	✓	✓	✓	✓	✓	✓	✓	✓		126	32	20	120	17	17	147	✓		1304	1322
4:00	✓	✓	✓	✓	✓	✓	✓	✓		120	31	20	120	8	12	150			1012	1351
5:00	✓	✓	✓	✓	✓	✓	✓	✓		123	30	19	120	11	13	149			1243	1329
6:00	✓	✓	✓	✓	✓	✓	✓	✓		125	30	19	120	11	17	148			1253	1364

DAYS 7A/M - 7P/M

OPERATOR [illegible]

TIME

WATER COLUMN BLOWDOWN ______

BOILER BLOWDOWN ______

NIGHTS 7P/M - 7A/M

OPERATOR JTP

TIME

WATER COLUMN BLOWDOWN

BOILER BLOWDOWN

D-14

Champion International Corporation

Monday 11/2/[illegible]

HOUR	WATER LEVEL Boiler Drum #1	#2	#3	DA TANK	STORAGE TANK	PRESSURE DRUM	FEED WATER	DA TANK	DIESEL PUMP	DRAFT / PRESSURE UNDER GATE	FURNACE DRAFT	BOILER OUTLET	Boiler #1 ID Fan AMPS #1 MTR	#2 MTR	INSTRUMENT AIR	O_2	TEMPERATURE DA TANK	BOILER OUTLET	F.W.P.	#3 FURNACE
7:00 A																				
8:00	.2	0	.3	18	✓	539	664	41	125		.46		167		70	10.0	277	721		1349
9:00	0	.2	.1	2	✓	525	662	45	125		.19		167		70	11.4	280	633		1324
10:00	0	.1	.2	2	✓	537	637	34	125		.39		166		70	6.6	279	715		1425
11:00	.1	0	.2	1	✓	525	651	36	125		.44		162		70	5.6	279	727		1452
12:00	.1	0	.5	3	✓	540	716	42	125		.34		171		[illegible]	7.1	282	697		1475
1:00 P	.1	.1	.3	3	✓	534	691	39	125		.33		184		70	9.9	276	737		1446
2:00	.1	.1	.2	4	✓	530	654	39	125		.36		166		70	10.3	286	670		1403
3:00	[illegible]	.1	.0	3	✓	533	653	43	125		.39		164		70	10.0	278	735		1500
4:00	Ra Kings [illegible]																			
5:00																				
6:00	.1	.5	.3	.2	✓	533	592	41	125		.47		213		70	9.8	281	731		1405
7:00	0	.2	.2	-4	✓	525	699	46	125		-.33		196		70	10.4	282	754		1367
8:00	.1	-.2	-.3	-19	✓	530	641	41	125		-.39		166		70	9.5	282	684		1352
9:00	-.1	.0	.1	-25	✓	532	638	34	125		-.19		166		70	9.1	271	697		1342
10:00	.2	.2	-.1	?	✓	511	656	40	125	1	-.09		171		70	9.1	282	699		1405
11:00	0	0	.4	?	✓	534	712	40	125		-.10		164		70	8.1	284	693		1393
12:00	-.2	.5	-1.4	?	✓	531	614	35	125		-.22		169		70	8.7	279	716		1503
1:00 A	-.1	.2	0	?	✓	521	604	36	125		-.16		169		70	5.7	279	729		1369
2:00	0	.1	-.7	?	✓	528	627	41	125		-.15		169		70	9.0	283	646		1314
3:00	-.1	.1	-.5	?	✓	527	671	38	125		-.11		194		70	9.3	283	749		1356
4:00	-.1	0	0	?	✓	516	675	41	125		-.30		192		70	8.4	283	762		1333
5:00	0	.2	0	?	✓	539	637	36	125		-.34		212		70	7.8	281	754		1390
6:00	.2	.5	.2	?	✓	487	717	36	125		-.30		196		70	9.7	281	809		1288

HOUR	MECHANICAL DRIVES R.S.V.'S	SAND CLASS	I.D. FANS	I.D. FAN BEARINGS	G.A.S.	I.D. TURBINE	SCRUBBERS	EMERGENCY STACKS	CONVEYOR DRIVES	STEAM FLOWS [illegible]	KILNS	TURBINE	[illegible]	#1	#2	#3	[illegible]	[illegible]	[illegible] #1	#2
7:00 A																				
8:00	✓	✓	✓	✓	✓	✓				125	43	16	120	13	13	136			1363	1312
9:00	✓	✓	✓	✓	✓	✓				99	40	16	120	11	13	127			[illegible]	1394
10:00	✓	✓	✓	✓	✓	✓		✓	✓	109	41	15	125	13	13	145			1351	1391
11:00	✓	✓	✓		✓	✓			✓	122	41	14	130	15	15	135			1365	1363
12:00	✓	✓	✓	✓	✓	✓			✓	129	41	15	120	13	15	140			1396	1364
1:00 P	✓	✓	✓	✓		✓	✓		✓	131	39	16	120	14	14	142			1354	1362
2:00	✓	✓	✓	✓		✓	✓	✓	✓	127	33	15	120	15	13	125			1376	1371
3:00	✓	✓	✓							131	47	15	120	14	14	140			[illegible]	1333
4:00																				
5:00																				
6:00										125	41	16	120	14	15	142			1370	1376
7:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	126	39	18	120	12	13	142			1328	1368
8:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	105	40	14	120	12	14	122			1262	1300
9:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	103	37	15	120	9	13	118			1239	1292
10:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	127	37	15	120	12	12	141			1277	1287
11:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	122	33	14	120	10	10	135			1236	1281
12:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	120	51	16	120	14	17	146	✓		1272	1241
1:00 A	✓	✓	✓	✓	✓	✓	✓	✓	✓	117	47	15	120	12	12	142			1274	1283
2:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	128	43	15	120	11	12	149			1266	1298
3:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	122	41	17	120	11	11	143			1259	1287
4:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	131	40	18	120	11	12	150			1247	1310
5:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	135	38	18	120	14	15	149	✓		1366	1364
6:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	129	37	18	120	15	13	139			1328	1277

DAYS 7A/M - 7P/M

OPERATOR [signature]

	TIME
WATER COLUMN BLOWDOWN	7:45
BOILER BLOWDOWN	

NIGHTS 7P/M - 7A/M

OPERATOR [signature]

	TIME
WATER COLUMN BLOWDOWN	
BOILER BLOWDOWN	

Champion
Champion International Corporation

Friday Nov. 2/1992

HOUR	WATER LEVEL Boiler Drum #1	#2	#3	DA TANK	STORAGE TANK	PRESSURE DRUM	FEED WATER	DA TANK	DIESEL PUMP	DRAFT / PRESSURE UNDER GATE	FURNACE DRAFT	BOILER OUTLET	Boiler #1 ID Fan AMPS #1 MTR	#2 MTR	INSTRUMENT AIR	O2	TEMPERATURE DA TANK	BOILER OUTLET	F.W.P.	#2 FURNACE
7:00 A	.2	.3	-.3	✓	✓	533	255	29	125		-.32		176		11	11.1	265	642		1170
8:00	.1	-.2	.2	✓	✓	527	696	34	125		-.38		166		70	14.0	279	680		1329
9:00	.1	-.1	0	✓	✓	538	668	37	125		-.43		210		70	7.0	278	735		1420
10:00	Rake Grates																277	719		
11:00	0	-.2	.1	✓	✓	536	634	34	125		-.40		196		70	9.9	277	719		1319
12:00	.1	.2	0	✓	✓	530	658	32	125		-.39		176		70	8.4	277	716		1439
1:00 P	-.1	.1	-.6	✓	✓	531	599	38	125		-.37		173		70	9.5	242	693		1468
2:00	-.1	0	.4	✓	✓	524	714	36	125		-.31		180		70	10.7	279	766		1447
3:00	-.1	0	-.1	✓	✓	529	654	36	125		-.37		217		70	7.8	241	804		1456
4:00	0	0	-.4	✓	✓	527	595	37	125		-.36		187		70	9.4	282	723		1444
5:00	Rake Grates																			
6:00	.1	-.2	-.1	✓	✓	536	587	38	125		-.32		201		70	8.6	241	766		1455
7:00	0	-.3	-.1	✓		538	676	40	125		-.47		164		70	10.2	283	703		1477
8:00	0	.2	.5	✓	✓	537	732	40	125		-.29		166		70	9.3	281	729		1492
9:00	-.2	-.1	-.3	✓	✓	525	624	39	125		-.34		176		70	10.7	279	733		1578
10:00	-.1	0	-.1	✓	✓	523	641	43	125		-.17		157		70	7.8	284	683		1420
11:00	-.1	.1	0	✓	✓	537	733	36	125		-.30		180		70	11.2	279	726		1473
12:00	0	-.2	0	✓	✓	534	629	35	125		-.21		205		70	7.5	275	753		1501
1:00 A	.1	0	-.8	✓	✓	530	603	34	125		-.18		173		70	9.3	276	701		1508
2:00	.1	-.1	.1	✓	✓	529	653	39	125		-.10		207		70	6.7	275	693		1523
3:00	-.2	-.1	0	✓	✓	518	642	37	125		-.12		178		70	10.3	277	692		1487
4:00	0	0	-.4	✓	✓	521	592	33	125		-.25		189		70	7.7	274	727		1471
5:00	.1	0	.4	✓	✓	541	737	34	125		-.57		203		70	10.3	274	298		1557
6:00	0	0	1.0	✓	✓	524	656	38	125		-.12		177		70	8.2	281	737		1422

HOUR	MECHANICAL DRIVES RSVS	SAND CLASS	ID FANS	ID FAN BEARINGS	FD FAN	FD TURBINE	SCRUBBERS	EMERGENCY STACKS	[illegible] DRIVES	STEAM FLOWS [illegible]	KILNS	TURBINE	PSI	#	#	#	TDS	UNIT PH	Furnace Temp #1	#2
7:00 A	✓	✓	✓	✓	✓	✓	✓	✓	✓	107	45	7	120	12	8	121			1409	1371
8:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	104	44	16	120	20	17	114			1503	1432
9:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	105	44	16	120	15	19	120			1367	1430
10:00																				
11:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	129	34	16	120	19	17	131			1512	1433
12:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	128	38	16	120	20	18	132			1550	1445
1:00 P	✓	✓	✓	✓	✓	✓	✓	✓	✓	128	37	16	120	13	16	132			1468	1432
2:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	131	39	17	120	12	15	129			1356	1438
3:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	135	37	19	120	5	17	154	✓		1047	1434
4:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	131	37	11	120	6	19	145			1040	1428
5:00																				
6:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	130	55	16	120	15	20	135			1361	1456
7:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	126	34	15	120	16	19	128			1403	1457
8:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	129	28	15	120	17	16	132			1319	1346
9:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	122	44	16	120	14	16	148	✓		1316	1345
10:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	121	36	14	120	13	9	136			1318	1323
11:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	121	51	16	120	13	15	146			1317	1347
12:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	121	46	18	120	7	15	148			1088	1342
1:00 A	✓	✓	✓	✓	✓	✓	✓	✓	✓	127	45	15	120	13	15	145			1335	1340
2:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	131	43	18	120	14	15	149	✓		1329	1348
3:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	126	44	16	120	18	16	141			1392	1357
4:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	126	43	17	120	14	12	147			1339	1287
5:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	130	41	18	120	14	16	147	✓		1394	1331
6:00	✓	✓	✓	✓	✓	✓	✓	✓	✓		43	15	120	14	14	141			1344	1368

DAYS 7A/M - 7P/M

Pushup
#1 sump pit

OPERATOR [illegible]

TIME

WATER COLUMN BLOWDOWN ______

BOILER BLOWDOWN ______

NIGHTS 7P/M - 7A/M

OPERATOR [illegible]

TIME

WATER COLUMN BLOWDOWN ______

BOILER BLOWDOWN ______

![Champion — Champion International Corporation]

Monday 11/10/97

HOUR	WATER LEVEL Boiler Drum #1	#2	#3	DA Tank	Storage Tank	PRESSURE Drum	Feed Water	DA Tank	Diesel Pump	DRAFT / PRESSURE Under Gate	Furnace Draft	Boiler Outlet	Boiler #3 ID Fan AMPS #1 MTR	#2 MTR	Instrument Air	O2 % O2	TEMPERATURE DA Tank	Boiler Outlet	F.W.P	#1 Furnace
7:00 A	.1	.0	-.4	-.5	✓	539	731	37	125		.23		164		70	8.3	279	684		1338
8:00	0	-.1	.2	.5	✓	525	664	32	125		.12	-	151		70	10.3	274	661		1359
9:00	-.1	0	0	.4	✓	521	721	38	125		.21		116		70	10.0	281	738		1381
10:00	0	.2	.2	.3	✓	534	664	43	125		.21		162		70	10.3	283	695		1324
11:00	.1	.1	0	.5	✓	535	714	35	125		.24		170		70	9.0	280	734		1349
12:00	0	-.1	.2	5	✓	525	716	40	125		.21		173		70	10.3	271	697		1405
1:00 P	-.1	-.1	.3	5	✓	543	715	38	125		.25		171		70	10.2	279	701		1423
2:00	-.1	.1	.2	.1	✓	523	647	39	125		.12		173		70	9.0	218	615		1395
3:00	.1	.1	.2	.1	✓	532	654	31	125		.14		174		[illegible]	10.3	275	713		1353
4:00	.1	.1	0	.5	✓	524	737	35	125		.16		166		70	9.9	277	707		1411
5:00	.1	-.1	0	.3	✓	532	651		Rocking grates											
6:00	1	.1	0	.3	✓	530	651	37	125		.20		176		70	8.1	273	717		1481
7:00	0	0	0	.4	✓	523	682	36	125		.18		176		70	10.0	277	742		1431
8:00	.2	.1	.1	.2	✓	527	678	39	125		.23		195		70	10.3	278	721		1495
9:00	.2	.1	.1	.5	✓	530	612	36	125		.26		198		70	10.2	296	736		1450
10:00	.1	0	.1	.3	✓	529	720	40	125		.19		153		70	10.4	280	631		1290
11:00	0	.3	.3	.4	✓	552	725	33	125		.53		160		70	12.2	269	658		1339
12:00	.1	.2	0	1	✓	539	722	37	125		.40		164		70	11.1	275	680		1390
1:00 A	.2	.1	0	.4	✓	535	611	35	125		.32		182		70	9.3	223	766		1524
2:00																				
3:00	.1	.2	.1	.4	✓	539	687	36	125		.40		169		70	9.9	279	723		1503
4:00	.1	.1	.1	.5	✓	536	622	39	125		.37		185		70	10.2	229	734		1541
5:00																				
6:00	.1	0	.2	.4	✓	534	700	32	125		.28		150		70	10.0	225	662		1414

HOUR	MECHANICAL DRIVES R.W.S.	Sand Class	I.D. Fans	I.D. Fan Bearings	F.D. Fan	F.D. Turbine	Scrubbers	Emergency Stacks	Drive	STEAM FLOWS PM	Kilns	Turbine	PSI	#1	#2	#3	TDS	pH		Furnace Temp #1	#2
7:00 A	✓	✓	✓	✓	✓	✓	✓	✓	✓	97	41	12	120	13	14	111				1281	1310
8:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	94	48	14	120	12	14	113				1274	1311
9:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	104	38	16	120	12	14	121				1274	1304
10:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	96	39	14	120	15	13	112				1278	1314
11:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	105	37	15	120	12	15	120				1275	1324
12:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	107	37	15	120	12	13	123				1267	1326
1:00 P	✓	✓	✓	✓	✓	✓	✓	✓	✓	100	36	15	120	13	14	99				1266	1311
2:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	80	35	14	120	12	14	100				1254	1309
3:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	109	34	14	120	13	14	101				1255	1320
4:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	104	34	15	120	13	14	100				1259	1323
5:00																					
6:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	110	52	15	120	14	14	110				1252	1164
7:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	111	44	17	120	14	7	135				1296	1119
8:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	111	41	17	120	5	12	137				1165	1211
9:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	133	39	18	120	1	8	152				1229	1306
10:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	90	41	14	120	5	16	112				1029	1365
11:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	73	39	14	120	12	7	92				1301	1104
12:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	100	40	15	120	12	18	114				1231	1435
1:00 A	✓	✓	✓	✓	✓	✓	✓	✓	✓	121	51	16	120	14	12	148	✓			1310	1303
2:00																					
3:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	123	45	15	120	13	12	145				1309	1518
4:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	125	43	17	120	14	11	141				1312	1225
5:00																					
6:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	104	45	13	120	14	14	125				1334	1297

DAYS 7A/M - 7P/M

OPERATOR [illegible signature]

TIME

WATER COLUMN BLOWDOWN ______

BOILER BLOWDOWN ______

NIGHTS 7P/M - 7A/M

OPERATOR Wass

TIME

WATER COLUMN BLOWDOWN ______

BOILER BLOWDOWN

Champion
Champion International Corporation

Thursday 11/6/97

HOUR	WATER LEVEL Boiler Drum #1	#2	#3	DA TANK	STORAGE TANK	PRESSURE DRUM	FEED WATER	DA TANK	DIESEL PUMP	DRAFT / PRESSURE UNDER GATE	FURNACE DRAFT	BOILER OUTLET	Boiler #3 ID Fan AMPS #1 MTR	#2 MTR	INSTRUMENT AIR	O_2	TEMPERATURE DA TANK	BOILER OUTLET	F.W.P.	#3 FURNACE
7:00 A																				
8:00	.1																			
9:00	0	.1	.4	0	✓	[illegible]	685	32	125		.18		162		70	9.8	272	683	135	1440
10:00	0	.3	.2	.5	✓	535	640	28	125		.23		184		70	9.7	273	749	135	1421
11:00	.1	.1	.1	.25	✓	540	622	25	126		.21		173		70	10.7	268	721	135	1518
12:00	.1	0	0	.24	✓	537	682	32	125		.28		189		70	11.1	276	779	135	1479
1:00 P	0	.1	.1	?	✓	540	686	29	125		.38		171		70	10.7	273	722	135	1401
2:00	.1	.1	.9	?	✓	500	589	27	125		.22		196		70	10.1	271	753	135	1437
3:00	.1	0	.2	?	✓	538	641	30	125		.35		185		70	10.0	272	746	135	1489
4:00	0	.1	.2	?	✓	542	668	34	125		.38		171		70	10.6	275	727	135	1501
5:00	.2	0	.1	?	✓	537	632	29	125		.20		201		70	8.1	272	774	135	1571
6:00	.1	0	.3	?	✓	490	600	25	125		.31		189		70	10.8	265	658	135	1289
7:00	.1	0	.3	-	✓	512	671	30	125		.28		192		70	10.4	273	759	135	1479
8:00	.1	0	.2	-	✓	522	615	30	125		.14		178		70	9.7	275	720	135	1463
9:00	.1	.1	.1	-	✓	508	602	27	125		.16		192		70	9.5	266	790	135	1477
10:00	.1	0	.2	-	✓	531	621	31	125		.21		169		70	8.9	279		135	1461
11:00	.1	.1	.3	-	✓	517	636	34	125		.17		180		70	11.3	281	735	135	1417
12:00	.2	.2	.4	-	✓	523	631	27	125		.24		162		72	9.5	266	704	135	1411
1:00 A	.2	.1	.2	-	✓	530	632	33	125		.20		199		70	9.5	276	746	135	1477
2:00	.2	.2	.2	-	✓	530	599	26	125		.20		185		70	10.3	262	709	135	1398
3:00	.2	.1	.1	-	✓	533	712	30	125		.24		174		70	10.5	270	753	135	1433
4:00	.2	.2	.3	-	✓	526	638	31	125		.20		169		70	9.8	275	700	135	1429
5:00	.4	.3	.4	-	✓	536	691	37	125		.20		178		70	8.6	280	733	135	1475
6:00	0	0	0	-	✓	533	660	31	125		.12		178		70	7.9	277	721	135	1458

HOUR	MECHANICAL DRIVES R.S.V.'S	SAND CLASS	I.D. FANS	I.D. FAN BEARINGS	F.D. FAN	F.D. BURNERS	SCRUBBERS	EMERGENCY TANKS	[illegible]	STEAM FLOWS PLY	KILNS	TURBINE	TNT	#1	#2	#3	Furnace Temp #1	#2
7:00 A																		
8:00																		
9:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	114	45	15	112	17	17	128	1303	1317
10:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	114	43	16	120	15	15	131	1322	1291
11:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	127	41	16	120	13	14	142	1308	1303
12:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	128	41	18	120	12	14	146	1312	1254
1:00 P	✓	✓	✓	✓	✓	✓	✓	✓	✓	127	40	15	120	12	13	148	1298	1303
2:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	129	39	18	120	14	13	143	1290	1301
3:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	124	37	17	120	11	14	148	1301	1298
4:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	122	37	16	120	13	14	133	1303	1289
5:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	133	33	18	120	4	15	151	[illegible]	1321
6:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	115	29	16	120	15	16	128	1331	1301
7:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	129	50	17	120	12	14	156 ✓	1269	1285
8:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	124	45	17	120	12	14	147	1288	1291
9:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	126	42	18	120	—	14	140	1315	1307
10:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	121	41	15	120	15	14	135	1328	1294
11:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	119	39	17	120	14	15	136	1319	1298
12:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	120	39	16	120	13	14	134	1284	1306
1:00 A	✓	✓	✓	✓	✓	✓	✓	✓	✓	124	34	17	120	14	15	135	1365	1308
2:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	124	32	16	120	13	14	143	1305	1309
3:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	98	47	16	120	12	14	118	1339	1299
4:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	105	41	15	120	12	14	124	1278	1305
5:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	123	45	16	120	12	13	144	1272	1311
6:00	✓	✓	✓	✓	✓	✓	✓	✓	✓	125	44	16	120	11	14	144	1271	1292

DAYS 7A/M - 7P/M

OPERATOR [signature]

TIME

WATER COLUMN BLOWDOWN ________

BOILER BLOWDOWN ________

NIGHTS 7P/M - 7A/M

OPERATOR Morris

TIME

WATER COLUMN BLOWDOWN ________

BOILER BLOWDOWN ________

T.C. Boone 240

D-18

APPENDIX E

OZONE FORMATION MODELING RESULTS

Dom the following is a summary of the "worst case" VOC and NOx emissions associated with the Champion Camden Mill Kiln project.

Nitrogen Dioxide	255 lbs/day	50 tons/yr
VOC	1070 lbs/day	200 tons/yr

I believe the estimates are an upper bound on the emissions for these pollutants and that the actual emissions increase we will project will be less than these values.

Please call me at 610/701-7218 if you have questions or need additional information.
Have a nice Thanksgiving.

John Barone

cc: T. Kassabaum
J. Keane

B
7/7
2538

TNRCC
Protecting Texas by Reducing and Preventing Pollution

FAX TRANSMITTAL

DATE: 12/2/97 NUMBER OF PAGES *(including this cover sheet)*: 4

TO: Name: JOHN BARONE
Organization: WESTON
FAX Number: 610-701-7401

FROM: TEXAS NATURAL RESOURCE CONSERVATION COMMISSION
Name: DOM RUGGERI
Division/Region: NSRP
Telephone Number: 512-239-1508
FAX Number:

NOTES: John - here's a copy of the memo I gave Patrick + Kevin. Call if you have questions.

Dom

Texas Natural Resource Conservation Commission

INTEROFFICE MEMORANDUM

To:	Patrick Agumadu, Kevin Ellis Mechanical Section	Date:	December 2, 1997
From:	Dom Ruggeri, Team Leader Air Dispersion Modeling Team		
Subject:	Ozone Air Quality Analysis for Proposed Champion PSD Permit		

John Barone, Champion's consultant, gave me his estimate of worst-case emissions from the proposed PSD project near Camden, Texas. I used a screening procedure referred to as the Scheffe technique to conduct the evaluation. The technique calculates an ozone increment due to a VOC dominated point source (that is, VOC mass emissions greater than NO_x emissions). Based on my evaluation, the proposed emissions should not significantly affect the ozone standard in Polk County. In addition, we should be able to use ambient monitoring data from Jasper County to satisfy the preconstruction monitoring requirement that would be triggered by a VOC increase of 100 tons/year. The procedure and screening table are attached.

Attachments

Screening Procedure for Ozone Air Quality Analysis for Champion
Based on the Scheffe Table 1

Given:

Total Nonmethane VOCs (NMOC) = 200 tons/year
Maximum daily rate = 1070 lb/day = 195 tons/year
Total NO_x = 50 tons/year

Monitored 1-hour ozone concentration for 1992 in Jasper County = 0.110 parts per million (ppm).

Ozone increment = 0.015 ppm. The ozone increment is the difference between the monitoring standard of 0.125 ppm and the predicted increase in ozone due to the new or increased emissions. In this case, 0.125 - 0.110 ppm.

Screening Estimate Procedure:

- Determine the molar equivalent NMOC/NO_x ratio based on annual estimates. The molar equivalent conversion factor represents the ratio of NO_2 to CH_4 molecular weights and is used to relate the emissions to molar units consistent with ambient NMOC/NO_x ratios. Use this value to determine the appropriate column in the screening table. Table 1 is used because the facility is in a rural environment.

  200 / 50 (2.875) = 11.5 (column 3 of Table 1)

- Calculate the annual NMOC emission rate in tons/year from the daily maximum rate.

  Annual rate = 1070 lb/day = 195 tons/year (column 1 of Table 1). Applicant assumes 200 lb/day as worst case.

- Determine the ozone increment from the appropriate screening table.
  The ozone increment is determined from the following interpolation of columns 1 and 3 of Table 1:

  ozone increment = 0.75 pphm or 0.0075 ppm

- Add the delta to the maximum monitored ozone concentration to predict the worst-case impact of the addition of the Champion facility's emissions.

  0.0075 + 0.110 = 0.118 ppm. This concentration is below the monitoring standard of 0.125 ppm.

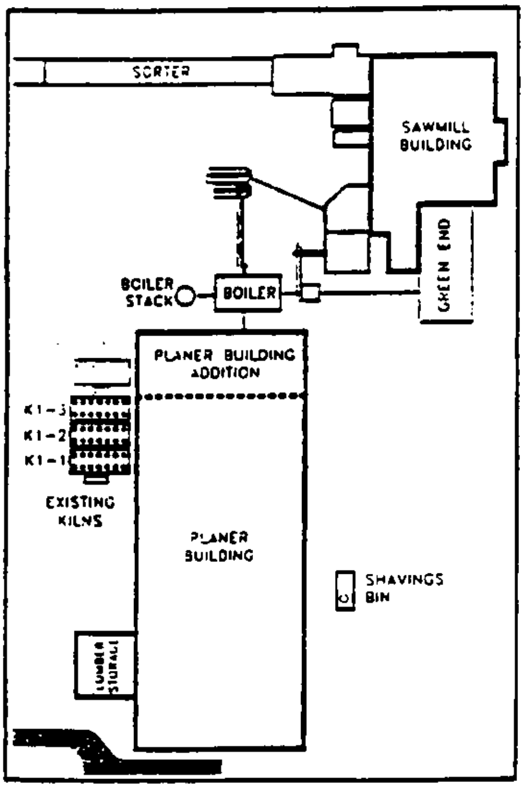
Table 1. Rural based ozone increment (pphm) as a function of NMOC emissions and NMOC/NOx ratios.

	NMOC/NOx TONS NMOC/TONS NOx (PPMC/PPM)		
1	2	3	4
NMOC EMISSIONS (TONS/YR) ↓ VOC	> 20.7 (> 20)	5.2-20.7 (5-20)	< 5.2 (< 5)
50	0.4	0.4	1.1
75	0.4	0.4	1.2
100	0.4	0.5	1.4
300	0.8	1.0	1.7
500	1.1	1.4	1.9
750	1.6	1.9	2.3
1000	2.0	2.4	2.7
1500	2.7	3.0	3.3
2000	3.4	3.8	3.7
3000	4.8	5.2	4.3
5000	7.0	7.5	4.8
7500	9.8	10.1	5.1
10000	12.2	12.9	5.4

* multiply pphm by 0.01 to obtain ppm

FINAL REPORT

PREVENTION OF SIGNIFICANT DETERIORATION (PSD) PERMIT APPLICATION FOR INTERNATIONAL PAPER COMPANY RIEGELWOOD, NORTH CAROLINA



Prepared for:

INTERNATIONAL PAPER

P.O. Box 57, Federal Road
Riegelwood, North Carolina

Prepared by:

Woodward-Clyde

3109 Poplarwood Court
Suite 301
Raleigh, North Carolina 27604

September 1996

Project No. 96R129

1.0
EXECUTIVE SUMMARY

1.1 BACKGROUND

Federal Paper Board Inc., a wholly-owned subsidiary of International Paper Company, proposes to construct a new lumber drying kiln at its Armour sawmill facility located in Riegelwood, North Carolina. This report constitutes a preconstruction permit application request for New Source Review (NSR) in accordance with the North Carolina regulations governing the Prevention of Significant Deterioration (PSD). The construction project is subject to PSD because the facili is considered a major stationary source, having the potential to emit 250 tons or mo er year of volatile organic compounds (VOCs) and carbon monoxide, and because the maximum emission increases of VOCs from the proposed kiln exceed PSD "significance rates" for VOC of 40 tons per year. This application also constitutes a request to discharge toxic air pollutants because the kiln project will result in a slight increase in emissions of two North Carolina toxic air pollutants (TAPs). This report contains air dispersion modeling analyses demonstrating that off-site maximum ambient air concentrations of these pollutants are well below concentrations considered hazardous to health, as specified in North Carolina regulation 15A NCAC 2D. 1100.

1.2 SUMMARY AND CONCLUSIONS

Under North Carolina's PSD program, preconstruction permit applications must assess the following in regards to installation of the proposed kiln: (1) best available control technology (BACT) for VOC emissions and (2) an "additional impacts analysis," which assesses potential air, soils, vegetation, and visibility impacts. The conclusion of the BACT analysis is that installation of air pollution controls are cost-ineffective and that a requirement to install air pollution controls would cause such severe economic impacts that installation of the kiln would make the project economically unviable. The conclusion reached in the additional impacts analysis is that potential adverse environmental impacts associated with installation of the lumber kiln would be insignificant and that beneficial impacts will actually be realized by the facility's increased capacity to use pine trees downed by Hurricane "Fran," which are readily available throughout eastern North Carolina.

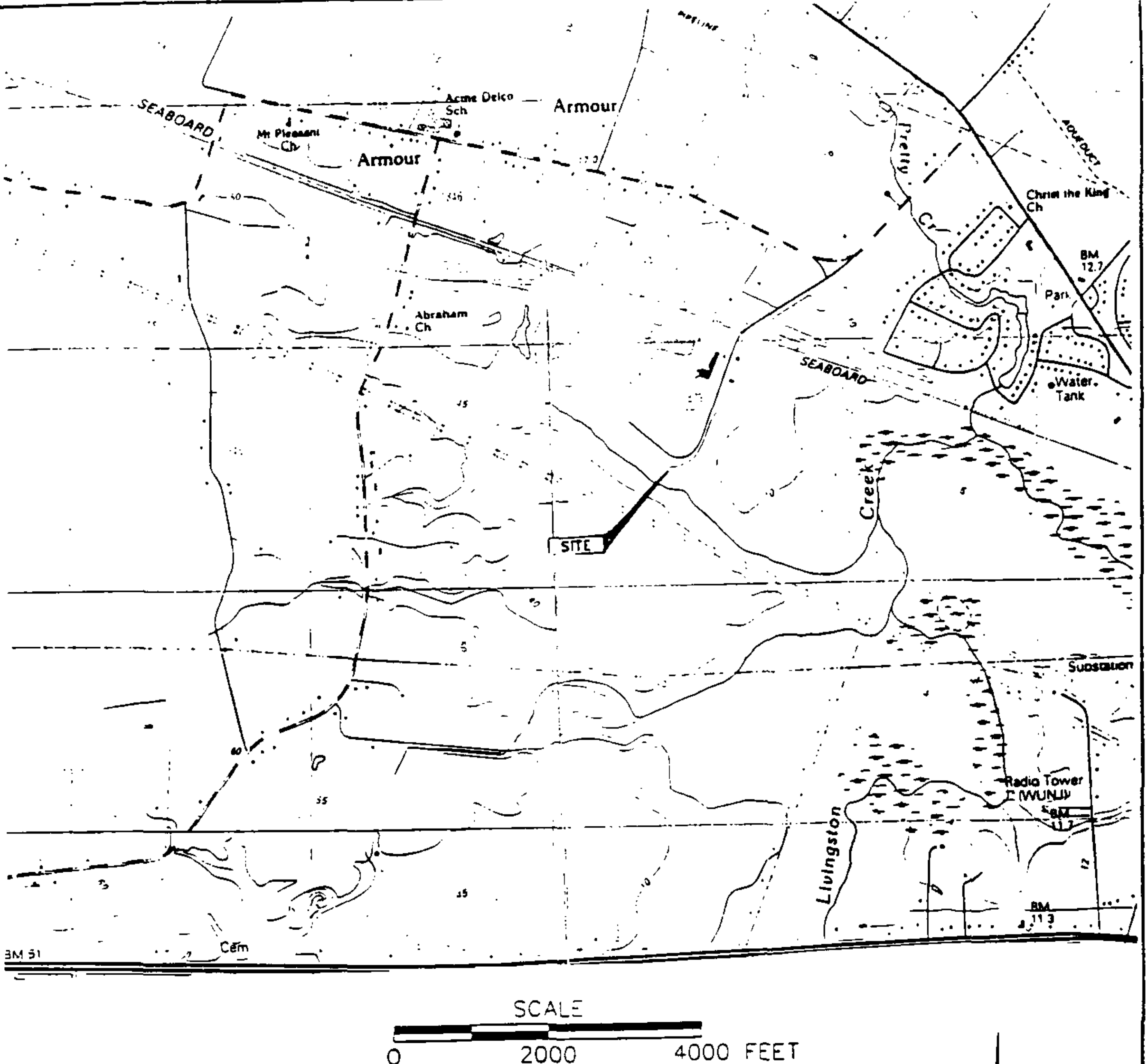
Due to emission increases associated with this project, formaldehyde and acetaldehyde are subject to permitting under the North Carolina Air Toxics Program and, consequently, air dispersion modeling was performed to demonstrate that emissions of these pollutants from the Armour facility will not cause or contribute to concentrations of toxic air pollutants exceeding allowable North Carolina acceptable ambient levels (AALs). Results from the modeling analysis indicate that maximum emission rates from all sources at the facility result in off-site concentrations of formaldehyde and acetaldehyde of approximately 0.2 percent and 13 percent, respectively, of the AALs. However, basing enforceable emission limitations on these estimated "worst-case" emission rates substantially increases the stringency of the permit limits beyond that of the North Carolina regulation and provides little or no flexibility for accommodating unforeseen changes in available emission factors or calculated emission rates. Thus, adopting these "worst-case" emission estimates as permit limits creates the potential for inadvertently exceeding the air permit limits even though the predicted ambient concentrations are significantly lower than the AALs allowed in 15A NCAC 2D. 1104. Therefore, is requesting emission limitations for formaldehyde and acetaldehyde which closely correspond to the AALs allowed in 15A NCAC 2D. 1104. This approach provides a window of operating flexibility that is well within compliance requirements, without being unduly restrictive. These "optimized" emission rates have been modeled and are outlined in this document.

1.3 PERMIT REQUEST

International Paper is committed to demonstrating compliance with all federal and North Carolina air quality protection requirements. This permit application fulfills all federal and North Carolina PSD application requirements specified in the relevant PSD regulations, the New Source Review Workshop Manual published by EPA, and by the North Carolina Division of Air Quality (NCDAQ) during a preapplication meeting in July 1996. Therefore, International Paper requests permission to construct a new lumber drying kiln and that a Permit to Construct the Operate under the North Carolina Air Quality Regulations be issued.

1.4 DOCUMENT CONTENTS AND ORGANIZATION

This application contains six additional sections and six appendices. Section 2.0 provides an overview of the facility and the proposed modification. Section 3.0 identifies the air quality regulatory requirements affecting the new lumber drying kiln. Sections 4.0 through 6.0 contains the PSD applicability, BACT, and additional impact analyses, respectively. Section 7.0 summarizes the North Carolina TAP modeling analysis and compliance demonstration.



Reference:

U.S. Geological Survey
Spring Hope Quadrangle
North Carolina
7.5 Minute Series (Topographic)
National Geodetic Vertical Datum
1978

FIGURE 2-1
SITE LOCATION MAP
INTERNATIONAL PAPER - ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

FIG. NO.
2-1

2.0
SITE AND PROCESS DESCRIPTIONS

2.1 SITE DESCRIPTION

The International Paper Armour facility is located in Columbus County, North Carolina, which is in the southeastern corner of the state. A site location map with topographical features is presented in Figure 2-1. Based on area classification systems recognized by EPA, the facility is located in a rural section of the state. EPA guidance shows two alternative procedures to determine whether the character of an area is predominately urban or rural: (1) land use typing or (2) population density. The area classification system as described by Auer in the Journal of Applied Meteorology, Vol. 17 pg. 636-643, 1978, Correlation of Land Use and Cover With Meteorological Anomalies, was used to classify the area as rural. This system uses USGS maps and an area 3 kilometers in radius around a source in the determination.

2.1.1 Class I Areas

There are no Class I areas within 100 kilometers (60 miles) of the Armour facility.

2.1.2 Topography

The Armour facility is located near the southern coast of North Carolina. The terrain surrounding the site is predominantly flat with elevations changing only a few feet within several kilometers of the plant site. Therefore, intermediate or complex terrain is not required in the air dispersion modeling analysis presented in Section 7.0 of this report.

2.1.3 Climatology and Meteorology

The site lies within a general climatic region known as Humid Subtropical. Temperatures are moderate with long summers and brief winters. An extended summer drought may result from

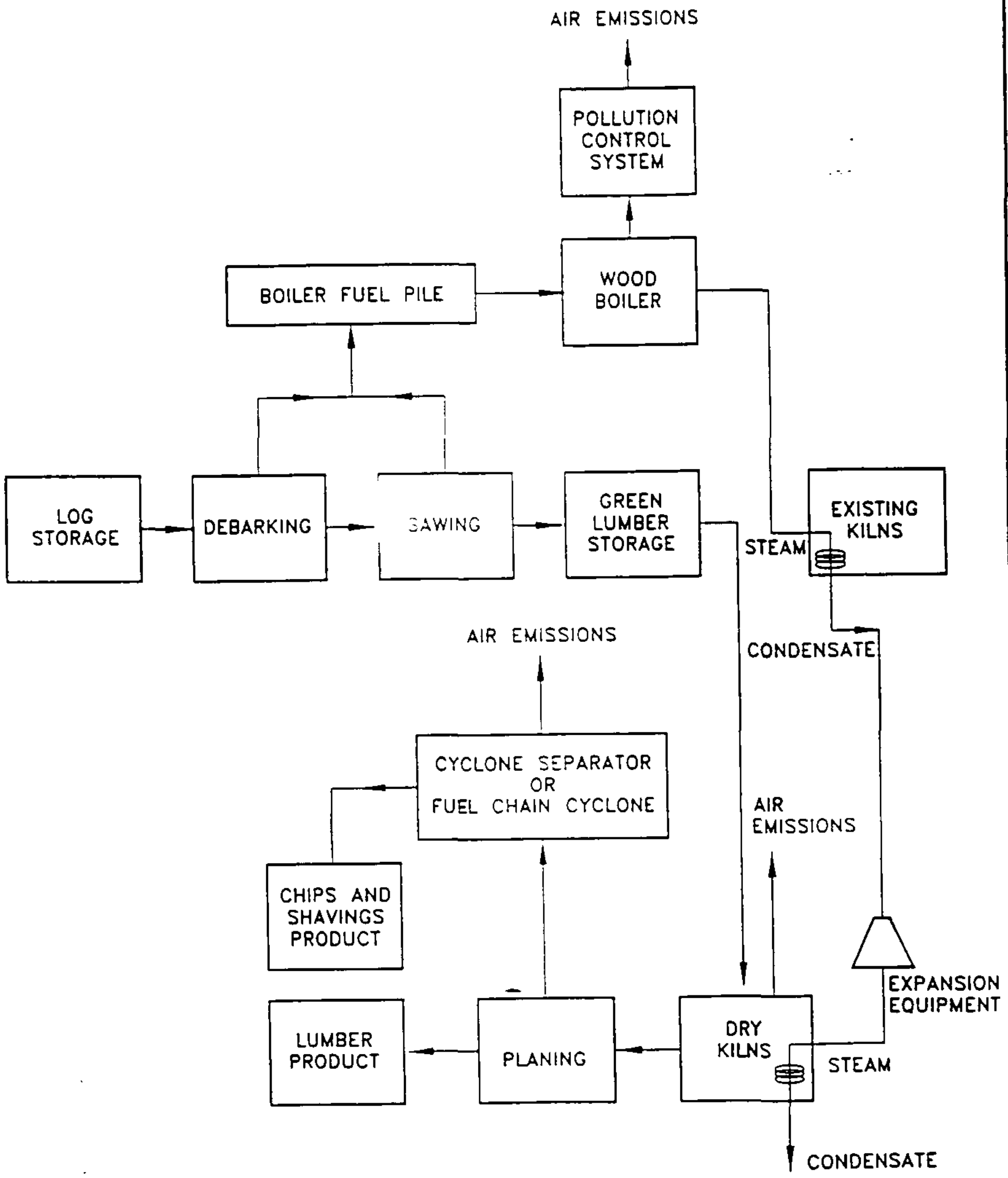


FIGURE 2-2
SIMPLIFIED LUMBER MANUFACTURING PROCESS FLOW DIAGRAM
INTERNATIONAL PAPER - ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

Location: HOUSTON, TX. CADD 1, File name: K:\DWG\96R129\PFD.DWG Last edited: 09/12/96 @ 13:29

dominance of the Bermuda high pressure off the east coast. Warm, moist air from the tropics dominates summer conditions while cooler, drier continental polar air typically controls winter weather.

Daily mean air temperatures over most of eastern North Carolina range between 41°F and 50°F in January, the coldest month, and between 75°F and 81°F in July, the warmest month. Annual precipitation averages about 50 inches per year throughout the basin.

2.2 PROCESS DESCRIPTIONS

2.2.1 Existing Operations

International Paper's Armour sawmill facility is located on Federal Road in Columbus County. The primary product manufactured at this facility is southern yellow pine dimensional lumber, corresponding to a standard industrial classification (SIC) code of 2421. The facility is located on 184 acres and employs approximately 183 full time employees. The debarking, planing, sawing, and production units operate 52 weeks per year, 5 days a week, and 16 hours per day. Some units such as the wood-fired boiler and lumber drying kilns, are operated on a 24 hour per day, 7 day a week schedule. A plot of the facility is included with the preconstruction permit application forms in Appendix A.

A simplified process flow diagram for lumber manufacturing is presented in Figure 2-2. Air emission sources identified on this diagram are permitted to operate under North Carolina Air Permit No. 2248R10. All air emission sources covered by this modification request are identified in Figure 2-3.

In the lumber manufacturing process, pine logs are trucked in, debarked, and cut into appropriate dimensions in the sawmill. The green lumber is then planed and dried. Three steam-fired kilns are used to dry the lumber reducing moisture content from approximately 50 to 20 percent. Steam is provided by a 93 million Btu/hr wood-fired boiler. The dried lumber is sorted by length, size, and grade and transported by truck or rail for delivery to customers.

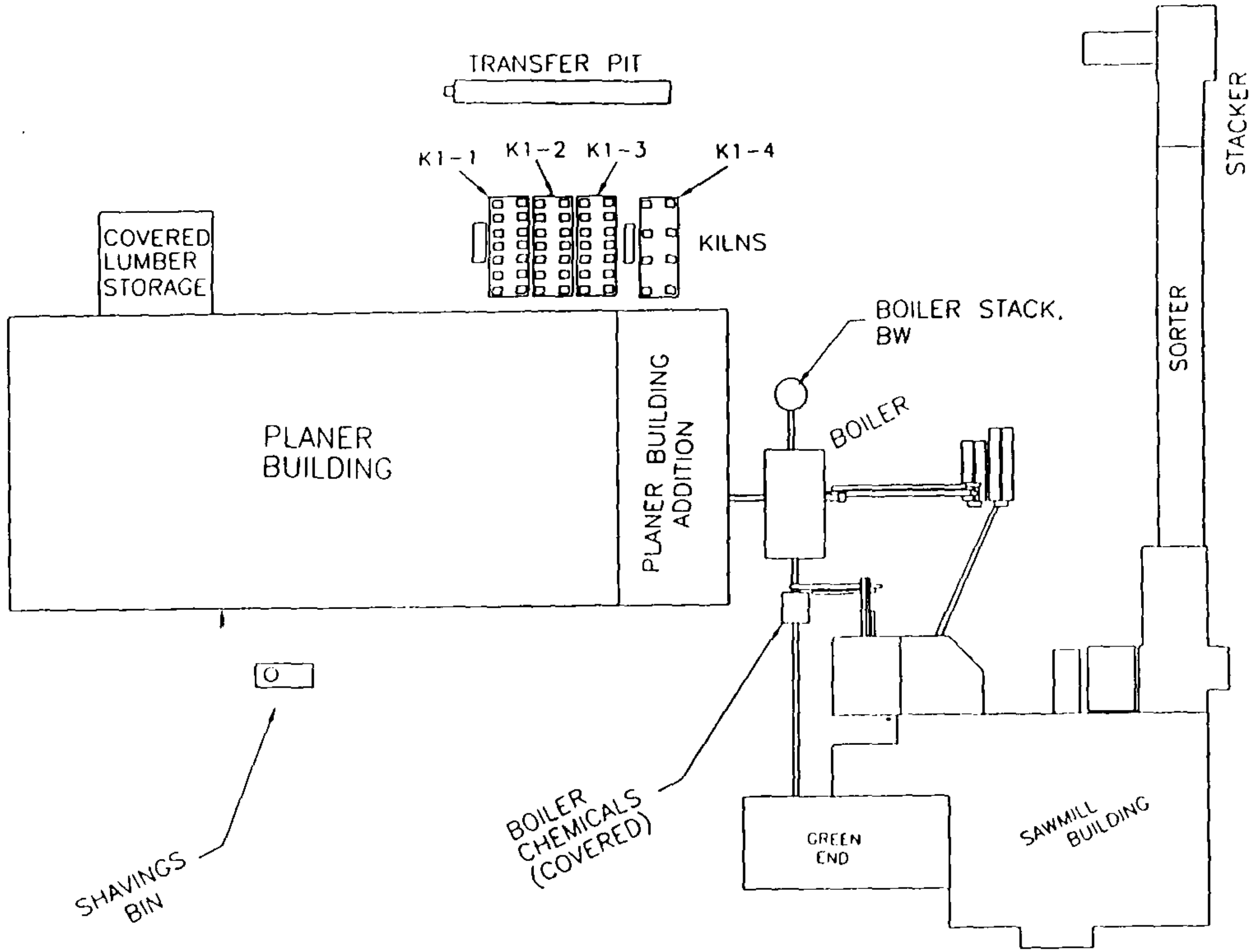


FIGURE 2-3
LOCATION OF AIR EMISSION SOURCES (MODELED SOURCES ONLY)
INTERNATIONAL PAPER - ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

FIG NO 2-2

Secondary products generated at this facility are wood chips, sawdust, bark, and shavings. Wood chips and shavings created from the sawing and planing processes are collected by the cyclone separator and fuel chain cyclone. Chips and shavings collected by the cyclone separator are sold and shipped off-site; those collected by the fuel chain cyclone are used to fuel the wood-fired boiler.

2.2.2 Proposed Modification

With this application, International Paper is proposing to increase the capacity of the Armour facility by 32.9 million board feet per year. The maximum capacity of the proposed kiln is 135,000 board feet per drying cycle, with each drying cycle requiring 36 hours. The kiln is to be located adjacent to the three existing kilns at the facility, as shown in Figure 2-3. A schematic of the proposed kiln is presented in Figure 2-4.

Drying is accomplished by circulating heated air over stacked "green" lumber. Moisture removed from the lumber is exhausted through vents located in the roof of the kiln. Kiln temperatures and relative humidity are carefully controlled throughout the drying cycle via control of heat input and adjustment of fresh air intake to and moist air exhaust from the kiln. Temperatures during a typical drying cycle range from approximately 170 to 220°F, dry bulb, and remain fairly constant at 160°F, wet bulb.

Heating in the kiln is to be accomplished using "flash steam" generated from the thermal energy retained in the waste steam condensate from the three existing kilns and supplemented as necessary by steam from the facility's wood-fired boiler. Flash steam is to be produced by reducing the 150 pounds per square inch gauge (psig) pressure of condensate from the existing kilns to a pressure of approximately 25 psig, which revolatilizes ("flashes") a significant amount of condensate to steam. Currently, the thermal energy of the condensate from the existing kilns is not utilized.

3.0
REGULATORY APPLICABILITY

3.1 INTRODUCTION

The purpose of this section is to summarize all federal and state regulations that are applicable to operation of the proposed kiln and to explain why certain regulations applicable to the kiln. Regulatory applicability discussions are separated into two categories: 1) federally-enforceable requirements and 2) state-only requirements. Requirements are presented in this format to facilitate their incorporation into the facility's "Title V" Operating Permit, which is to contain separate sections for federally-enforceable and state-only permit requirements. A Title V permit application has already been submitted by International Paper to the NCDAQ for the Armour facility.

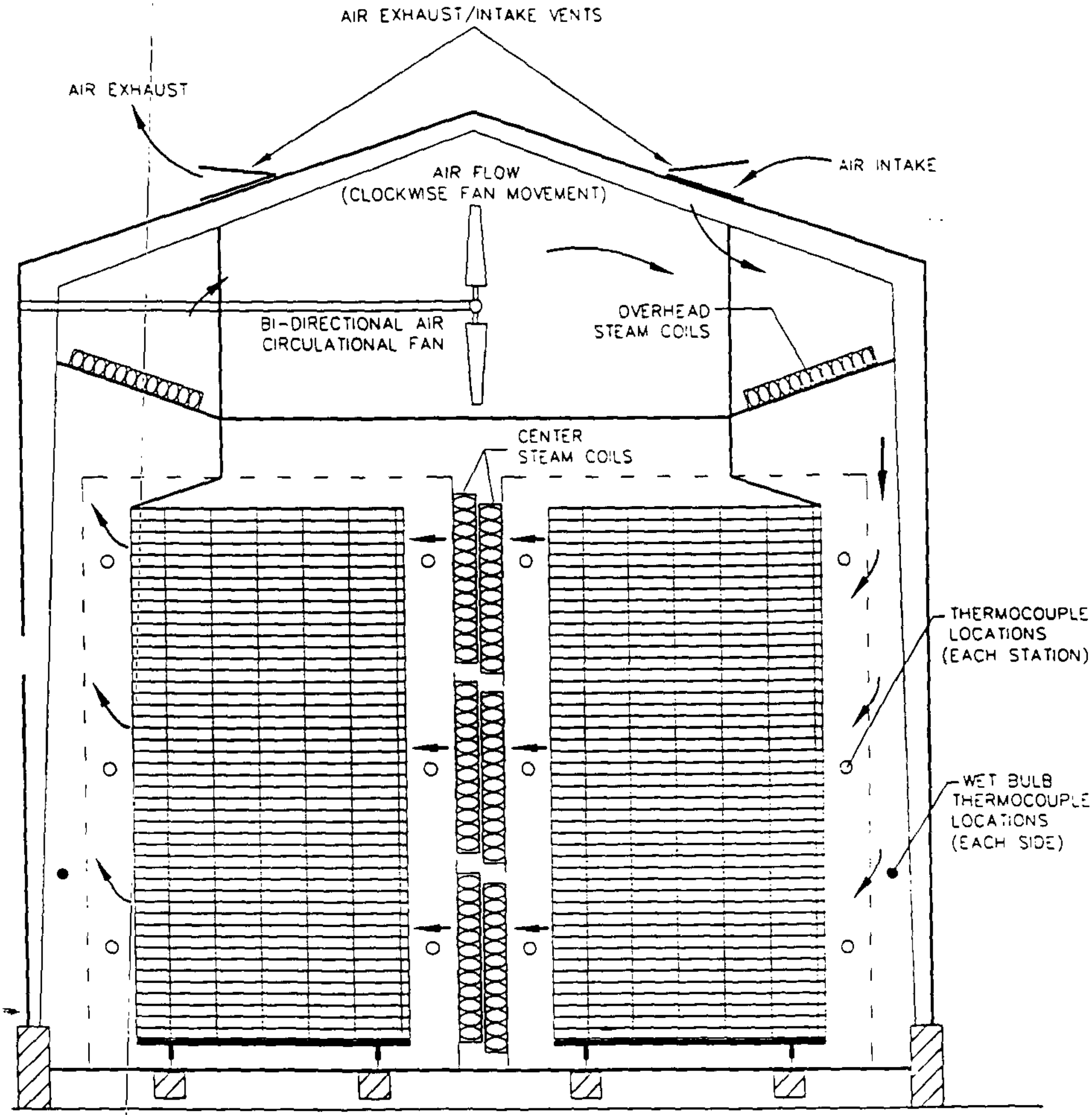
3.2 FEDERALLY-ENFORCEABLE REQUIREMENTS

This section describes applicable and important non-applicable regulations considered federally enforceable under North Carolina regulations. In this regulatory analysis for the proposed kiln, the following regulations were considered federally enforceable and were reviewed for potential applicability:

- Federal regulations that have been promulgated pursuant to the Clean Air Act, as amended in 1990; and
- North Carolina regulations that are part of the State Implementation Plan (SIP) approved by the EPA.

3.2.1 Applicable Requirements

Only two federally-enforceable regulation applies to operation of the proposed kiln, as described below.



Location: HOUSTON, TX. CAD 2, file name: C:\BLOCKS\BASE11.DWG Last edited 01/10/94 @ 10:54

FIGURE 2-4
SCHEMATIC OF LUMBER DRYING KILN
INTERNATIONAL PAPER - ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

visible emissions (EPA Reference Method 9) and, hence, emissions of water vapor do not trigger applicability of this regulation.

3.3 STATE-ONLY REQUIREMENTS

States may impose requirements upon a facility that are not based on federal regulations or are not specified in SIP regulations. These requirements are considered "state-only" requirements and are identified as such in this report to clarify to both the NCDAQ and to International Paper those conditions with which the facility must comply, but are not considered federally enforceable. Unlike the previous subsection discussing non-applicable federally-enforceable requirements, this section does not discuss non-applicable state-only requirements because there is clearly just one state-only regulation applicable to the new kiln.

The only state-only regulation that applies to the Armour facility is Control of Toxic Air Pollutants (15A NCAC 2D .1100), which prohibits new and modified sources of toxic air pollutants from emitting in quantities which cause or contribute to ambient air concentrations exceeding regulated levels. Section 7.0 of this report presents an analysis demonstrating applicability and compliance with this regulation.

Prevention of Significant Deterioration (15A NCAC 2D .0530). The North Carolina PSD regulations are designed to prevent significant deterioration of ambient air quality and deleterious impacts to the environment from major modifications at major sources of PSD pollutant emissions. PSD requires a number of environmental impact and pollution control technology assessments prior to construction, as well as continuing emission limitations after a PSD permit is issued.

This report and accompanying permit application forms fulfill all application requirements under North Carolina's PSD program. The only "continuing" requirement affecting the kiln upon issuance of a Permit to Construct and Operate will be to operate within the emission limits considered Best Available Control Technology (BACT) for VOC emissions (see Section 5.0). There are no PSD requirements associated with any other emission sources at the facility.

3.2.2 Non-Applicable Requirements

There are several key regulations that are sometimes applicable to emission units similar to the kiln, but are not applicable to the kiln proposed for the Armour facility. A brief discussion of each of these regulations is provided below to substantiate these findings.

Miscellaneous Volatile Organic Compound Emissions (15A NCAC 2D .0518) is a regulation that is applicable to various liquid hydrocarbon storage vessels and to equipment used to apply, evaporate, or dry photochemically reactive solvents. The proposed kiln does not meet either of these applicability criteria.

Particulates From Miscellaneous Industrial Processes (15A NCAC 2D .0515) does not apply because only VOC and water are emitted from the kiln.

Control of Visible Emissions (15A NCAC 2D .0521) does not apply because insignificant quantities of "visible emissions" are emitted from the kiln. Water vapor is emitted from the kiln and is visible; however, it is not measured using EPA's test method for quantifying

Detailed emission increase calculations are presented in Table 4-1; however, a brief summary of the calculations is provided below.

4.2.1 VOC Emissions Increase Calculations

The VOC emissions increase for the proposed kiln were calculated by multiplying a conservative emission factor for drying of southern yellow pine dimensional lumber by the maximum annual capacity of the kiln. The emission factor used, 5.73 lb VOC (as carbon)/MBF, was developed from numerous emission tests compiled by the National Council of the Paper Industry for Air and Stream Improvement (NCASI) for steam-heated lumber kilns drying southern yellow pine. The NCASI data included 14 VOC "emission factors," with each emission factor having been developed from several stack test results provided by NCASI member companies. Emission factors ranged from 0.63 to 5.3 pounds per thousand board feet (lb/MBF) of lumber dried, with an average of 3.15 lb/MBF. Using statistical mathematical principals and the "population" of emission factors developed by NCASI, the "99th percentile" of all emission factors is 5.73 lb/MBF, meaning that 99 percent of all emission factors that would be calculated if an infinite number of stack test were conducted on southern yellow pine drying are predicted to be less than 5.73 lb/MBF. Based on an emission factor of 5.73 lb/MMBF, maximum VOC emissions from the kiln are estimated to be approximately 94 tons per year, which exceeds the PSD significance threshold of 40 tons per year and, consequently, VOC is subject to PSD review.

The emission factor of 5.73 lb/MMBF used to estimate VOC emissions is believed to drastically overestimate the maximum emission increases from the proposed kiln. The Forest Products industry, other state permitting agencies, and EPA generally recognize that the best available emission factor for calculating long-term emissions from a lumber drying kiln is approximately 3.15 lb/MMBF, which is the average emission factor developed from the NCASI data discussed above. However, since emission limits under PSD are generally based on short-term emission rates, International Paper has decided to use an "ultra-conservative" emission factor to allow an adequate safety margin over the best available emission factor of

4.0

PREVENTION OF SIGNIFICANT DETERIORATION APPLICABILITY ANALYSIS

4.1 INTRODUCTION

Major modifications to major stationary sources are required by the Clean Air Act to obtain an air permit before commencing construction. The process is called New Source Review (NSR) and requires the source to obtain a PSD permit if the source making a modification is located in an attainment area. Since the Armour facility is a major stationary source and is located in an attainment area for all pollutants regulated under NSR, the analysis presented in this section was conducted to determine PSD applicability.

In short, PSD applicability is determined by comparing the total emission increases of PSD pollutants associated with a modification to their respective PSD "significant emission rates." Each pollutant for which emission increases exceed a significant emission rate is considered a "major modification" and is subject to PSD permitting requirements. The proposed modification will increase volatile organic compound (VOC), total suspended particulate (TSP) and particulate matter, 10 micron diameter or smaller (PM-10). The PSD significant emission rates for these pollutants are 40, 25, and 15 tons per year, respectively.

4.2 NET EMISSION INCREASE CALCULATIONS

The only PSD pollutant emitted from the proposed kiln is VOC. However, operation of the kiln will also increase the utilization of other operations at the Armour facility because lumber drying is the "bottleneck" of the facility. Consequently, emission increases associated with the "debottlenecked" sources are included in the applicability analysis. Debottlenecked emission sources at the facility are debarking, sawing, and planing operations, which emit TSP and PM-10. The wood-waste boiler was not considered a debottlenecked source because: 1) the proposed kiln will use flash steam from the three existing kilns, which has no effect on boiler combustion, and 2) the occasional supply of steam by the boiler to the proposed kiln will be minimal and will not measurably alter the quantity of steam produced by this existing boiler.

TABLE 4-1
PSD APPLICABILITY DETERMINATIONS
INTERNATIONAL PAPER ARMOUR FACILITY
WCC PROJECT NO. 96R129

Assumptions

- The maximum emissions increase associated with installation of a 32.9 million board feet (32.9 MMBF) per year kiln includes emission increases from the kiln and planing operations
- Sawmill fugitives from debarking and sawing operations and road fugitives are not included in calculations because fugitive emissions are not required in PSD emission increase calculations for this type of facility
- Wood waste collection system TSP emissions conservatively based on the maximum emissions from either the cyclone separator and fuel chain cyclone (4 lb/hr) divided by the ratio of planed wood in 1994 to production hours in 1994 (163 MMBF/3925). Resulting conservative emission factor = 96.3 lb TSP/MMBF
- PM-10 emissions from the collection system are conservatively estimated to be 30 percent of total suspended particulate (TSP) emissions.
- Boiler emissions are not included in these calculations because waste steam will be used to heat the kiln

Emissions Unit	Point Source Identification Number	Activity Factor		Emission Factor			Emissions (tpy)		
		Value	Units	Pollutant	Value	Units	TSP	PM-10	VOC
Wood Waste Cyclones	A1-1 and C1-1	32.9	MMBF/yr	TSP	96.3	lb/MMBF	1.58		
		32.9	MMBF/yr	PM-10	28.9	lb/MMBF		0.48	
Proposed Drying Kiln	K1-4	32.9	MMBF/yr	VOC	5.73	lb/MBF[1]			94.26
Totals from Project							1.58	0.48	94.26
PSD Levels (tpy)							25	15	40
Subject to Review?							**No**	**No**	**Yes**

Notes:

1 "A Small Scale Kiln Study on Method 25A Measurements of Volatile Organic Compound Emissions From Lumber Drying" (background test data). Technical Bulletin No. 718. National Council of the Paper Industry for Air and Stream Improvement. July 1996

3.15 lb/MMBF. On a short term basis, emission rates may fluctuate drastically due to a number of operating variables. Significant variations are even possible between different batches of lumber being dried due to the variability of the VOC content of undried lumber. Based on the best available emission factor of 3.15 lb VOC/MMBF, the estimated maximum emission increase associated with the proposed kiln is only 51.7 tons per year, corresponding to an emission rate 45 percent lower than that calculated using the ultra conservative factor.

4.2.2 Particulate Matter Emissions Increase Estimates

Debarking and sawing operations have no point source emissions and only minor fugitive emissions of particulates. This facility does not belong to one of the PSD Source Categories for which fugitive emissions must be included in emission increase calculations and, therefore, the minor particulate matter increases from the debarking and sawing operations were not included in the PSD applicability analysis. Emissions from planing operations are controlled by two wood waste cyclones. Only one wood waste cyclone is operated at any time to control planing emissions. In order to conservatively estimate emissions, the emission increase calculations presented in Table 4-1 were based on continuous operation of the wood waste cyclone with the higher particulate emissions rate. maximum TSP and PM-10 emissions from the cyclones are estimated to be 1.58 and 0.47 tons per year, respectively, which are well below their PSD significance levels of 25 and 15 tons per year, respectively. consequently, TSP and PM-10 are not subject to PSD review.

5.2 TECHNICAL APPROACH

The BACT analysis for VOC emissions from the lumber drying kiln was performed based on the "top-down" approach outlined in the December 1, 1987 policy memorandum issued by the EPA and in EPA's New Source Review Workshop Manual. The first step in this analysis was to characterize the emission stream of interest to identify all control options with a practical potential for application to control VOC emissions from the proposed kiln. After identifying available control options, infeasible options were rejected from additional consideration. Next, the economic, environmental, and energy impacts associated with each control option were evaluated in decreasing order of control effectiveness to determine whether negative impacts preclude their selection as BACT.

5.3 CHARACTERIZATION OF IISSION STREAM

The first step in this BACT analysis was to characterize the emissions from each emission source for which BACT is required in order to identify possible control options. Information pertaining to the exhaust stream from the proposed lumber drying kiln was obtained from numerous sources including studies of emissions from lumber drying conducted by NCASI, humidity data based on typical wet and dry bulb temperatures of kiln exhausts, suggested drying schedules from Wellons, Inc. (kiln manufacturer), actual process data from a nearly identical kiln operated by another lumber manufacturing company in North Carolina, and a number of industry experts familiar with kiln operating procedures and exhaust characteristics.

Typical kiln exhaust characteristics upon which control technology feasibility and costs were based are discussed below. A summary of these characteristics is presented in Table 5-1. A chart of actual run data for a typical flash steam-heated kiln is presented in Appendix E of this report. This chart was provided by another lumber manufacturer operating a flash steam kiln in the southeastern United States.

5.0 BEST AVAILABLE CONTROL TECHNOLOGY ANALYSIS

Emission units subject to PSD review are required to apply Best Available Control Technology (BACT) to each new or modified emissions unit to reduce emissions of each pollutant for which the source is subject to PSD review. BACT is defined as an emission limitation based on the maximum degree of reduction of each pollutant subject to PSD review that the permitting authority determines to be achievable, taking into account economic, environmental and energy impacts. This emission limit can be based on the application of air pollution equipment, specific production processes, methods, systems or techniques. In no event can the application of BACT result in the emission of any pollutant that would exceed applicable New Source Performance Standards (NSPS) or National Emission Standards for Hazardous Air Pollutants (NESHAP).

As discussed in Section 3.0, no NSPS or NESHAP apply to lumber drying and, consequently, the BACT analysis for the Armour facility does not involve "mandatory" control technologies or "minimum" pollution control efficiencies.

5.1 POLLUTANT APPLICABILITY

The International Paper facility is a major PSD facility as described in Section 1.1. Because the emission increase from the proposed kiln exceeds the PSD significant emission rate for VOC (40 tons per year), the project is considered a major modification and, thus, subject to PSD review. Therefore, a BACT evaluation must be performed to determine the feasibility of reducing VOC emissions. EPA guidelines require that the BACT analysis evaluate benefits associated with any reduction of emissions of hazardous air pollutants resulting from adding controls for VOC. These are addressed in the "environmental impacts" portion of the BACT analysis. Three biogenic (i.e., naturally occurring) hazardous air pollutants, acetaldehyde, formaldehyde, and methanol are emitted as a small constituent of the VOC emitted from the kiln and are therefore discussed in this BACT analysis.

Kiln Vent Locations and Operating Characteristics: A total of eight vents measuring 28 inches by 28 inches are spaced equidistantly along the V-shaped roof of the proposed kiln, which measures 34 feet wide by 68.5 feet long. Four of the eight vents are located on both sides of the kiln roof and each set of four vents react in unison during the kiln drying cycle. At any given time, one set of vents allow moisture to exhaust from the kiln while the other set of vents allow dry make-up air to enter from the atmosphere. Approximately every two hours, the direction of heated air circulating within the kiln is changed to ensure proper drying. As this direction is changed, kiln dampers are automatically adjusted to allow vents that were exhausting to provide the fresh air intake and vents that were providing fresh air to exhaust.

Exhaust Flow Rate: Exhaust flow rates in flash steam kilns like the one proposed at the Armour facility can be highly variable, largely because the availability of steam to the kiln heat exchangers is variable and is dependent upon the quantity of high-pressure condensate available from the existing kilns (see Section 2.2.2). The amount of venting is controlled by sophisticated automated controls that are influenced by a variety of kiln process parameters including relative humidity, moisture removal rate, and internal kiln temperatures and, therefore, is directly linked to the quantity of flash steam available.

During periods when flash steam supply does not completely meet necessary heat demands, vents may completely or almost completely close rapidly to maintain optimal conditions within the kiln. After return of an adequate steam supply to the kiln, kiln conditions may rapidly rise to their proper set point conditions or may even slightly overshoot these conditions causing a response by the kiln controls to quickly open the vents to maintain optimum drying conditions. As a visual aid to understanding the rapid fluctuation in kiln vent positions/exhaust flow rates, two figures depicting vent position (0 to 100%) charted over a typical flash steam-heated kiln cycle are provided in Appendix E.

Based on the vendor-recommended drying schedule for this kiln, the total cycle drying time of the proposed kiln is approximately 36 hours. There is typically no venting to the atmosphere during the first six hours of the drying cycle as stacked lumber is heated from ambient temperatures. After 6 hours, substantial evaporation from the lumber begins.

Table 5-1
Steam-Heated Lumber Kiln Exhaust Stream Characteristics
International Paper - Armour Facility
Woodward-Clyde Project No. 96R129

Parameter	Range	Average
Flow Rate (actual cubic feet per minute)	0 - 15,000	11,700
Temperature (°F)		
Dry Bulb	170 - 230	180
Wet Bulb	160 - 180	160
Moisture		
Percent by Weight	27.5 - 29.5	28.5
Evaporation Rate (lb/hr)	0 - 10,000	8,000
VOC Concentration (ppmv)	600 - 2,000	1,000

requiring venting of moisture from the kiln. This venting continues through the 36th hour, excluding periods when an inadequate steam supply is available causing vents to completely close. For purposes of BACT cost estimates, an average kiln exhaust rate of 11,700 actual cubic feet per minute (acfm) and a maximum flow rate of 15,000 acfm were specified.

Exhaust Temperature and Moisture Content: Between hours 6 and 30 or the drying cycle, kiln exhaust temperatures are typically equal to the nominal kiln set points of 170 deg. F dry bulb and 160 deg. F wet bulb, resulting in a nearly saturated air exhaust stream. The moisture content of the exhaust is approximately 29.5 percent by weight, and 47.5 percent by volume. Between hours 30 and 36, exhaust temperatures are approximately 220 deg. F dry bulb and 160 deg. wet bulb with 27.5 and 44.3 percent moisture by weight and volume, respectively. A constant evaporation rate of 8,000 pounds per hour of water was assumed in the BACT analysis, although actual rate of evaporation may fluctuate during the cycle.

VOC Concentrations: Based on industry experience and background data obtained in the NCASI kiln study mentioned earlier, the ppmv concentration of VOC in the kiln exhaust peaks at approximately 2,000 ppmv VOC, shortly after the kiln begins venting and thereafter, decreases to a concentration of around 800 ppmv over the next few hours. VOC concentrations remain fairly constant at about 800 ppmv during the rest of the drying cycle, although a gradual decrease during the last few hours of the drying cycle is possible. A chart of typical VOC concentrations during the drying cycle is presented in Appendix E.

VOC Emission Rate: The VOC emissions rate during the drying cycle is expected to vary during the drying cycle due to the extreme fluctuations in flow rate and, to a lesser extent, fluctuations in VOC concentration. To simplify the BACT analysis and efforts to obtain cost information from control technology vendors, a constant VOC emission rate of 35.5 pounds per hour was assumed for the first four hours of the drying cycle, during the period when peak VOC concentrations typically occur, and 14.2 pounds per hour during the rest of the cycle.

5.4 IDENTIFICATION OF AVAILABLE CONTROL TECHNOLOGIES

An extensive study of potentially applicable control technologies was conducted prior to evaluation of specific control options to ensure that the top-down BACT analysis would be as comprehensive as possible. Information from the following sources were used in the analysis:

- BLIS database (the RACE/BACT/LAER Clearinghouse) located on the Technology Transfer Network on EPA's electronic bulletin board system;
- Pollution control technology vendors;
- Plywood and oriented strandboard manufacturers using pollution control technologies considered in the BACT analy that, although control emissions from very different applications, control similar VOC species;
- EPA Regional personnel responsible for review of PSD BACT analyses;
- North Carolina and Virginia permitting staff;
- EPA control technology documents;
- Experts familiar with both the Lumber Manufacturing Industry and control of similar VOCs;
- Lumber drying kiln manufacturers including the likely manufacturer of the proposed kiln (Wellons, Inc.); and
- Babcock and Wilcox, manufacturer of the wood fired steam boiler at the Armour facility.

Information obtained from the data sources reviewed and interviews conducted during this study indicate that no pollution controls have ever been applied to lumber drying kilns and that the combined characteristics of the exhaust from steam-heated lumber drying kilns present a number of obstacles to control. However, several control technologies were identified that have been used by other industries to control similar VOC species and were considered in this analysis. These technologies are as follows:

- Regenerative catalytic oxidation;
- Regenerative thermal oxidation;
- Non-regenerative thermal oxidation technologies;

- Carbon adsorption:
- Biofiltration: and
- Thermal oxidation in the existing wood-fired boiler.

Although a few other pollution control technologies are available that reduce VOC emissions. these technologies primarily target reduction of other criteria pollutants and are generally recognized by industry and permitting agencies as not being particularly effective for VOC pollution control. For example. wet electrostatic precipitators and wet scrubbing systems are control technologies designed to reduce particulate matter emissions and have low reduction efficiencies for the VOC species typically emitted from lumber kilns. Consequently, these technologies were not considered in this analysis.

5.5 GENERAL CHALLENGES OF KILN EMISSIONS CONTROL

The purpose of this section is to describe the technical challenges that are involved in applying any of the previously mentioned control technologies to lumber kiln emissions. Although the control technologies previously identified have been proven as being effective VOC control technologies for specific applications. none of these technologies has been applied to steam-heated lumber kilns or emission streams with a similar combination of characteristics and. consequently. there are a number of inherent difficulties in designing a cost-effective control system for a lumber kiln. Because emission control technologies have never been applied to lumber kilns. actual maintenance and operational problems are unknown and it is possible that the technologies considered in this BACT analysis would cost substantially more than presented in this analysis. These challenges are categorized as follows:

- Exhaust collection/kiln air intake ductwork and automated control system design:
- Reduction of condensation formation;
- Collection and treatment of condensation:
- Maintenance: and
- Potential pollution control system re-engineering after installation.

Each of these challenges are discussed below.

5.5.1 Exhaust Collection/Kiln Air Intake Design

To summarize the operation of the kiln exhaust collection and air intake system, two sets of four vents are spaced equidistantly along the roof of the proposed kiln, which measures 34 feet wide by 68.5 feet long. Each set of four vents react in unison during the kiln drying cycle and, at any given time, one set of vents exhaust from the kiln while the other set of vents intake air from the atmosphere. As the direction of "drying air" inside the kiln is changed, dampers are automatically adjusted to allow switching between intake and exhaust vents. A drawing of the kiln air intake, circulation, and exhaust flow patterns is presented in Figure 2-1.

In order to route emissions from the kiln to any pollution control device, a complex ductwork system must be connected to all eight exhaust vents on the kiln roof, which in turn connects all vents to a single duct connected to the pollution control device. While many pollution control systems have been designed that connect multiple vents to a single control device, this design is especially complicated because several damper controllers and additional ductwork must be installed to allow instantaneous switching between air intake ducts and exhaust ducts. Damper controls must always allow one set of vents to exhaust while the other intakes air. Design and operation of this system are further complicated by the extraordinary measures necessary to reduce condensation, collect and treat condensate, and finally to prevent malfunction of the ductwork control system due to condensation, each of which is discussed in the following subsections.

5.5.2 Reduction of Condensation Formation

One of the most critical aspects of operation of any pollution control system for a lumber kiln is that condensation of the kiln exhaust must be minimized as much as possible to reduce the number and severity of system malfunctions and to reduce the amount of wastewater that must be treated. As explained earlier, approximately 8,000 pounds (960 gallons) per hour of water is evaporated and exhausted from the kiln in a nearly saturated air stream.

First, any ductwork system must be very well insulated due to the large surface area involved. Furthermore, ductwork would be heated if possible. Typical "heat tracing" techniques such as steam and electrical tracing are not viable options due to the substantial costs of tracing such large surface areas and the great financial risks of tracing large amounts of ductwork that may require frequent disassembly, maintenance, and re-design. Routing of hot combustion gases from thermal and catalytic oxidation technologies and introducing these gases directly into the kiln exhaust ductwork would have the greatest likelihood of reducing condensation. However, it is unlikely that this method can completely prevent all condensation and requires additional ductwork and damper controls. Although it is theoretically possible to introduce enough hot gas from the oxidation technologies to prevent condensation, reintroduction of gases causes the total air flow rate to the oxidation control device to increase, which increases the size and cost of the oxidation equipment. Other technologies under consideration in this BACT analysis cannot heat the kiln exhaust and would generate considerable condensate.

5.5.3 Condensation-Related Problems

Kiln condensate is very "sticky" due to the presence of resinous VOC compounds in the exhaust and points of condensation will, over time, build up and could cause severe blockages and malfunctions of ductwork dampers openings. The quantity of buildup could not be predicted by any of the various control technology vendors and kiln experts consulted during this BACT analysis. However, several persons interviewed about problems caused by kiln condensate agreed that severe control system malfunctions are possible and that an abnormally large amount of maintenance labor is likely. Because pollution controls on the proposed kiln would be the "first-of-a-kind," substantial ductwork re-engineering and replacement is possible due to problems caused by condensation.

Condensation in control system ductwork must be collected and treated prior to off-site discharge to remove VOC and to adjust pH because the condensate is slightly acidic. The facility is equipped with ponds that provide recirculating water to the facility's boiler exhaust scrubber; however, the condensate cannot be managed in these ponds due to insufficient capacity. Therefore, additional wastewater treatment facilities would have to be constructed to manage the condensate. *It is important to note that the costs of wastewater treatment were not included in any of the cost impacts analyses presented in this section due to the difficulty of accurately estimating the quantity of condensate generated.*

5.6 TECHNICALLY INFEASIBLE AND INFERIOR CONTROL OPTIONS

Of the "available" control technologies presented earlier, one of the technologies is technically infeasible and another is inferior to other technologies under consideration and, consequently, these technologies were rejected from further consideration as BACT. The following describes these control technologies.

Adsorption systems utilize adsorp: media that must be periodically regenerated to desorb VOC from the adsorption media s that the media can be reused. Although some VOC can be desorbed by chemical treatment, information obtained during this study indicates that terpenes, the primary VOC constituent in kiln exhaust, must be thermally desorbed and that temperatures necessary for desorption are excessively high and would damage any commercially-available adsorption media. Therefore, adsorption is technically infeasible due to an inability to desorb kiln VOCs from the adsorption media.

Regenerative oxidation technologies considered in this BACT analysis are superior to other oxidation technologies sometimes used to control VOC emissions, such as simple flaring and recuperative thermal oxidation. Therefore, these "other" oxidation technologies were not evaluated. Regenerative oxidation technologies are almost as effective at controlling VOC emissions as the "other" oxidation technologies, 95 percent control efficiency for regenerative technologies compared to 98 or higher percent efficiency for other technologies; however, regenerative technologies are much more cost-effective for controlling VOC in the kiln exhaust because regenerative technologies use much less fuel.

5.7 TECHNICAL EVALUATION AND RANKING OF FEASIBLE CONTROL TECHNOLOGIES

This section presents a technical evaluation of each control technology included in the analysis, describing the principals of operation and the VOC control efficiency associated with each technology. The technical evaluation of control technologies is followed by "ranking" of the effectiveness of each technology.

5.7.1 Technical Evaluation of Feasible Control Technologies

5.7.1.1 Regenerative Catalytic and Thermal Oxidation

The principles utilized in regenerative catalytic and thermal oxidation of VOC are based on simple chemistry and heat transfer phenomena. Since oxidation technologies have been widely accepted as the most effective technologies for VOC destruction and are well-understood by the environmental community, a rigorous technical evaluation is unwarranted. However, a brief explanation is provided here to provide those readers unfamiliar with these technologies with enough background to understand the basic principles of operation and performance of these technologies.

Oxidation, often called "combustion", of VOC involves a chemical reaction between hydrocarbons and oxygen to form carbon dioxide and water. Combustion of VOC emissions streams occurs spontaneously at elevated temperatures, which are typically attained by combustion of an auxiliary fuel within the "combustion zone" of the combustion equipment. The percent conversion of VOC to carbon dioxide and water is dependent upon temperature and "residence time" of the VOC in the fuel combustion zone. Combustion of VOC in the presence of a catalyst is referred to as "catalytic oxidation" and requires substantially lower temperatures for oxidation to occur and, therefore, requires less auxiliary combustion fuel.

Regenerative oxidation systems operate on the same principal of reacting VOC in the presence of oxygen at elevated temperatures; however, the heat generated by combustion of auxiliary fuel and VOC is "reused" to reduce the amount of auxiliary fuel necessary for VOC oxidation. VOC oxidation is accomplished by passing the emission stream being controlled through a heated "bed" of media such as ceramic packing to preheat the emission stream, followed by a final combustion zone in which auxiliary fuel is burned to "boost" the stream to the required combustion temperature. Exhaust from the combustion zone is then passed through another packed bed, which absorbs and retains heat until it can be used later to preheat the emission stream being controlled. Air flow is periodically switched to allow beds through which hot exhaust gases have passed to preheat the emission stream prior to passing through the combustion zone. Regenerative systems are typically designed to recover nearly all heat of combustion, greatly reducing auxiliary fuel requirements.

The regenerative catalytic and thermal oxidizer (RCO and RTO) upon which the BACT evaluations were based is manufactured by Monsanto-Envirochem and REECO, respectively. The design specifications for this system include 85.5 percent overall VOC destruction efficiency based on 95 percent destruction efficiency within the oxidizer and a 90 percent "capture" efficiency to account for a 10 percent loss of emissions from kiln and ductwork leakage. The RCO and RTO also include ductwork needed to recirculate hot gases from a "hot zone" of the oxidizer to the kiln exhaust collection points directly above the kiln to raise kiln exhaust temperatures and reduce condensation.

5.7.1.2 Thermal Oxidation Using Existing Boiler

Another control option considered in the BACT analysis is thermal oxidation of VOC in the facility's existing wood-fired boiler. In this option, kiln exhaust is collected by a ductwork system similar to the two previous options and routed through a single duct 150 to 200 feet long to the boiler. The exhaust is introduced--as "combustion air" in the boiler and, consequently, most of the VOC in the kiln exhaust is destroyed. The VOC control efficiency of this option is estimated to be approximately 76.5 percent, based on a 90 percent VOC destruction efficiency in the boiler and a 15 percent loss of VOC from kiln and ductwork leakage. Fugitive losses were estimated to be higher for the existing boiler than for RCO and RTO technologies because more than twice the amount of ductwork would be necessary to route kiln exhaust from the kiln to the boiler. The VOC destruction efficiency is slightly lower than the RCO and RTO technologies due to uncertainties regarding air turbulence in the boiler's combustion zone.

Using this control strategy, all ductwork between the kiln and boiler would be insulated but not heated and consequently, substantially greater condensation is likely to occur, increasing the likelihood of the operational difficulties associated with condensation. The surface area of ductwork required to route exhaust to the boiler is more than double the area required for the first two options evaluated in this analysis and, practically speaking, the kiln exhaust temperature cannot be "boosted" by introducing hot air from the boiler to the kiln exhaust due to the substantial distance from the boiler to the kiln.

Although this option has been considered "technically feasible" in this analysis, this option is believed to be the most technically complex and problematic of all options considered, and the ability to continuously and reliably operate this system within the cost estimated in this evaluation is highly questionable. Both the manufacturer of key components of the facility's wood-fired boiler, Babcock and Wilcox, and the engineering firm that constructed the boiler could not determine whether substantially greater costs and problems documented in this evaluation would be encountered without an extensive engineering study. Furthermore, this option has the greatest likelihood of adversely affecting existing operations at the facility because the wood boiler provides heat to the two existing lumber kilns and, therefore, any significant problems affecting the wood boiler's ability to provide a constant heat supply will adversely impact production.

One important technical limitation of combusting air in the *boiler that is not accounted for in the economic impacts of this analysis* is that the existing emission control system on the wood boiler (multicyclone followed by venturi scrubber and cyclonic separator) may be inadequate to handle the larger air flow rates resulting from using the kiln exhaust as combustion air. Kiln exhaust contains only slightly more than 50 percent air and in order to provide enough combustion air to the boiler for proper combustion, an estimated 30 to 40 percent higher gas flow rate to the boiler is necessary, resulting in a commensurate increase in flow rate from the boiler to the boiler pollution controls. With such a large increase in flow rate anticipated, it is easily possible that existing controls will be undersized and that replacements or modifications will be necessary.

5.7.1.3 **Biofiltration**

Biofiltration uses microorganisms to biologically degrade VOC into carbon dioxide and water. In biofiltration systems, the emission stream being controlled is passed through one or more beds of biomedia such as compost or beds of packing using nutrient recycle. Since biofilters are dependent upon biological activity to destroy VOC, removal efficiencies of biofilters are widely variable. All biofilters are extremely sensitive to a number of exhaust stream characteristics including moisture content, temperature, VOC species, and concentration, and bed retention time.

The biofiltration vendor contracted for the BACT evaluation has substantial experience in treating the same VOC species that are emitted from the lumber kiln, primarily alpha- and beta-pinenes, although this manufacturer has not built a biofiltration system for an emission stream with especially similar characteristics to the kiln exhaust. however, this vendor was able to provide rough estimates of necessary exhaust "conditioning" requirements and control efficiency. The only conditioning requirement for this system is that the kiln exhaust gas temperature must be cooled using a water-cooled heat exchanger to approximately 100 deg. F to achieve a temperature suitable for the biofiltration microorganisms. An estimated VOC control efficiency of nearly 90 percent was quoted as being achievable during "average" ppmv loading, but is much less during the first few hours of kiln venting when ppmv concentrations peak at about 2.5 times the "average" ppmv level. Consequently, 80 percent control efficiency was used in the BACT impact analyses.

The only major technical uncertainty about this control option other than actual control efficiency and than the technical considerations pertaining to reliability of the damper systems, which has been discussed in detail in previous sections, is whether or not the biofilter beds would periodically plug due to buildup of the sticky terpenes present in the kiln exhaust. It is believed that the likelihood of bed pluggage cannot be conclusively determined without pilot scale testing.

5.7.2 Ranking of Feasible Control Technologies

A summary of the VOC control efficiencies of all technologies under consideration, ranked in order of decreasing effectiveness is presented below:

- RCO and RTO = 85.5 percent;
- Existing wood-fired boiler = 76.5 percent; and
- Biofiltration = 72 percent.

5.8 IMPACTS ANALYSIS OF FEASIBLE CONTROL TECHNOLOGIES

As discussed earlier, the top-down BACT approach requires evaluation of control options beginning with the most stringent option, followed by evaluation of the remaining options in decreasing order of efficiency, if adverse economic, environmental, or energy impacts precludes selection of an option as BACT. Adverse economic impacts were determined for all control options evaluated and, consequently, all options identified in Section 5.5 were included in the following impacts analysis. In order to streamline discussion of each type of impact (i.e., economic, etc.) the impacts discussions of all technologies are discussed collectively.

5.8.1 Economic Impacts

As required by EPA, the following economic impacts portion of the BACT analysis includes budgetary estimates of total capital and annual costs, as well as an estimated cost effectiveness of each control technology evaluated, which is calculated from estimated annual costs and VOC control effectiveness. Although the cost estimates presented in the following analysis are considered high enough to demonstrate that all control options under consideration are cost prohibitive, these costs do not fully convey the magnitude of the economic impacts that would be caused by requirements to apply any of the technologies under consideration. Therefore, this evaluation presents other costs impacts, including impacts on profitability, competitiveness, and project viability.

5.8.1.1 Capital and Operating Costs and Cost Effectiveness

Tables 5-2, 5-3, 5-4, and 5-5 present results of the cost analyses for the RCO, RTO, existing boiler, and biofiltration options, respectively, and Table 5-6 presents a summary of all control options. Total capital costs range from $492,870 for existing boiler control to $1,279,500 for RTO control. Total annual costs range from $261,941 for use of the existing boiler to $444,997 for RTO control. All capital costs include a 50 percent contingency above vendor quote to adequately take into account the high capital costs that may be involved in construction cost overruns often associated with "first-of-kind" control systems and to account for the potentially high replacement, repair, and re-engineering costs involved in developing a control system that will provide continuous compliance with the control efficiencies of each option. Annual maintenance costs were estimated as being two times the costs typically associated with the technologies evaluated to account for the additional routine and repair maintenance costs that are anticipated.

Not only are the capital and maintenance cost contingencies deemed justifiable given that the control equipment vendors from whom capital cost quotes were obtained have not previously built a system to control an emissions stream with a similar combination of characteristics, but it is possible that these costs actually *underestimate* the actual capital and operating costs that would be incurred. It is important to note that these costs do not account for production losses to kiln down-time or costs associated with wastewater treatment of kiln condensate.

Cost effectiveness estimates are summarized in Table 5-6 and range from $6,623 per ton for existing boiler control to $10,067 per ton for RTO control, based on the "best available" emission factor of 3.15 lb VOC/MBF for lumber drying kilns (see Section 4.2.1). Using a "worst-case" emission factor of 5.73 lb VOC/MBF (see Section 4.2.1), cost effectiveness estimates range from $3,607 per ton for existing boiler control to $5,222 for RTO control.

International Paper believes that the cost effectiveness estimates presented in Table 5-6 are unreasonably high given that kiln pollution controls have not been required on any other kilns in the United States (and perhaps the entire world) and a requirement for International Paper to install such controls would severely damage the Armour facility's ability to remain competitive with other lumber manufacturers and drastically reduce profits (see Section 5.8.1.2 for further discussion). Furthermore, such costly controls are considered unnecessary because control of VOC emissions would have a minimal impact on air quality. Additional discussions pertaining to economic and environmental impacts are presented later in this analysis.

5.8.1.2 General Economic Considerations

In order to fully appreciate the economic impacts that would be incurred if any of the control options evaluated it is necessary to provide the following information pertaining to the Lumber Manufacturing Industry:

- Lumber pricing and profit margin;
- Costs of kiln control that result in a non-competitive position in the Lumber Market;
- Project viability; and
- Control cost relative to total project cost.

Lumber Pricing and Profit Margin

The Lumber Manufacturing Industry is characterized by stiff competition and low profit margins because the Lumber Manufacturing Industry is a fully mature industry and because lumber is a commodity item. Although manufacturers are theoretically free to set their own prices, prices are essentially set by the Chicago Board of Trade, which like other high-commodity items sold on the stock market, results in highly competitive pricing. International Paper and all other Lumber Manufacturers closely adhere to costs established by the Board of Trade to remain competitive.

The average profit margin realized by sales of lumber from the Armour facility are indicative of the low profit margins obtained by other lumber manufacturers. Over the past 10 years, the net profit margin on lumber sales from the Armour facility was approximately $24.95 per thousand board feet, corresponding to a profit of only 10.7 percent.

TABLE 5-2
REGENERATIVE CATALYTIC OXIDATION CONTROL COSTS
INTERNATIONAL PAPER COMPANY - ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

Basis:
1) Enviro-Chem Systems - Installed cost, fan & fuel operating costs
2) Control Technologies for Hazardous Air Pollutants, EPA/625/6-91/014 - Indirect Annual Costs
3) Carolina Distributors - Fuel Oil Costs
4) SPATCO Environmental - Fuel Oil Storage Costs
5) Wellons (Kiln Manufacturer) and REECO (Control Technology Vendor) - Ductwork Costs

Direct Costs	Cost	Cost Factor/Comments		
Total Capital Cost (TCC)	$844,500	Enviro-Chem, DynaCycle Model DCS-6 Includes 50% contingency; no lumber kilns before. Includes $35,000 catalyst replacement after 5 years and $18,000 for 4K fuel oil storage tank		

Note: RCO "footprint" = 20' x 22'. Assumes placement adjacent to kiln.

	Cost	Cost Factor/Comments		
Direct Annual costs				
Electricity Cost	$8,500	Elec. Cost=	$0.050	$/kWh
		Operation=	7,300	hr/yr
		(no venting for 6 of 36 cycle hours)		
Fuel Cost	$23,013	0.626 MM Btu/hr=	4,570 MM Btu/yr	
		@ 150,000 Btu/gal =	32,876 gal/yr	
		No. 6 fuel oil cost =	$0.70 /gal	
		Road-use No. 2 oil (Carolina Distributors,		
		~$0.01/gal greater cost than 0.3% sulfur)		
Operating Labor				
Operator	$19,422	Reference 2, scaled to 1996 dollars. 1.0 hr/8-hr shift		
		(Two times Reference 2 costs; never been done before)		
Supervisor	$2[illegible]	15% of operating labor		
Maintenance				
Labor	$21,370	Reference 2, scaled to 1996 dollars 1.0 hr/8-hr shift		
		(Two times Reference 2 costs; never been done before)		
Material	$21,370	100% of maintenance labor		
Indirect Annual Costs				
Overhead	$39,045	0.6	* C	C = operating labor + maintenance costs
Administration	$16,890	2%	TCC	
Property Taxes	$8,445	1%	TCC	
Insurance	$8,445	1%	TCC	
Capital Recovery	$137,485	0.1628	10 years, 10% interest	
Total Annual Cost	$306,897			

TABLE 5-3
REGENERATIVE THERMAL OXIDATION CONTROL COSTS
INTERNATIONAL PAPER COMPANY - ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

Basis:
1) Regenerative Environmental Equipment Co., Inc. (REECO) - Installed cost and energy costs
2) Control Technologies for Hazardous Air Pollutants, EPA/625/6-91/014 - Indirect Annual Costs
3) Carolina Distributors - Fuel Oil Costs
4) SPATCO Environmental - Fuel Oil Storage Costs
5) Wellons (Kiln Manufacturer) and REECO (Control Technology Vendor) - Ductwork Costs

Direct Costs	Cost	Cost Factor/Comments		
Total Capital Cost (TCC)	$1,279,500	REECO, Model VFC RE-THERM Includes 50% contingency; never been done before. Includes $20,000 for 4K fuel oil storage tank		
Direct Annual costs				
Electricity Cost	$20,075	Elec. Cost=	$0.050	$/kWh
		Motor= 125 hp =	55	kW
		Operation=	7,300	hr/yr
		(no venting for 6 of 36 cycle hours)		
Fuel Cost	$61,320	1.8 MM Btu/hr=	13,140 MM Btu/yr	
		@ 150,000 Btu/gal =	87,600 gal/yr	
		No. 6 fuel oil cost =	$0.70 /gal	
		Road-use No. 2 oil (Carolina Distributors, ~$0.01/gal greater cost than 0.3% sulfur)		
Operating Labor				
Operator	$19,422	Reference 2, scaled to 1996 dollars. 1.0 hr/8-hr shift (Two times Reference 2 costs; never been done before)		
Supervisor	$2,913	15% of operating labor		
Maintenance				
Labor	$21,370	Reference 2, scaled to 1996 dollars 1.0 hr 8-hr shift (Two times Reference 2 costs; never been done before)		
Material	$21,370	100% of maintenance labor		
Indirect Annual Costs				
Overhead	$39,045	0.6	* C	C = operating labor + maintenance costs
Administration	$25,590	2%	TCC	
Property Taxes	$12,795	1%	TCC	
Insurance	$12,795	1%	TCC	
Capital Recovery	$208,303	0.1628	10 years, 10% interest	
Total Annual Cost	**$444,997**			

TABLE 5-4
EXISTING BOILER CONTROL COSTS
INTERNATIONAL PAPER COMPANY - ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

Basis:
1) **Control Technologies for Hazardous Air Pollutants, EPA/625/6-91/014 (indirect annual costs)**
2) **Wellons (Kiln manufacturer) and REECO (Control Technology Vendor) - Ductwork Costs**
3) **Babcock and Wilcox and International Paper - Fuel Penalty Costs**
4) **Babcock and Wilcox and ETEC - VOC Destruction Efficienty**
5) **Plant Design and Economics, Peters, and Timmerhaus, McGraw-Hill, p.562 - Boiler Fan Cost**

Direct Costs	Cost	Cost Factor/Comments
Total Capital Cost (TCC)	$492,870	Includes 50% contingency for ducts and flow controls Includes boiler fan modification/replacement for increased flowrate to pollution controls (no contingency) Includes $20,000 engineering study to assess design modifications.

Note: Capital costs do not include any modifications to the boiler other than to introduce kiln exhaust air through preheater system and do not include any costs to existing pollution control equipment for the boiler other than those associated with modifying the boiler exhaust fan

Direct Annual costs	Cost	Cost Factor/Comments
Fan Electricity to Boiler	$20,440	Total ductwork length = 342 ft. Fan electrical requirements = 75 hp Hours per yerar = 7,300 Electricity Cost = $0.05
Fuel Penalty	$33,190	H2O rate to boiler = 8,000 lb/hr Enthalpy inc. from 160 F to 2,200 F: 776 Btu/lb Wood heat content = 9.00E+06 Btu/ton Fuel cost (per ton) = $7 Heat input from VOC in exhaust = 2,588 MM Btu/yr
Additional Boiler Fan Electricity	$4[illegible]	Reference 2, Fan Power Equation. KW-hr/yr = 84,752 Electricity Cost = $ 0.05 Increase flow (acfm) 12,829 Scrubber Pressure Drop = 5 inches of H2O
Operating Labor		
Operator	$19,422	Reference 2, scaled to 1996 dollars 1.0 hr/8-hr shift (Two times Reference 2 costs; never been done before)
Supervisor	$2,913	15% of operating labor Operation= 8,760 hr/yr
Maintenance		
Labor	$21,370	Reference 2, scaled to 1996 dollars. 1.0 hr/8-hr shift (Two times Reference 2 costs; never been done before)
Material	$21,370	100% of maintenance labor

Indirect Annual Costs	Cost	Cost Factor/Comments
Overhead	$39,045	0.6 * C; C = operating labor + maintenance costs

TABLE 5-4
EXISTING BOILER CONTROL COSTS
INTERNATIONAL PAPER COMPANY - ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

Basis:
1) Control Technologies for Hazardous Air Pollutants, EPA/625/6-91/014 (indirect annual costs)
2) Wellons (Kiln manufacturer) and REECO (Control Technology Vendor) - Ductwork Costs
3) Babcock and Wilcox and International Paper - Fuel Penalty Costs
4) Babcock and Wilcox and ETEC - VOC Destruction Efficienty
5) Plant Design and Economics, Peters, and Timmerhaus, McGraw-Hill, p.562 - Boiler Fan Cost

Administration	$9,857	2%	TCC
Property Taxes	$4,929	1%	TCC
Insurance	$4,929	1%	TCC
Capital Recovery	$80,239	0.1628	10 years, 10% interest
Total Annual Cost	$261,941		

TABLE 5-5
BIOFILTRATION CONTROL COSTS
INTERNATIONAL PAPER COMPANY - ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

Basis:
1) PPC Biofilter (capital and operating costs)
2) Control Technologies for Hazardous Air Pollutants, EPA/625/6-91/014 (indirect annual costs)
3) Wellons (Kiln Manufacturer) and REECO (Control Technology Vendor) - Ductwork Costs

Direct Costs	Cost	Cost Factor/Comments		
Total Capital Cost (TCC)	$1,106,565	PPC Biofilter Includes 50% contingency; no lumber kilns before. Includes $100,000 ductwork and electrical costs		

Note: Costs conservatively assume placement adjacent next to kiln, which is likely not feasible due to the large size of biofilter (~30' x 60')

Direct Annual costs	Cost	Cost Factor/Comments		
Non-labor Operating Cost	$13,140	Operation=	8,760	hr/yr
		$1.50/hr: year-round humidification and air circulation through beds		
Operating Labor				
Operator	$19,422	Reference 2, scaled to 1996 dollars. 1.0 hr/8-hr shift (Two times Reference 2 costs; never been done before)		
Supervisor	$2,913	15% of operating labor		
Maintenance				
Labor	$21,370	Reference 2, scaled to 1996 dollars. 1.0 hr/8-hr shift (Two times Reference 2 costs; never been done before)		
Material	$21,370	100% of maintenance labor		

Indirect Annual Costs	Cost			
Overhead	$3[illegible],045	0.6	* C	C = operating labor + maintenance costs
Administration	$22,131	2%	TCC	
Property Taxes	$11,066	1%	TCC	
Insurance	$11,066	1%	TCC	
Capital Recovery	$180,149	0.1628	10 years, 10% interest	
Total Annual Cost	$341,671			

TABLE 5-6
SUMMARY OF TOP-DOWN BACT: ECONOMIC IMPACT ANALYSIS
INTERNATIONAL PAPER COMPANY - ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

Average Lumber Selling Price (1987 - 1996): 233 $/MBF
Pre-tax Net Profit (International Paper sawmills, 1987 - 1996): 24.95 $/MBF
Pre-tax Net Profit, % ("no control"): 10.7%
Profit Margin after Most Cost Effective Control:[1] -0.5%

Control Alternatives	"True" VOC Emissions Reduction (ton/yr)[2]	"Worst-Case" VOC Emissions Reduction (ton/yr)[3]	Economic Impacts: Total Capital Cost ($)[4]	Annual Cost ($/yr)[4]	Unit Cost of Control ($/MBF)[5]	Percent of Net Profit Loss	"True" Cost Effectiveness ($/ton)[2,4]	"Worst-Case" Cost Effectiveness ($/ton)[3,4]
Regenerative Catalytic Oxidation	44.2	80.6	$844,500	$306,897	$30.68	123%	6,943	3,808
Regenerative Thermal Oxidation	44.2	80.6	$1,279,500	$444,997	$44.48	178%	10,067	5,522
Existing Boiler[6]	39.6	72.6	$492,870	$261,941	$26.18	105%	6,623	3,607
Biofiltration	37.2	67.9	$1,106,565	$341,671	$34.15	137%	9,179	5,034

Notes:
1. Represents net profit on lumber sales after emissions are routed to existing boiler. Net profit margin shown is well below the net profit typically achieved by most Industries in the United States.
2. "True" *emissions reductions* represent the emission reductions achieved by each control technology using the "best available" emission factor for lumber drying (3.15 lb/MBF) (see Section 4.2.1 for discussion of emission factor). "True" cost effectiveness was calculated by dividing the true emissions reductions by estimated annual costs.
3. "Worst-case" emissions reductions represent the reductions achieved by each control technology using highly conservative emission factor for lumber drying (5.73 lb/MBF) (see Section 4.2.1 for discussion of emission factor). "Worst case" cost effectiveness was calculated by dividing worst-case emissions reductions by estimated annual costs.
4. Costs do not include wastewater treatment, which although only a fraction of total system costs, will increase costs of all options shown.
5. Increased cost per thousand board feet (MBF) of lumber produced. Increase is based on the maximum estimated lumber production during first few years after kiln installation, which is approximately 30.5 percent of maximum capacity (10.0 MMBF/yr).
6. Capital costs do not include any modifications to the boiler other than to introduce kiln exhaust air through existing preheater system and do not include any costs to existing pollution control equipment for the boiler other than those associated with modifying/replacing the boiler fan. Any boiler modification could drive costs substantially higher and substantially reduce profits by more than the estimates presented above.

Cost of Control Would Result In Non-Competitive Position In Market

Although costs presented in the previous BACT analyses *may be underestimated* for reasons already discussed, the cost for all control options are considered unbearably high in a market characterized by very low profit margins. A summary of economic impacts are presented in Table 5-6. As shown in this table, the minimum cost of any of the control options evaluated in the BACT analysis (i.e., use of the existing boiler) would result in an increased production cost of $26.18 per thousand board feet (MBF), corresponding to a net profit of -0.5 percent and a loss in net profit of 105 percent. Thus, *all* profits would be consumed if pollution controls are required. In order to recoup these costs, International Paper would have to raise its lumber prices substantially higher than other competitors. However, since costs are essentially "fixed" by the market, these prices would be considered extremely uncompetitive, making sale of the lumber impossible.

Project Viability

In order to remain competitive with other manufacturers if pollution controls are required on the kiln, lumber from the kiln must be sold at essentially the same price as other manufacturers. However, because the costs to con[illegible] VOC emissions would result in unreasonably low profit, International Paper would consider the project economically unviable and would not install the kiln.

Control Cost Relative to Total Project Cost

Another issue that International Paper request reviewing agencies to consider when determining whether to concur with International Paper's finding that pollution controls are cost prohibitive is that the capital cost of even the least costly of the control options evaluated is more than 60 percent of the entire capital cost of the kiln installation project itself. Use of the existing boiler to control kiln emissions is expected to incur a capital cost of at least $492,870. For comparison, the total installed capital cost of the kiln is estimated to be $800,000.

5.8.2 Environmental Impacts

Table 5-7 summarizes the environmental impacts associated with each control option. An essentially negligible beneficial impact on air quality is accomplished by reducing acetaldehyde and formaldehyde emissions present in kiln exhaust using any of the control options evaluated. Emissions reductions of only 220, 110, and 1,218 pounds per year or less of acetaldehyde, formaldehyde, and methanol would be obtained using any option evaluated. The minimal environmental benefit that is realized is evidenced by the high cost effectiveness estimates associated with any of the control options under consideration. The cost effectiveness of controlling either acetaldehyde and formaldehyde is estimated to be a minimum of $2.7 million dollars per ton and for methanol at least $589,000 per ton.

Slight adverse air quality impacts are caused by the RCO, RTO, and existing boiler control options in that NO_x and HAPs are emitted from each option. RCO and RTO options emit up to 2.5 and 3.8 tons per year of NO_x, respectively, and substantially smaller quantities of HAPs from No. 2 fuel oil combustion required for heating. Up to 3.8 tons per year of NO_x and substantially smaller quantities of HAPs are emitted from the existing boiler option from the additional wood waste required to combust the kiln exhaust in the wood-fired boiler.

Although wastewater will be generated from kiln exhaust condensate, no adverse impacts are incurred from wastewater discharges because kiln condensate is dilute in VOC, which could readily be removed prior to discharge. There are no hazardous waste impacts associated with any of the options evaluated.

Not only are the beneficial impacts of reducing toxic air pollutants considered negligible, but it is believed that reduction of the primary pollutant being controlled, VOC, would have a negligible impact on air quality in the vicinity of the facility. Under the PSD program, VOC is regulated to prevent significant deterioration of air quality due to ozone formation. Ozone is formed in the atmosphere due to atmospheric chemical reactions of NO_x and VOC, catalyzed by sunlight and excessive ambient concentrations of ozone in the lower atmosphere can be injurious to health and damage vegetation. The facility is located in a lightly populated and developed area of North Carolina and ambient concentrations of ozone in this area are known to be significantly below regulated levels. It should also be noted that under PSD regulations, ambient air quality impacts are considered "significant" only when VOC emission increases associated with a modification are at least 100 tons per year, which is greater than the approximate 94 tons per year potential emissions increase associated with the kiln.

Recent developments in air dispersion modeling and studies in ozone formation seem to indicate that even substantial reductions in VOC emissions in rural areas such as Riegelwood will have a relatively small impact on ozone formation. This phenomena has been substantiated in previous modeling analyses conducted by the NCDEM using the Urban Airshed Model (UAM). Moreover, it should also be noted that VOC emissions from the proposed kiln are extremely small compared to the biogenic (naturally occurring) VOC emissions from forests in the vicinity of the facility and, consequently, reduction of VOC from the kiln will negligibly reduce ozone formation and concentrations in the area.

5.8.3 Energy Impacts

Table 5-7 summarizes the energy impacts that are associated with each control option. All of the technologies require energy to operate exhaust collection fans, with impacts ranging from 170.000 KWH per year for RCO control to 493.[illegible] KWH per year for existing boiler control. All of the oxidation technologies under consideration also require additional fuel. ranging from 4.570 million Btu per year for RCO control and 493.522 for existing boiler control. There are no additional fuel requirements associated with biofiltration.

5.9 BACT SELECTION

Results of the top-down BACT analysis indicate that there are no cost-effective pollution control technologies for control of VOC emissions from lumber drying kilns and. consequently, the BACT proposed for the kiln is "no control." All of the control technologies under consideration cause severe economic impacts that would make installation of the kiln uneconomically unviable. Furthermore, it is believed that controlling

TABLE 5-7
SUMMARY OF TOP-DOWN BACT: ENVIRONMENTAL AND ENERGY IMPACT ANALYSES
INTERNATIONAL PAPER COMPANY - ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

Control Alternatives	Toxic Pollutant Impacts						Adverse Impacts From Other Air Pollutants?[3] (Yes/No)	Hazardous Waste Impacts? (Yes/No)	Energy Impacts	
	Acetaldehyde		Formaldehyde		Methanol					
	Emission Reduction (ton/yr)[1]	Cost Effectiveness ($/ton)[2]	Emission Reduction (ton/yr)[1]	Cost Effectiveness ($/ton)[2]	Emission Reduction (ton/yr)[1]	Cost Effectiveness ($/ton)[2]			Electrical (kW*hr/yr)	Fuel (MM Btu/yr)
Regenerative Catalytic Oxidation	0.11	2,796,952	0.055	5,613,061	0.52	589,399	Yes	No	170,000	4,570
Regenerative Thermal Oxidation	0.11	3,876,757	0.055	7,780,067	0.52	816,945	Yes	No	401,500	13,140
Existing Boiler	0.10	3,126,005	0.049	5,354,448	0.47	562,243	Yes	No	493,552	45,260
Biofiltration	0.09	3,697,714	0.046	7,420,755	0.44	779,216	No	No	262,800	0

Notes:

1. Emission reductions based on maximum uncontrolled emission rates and VOC control efficiencies for each control option. Uncontrolled acetaldehyde and formaldehyde emission estimates are presented in Section 7. Methanol emissions calculated from draft AP-42 factors developed by NCASI in January 1995.
2. Cost effectiveness based on emission reductions shown in this table divided by annual costs presented in the cost analysis for each control option.
3. Determination of whether adverse impacts are caused by control alternative evaluated. "Yes" response indicates that criteria or hazardous air pollutants are emitted.

VOC emissions from the kiln would result in essentially no benefit in the air quality of the region because VOC emissions are dwarfed by biogenic emissions in the vicinity of the Armour sawmill and because reducing the quantity of VOC emissions from a source as minor as a lumber drying kiln will negligibly reduce ozone formation in the area.

6.0 ADDITIONAL IMPACTS ANALYSIS

6.1 INTRODUCTION

Under PSD application requirements, an additional impacts analysis is required to evaluate impacts on the industrial, commercial, and residential growth; soils and vegetation; and visibility from PSD pollutants emitted in significant quantities from a new or modified major stationary source. A discussion of each additional impact associated with the proposed VOC emission increases at the Armour facility is provided in this section.

The conclusion of the additional impacts analysis is that negligible adverse environmental impacts are associated with VOC emissions from the proposed kiln and that important beneficial impacts to the environment may be realized if a permit is expeditiously issused because International Paper will be able to salvage trees downed by Hurricane "Fran." Potential beneficial impacts are discussed in greater detail in Section 6.4.2.

6.2 GROWTH

It is anticipated that installation of a new kiln would have negligible impact on the industrial, commercial, and residential growth in the area. No new employees will be needed to accommodate the increased production of the facility and only minimal revenues will be introduced into local commerce from increased lumber production at the facility.

6.3 SOILS

The Armour facility is located in the southeast coastal region of North Carolina. The soils in the vicinity of the Armour facility are classified as Woodington-Foreston and have the following characteristics:

- Loamy fine sand;
- Weak fine to weak medium granular structure;
- Very friable;
- Common fine roots;
- Strongly and extremely acidic; and
- Poor to moderate drainage.

VOC can precipitate from the air and may accumulate in soil through wet deposition (rain, snow, mist) and dry deposition (sedimentation, impaction). The impact of deposition of air pollutants on soil is dependent upon many factors including pollutant type and ambient concentrations, the depth to bedrock and groundwater, vegetation, soil types, precipitation, temperature, organic content, and soil pH buffering capacity (United States Fish and Wildlife Service, 1978).

Since the only PSD pollutant subject to the impacts analysis is VOC rather than pollutants such as particulates or sulfates, for which deposition effects have been well-documented, it is difficult to determine the exact soil impacts due to deposition. However, it is highly unlikely that the maximum potential VOC emission increases of only 94 tons per year from the facility will significantly impact the surrounding soils.

6.4 VEGETATION

6.4.1 Adverse Impacts Analysis

Because of the relatively small amount of toxie-air pollutants present in the kiln exhaust (see calculations in Section 7.2) and since other VOC emitted from lumber drying have not been documented as having a particularly deleterious effect on vegetation, it is believed that the only vegetation impacts requiring evaluation are those associated with ozone.

Ozone is formed in the atmosphere due to atmospheric chemical reactions between NO_x and VOC, catalyzed by sunlight, and excessive ambient concentrations of ozone in the lower atmosphere can damage vegetation. Past modeling analyses by the NCDAQ using the Urban

Airshed Model (UAM) indicate that in most areas of North Carolina (rural and urban), the formation of ozone is NO_X limited due to the abundance of VOCs emitted from trees and vegetation (biogenic VOC). The large concentrations of biogenic VOC create high VOC/NO_X ratios, thus limiting the photochemical reactions that form ozone. Conclusions of the study were that even significant changes in VOC emissions have little impact on ozone concentrations, and that changes in NO_X emissions have a substantially greater impact. Due to the rural location of the Armour facility and the abundance of trees and vegetation in the area, it is unlikely that the VOC emission increases from the proposed kiln will cause a significant increase in ozone formation and, therefore, will have negligible impacts on vegetation in the area.

There are two additional points that should be made pertaining to VOC emissions from the kiln and area ozone concentrations. First, under PSD regulations ambient air impacts due to VOC emissions are considered "significant" only when VOC emissions increases associated with a modification are at least 100 tons per year, which is greater than the approximate 94 tons per year emissions increase associated with the new kiln. Second, it should be noted that the facility is located in a lightly populated and developed area of North Carolina where "background" ambient ozone in the area are below regulated limits, installation of the proposed kiln should not threaten the national ambient air quality standards (NAAQS), which are intended to protect not only ambient air quality, but also the natural resources of the environment affected by air quality, such as vegetation.

6.4.2 Beneficial Impacts Analysis

In early September of 1996, Hurricane "Fran" downed hundreds of thousands of southern yellow pines located in southeastern/eastern North Carolina. As of late September, only a small fraction of these pines have been cleared and of the pines that have been cleared, most are being discarded as "undesirable waste."

The Armour facility, as well as other nearby lumber manufacturers, are attempting to salvage as many of these trees for lumber production as possible to effectively utilize natural resources.

However, in order for lumber manufacturers to be able to use these trees, trees must be gathered and processed in a timely fashion, before lumber quality is compromised

Installation of the proposed lumber kiln will result in a beneficial environmental impact in that the kiln will increase the production capacity of the facility and, consequently, increase the facility's ability to use downed timber. However, the magnitude of these benefits are directly linked to the length of time required to obtain the requested PSD permit.

6.5 VISIBILITY IMPAIRMENT

Visual quality in the vicinity of the Armour facility is currently excellent due to the rural nature and low density population of the region. Although VOC is a precursor to ozone, which is known to cause "haze" in significant concentrations, there are currently no regulatory approved modeling tools to quantify impacts of VOC on visibility. However, as discussed in vegetation analysis VOC emissions from the kiln are expected to cause a negligible increase in area ozone concentrations and, consequently, a negligible impact on visibility.

7.0 NORTH CAROLINA AIR TOXICS APPLICATION AND MODELING

7.1 INTRODUCTION

As part of this application a facility-wide air dispersion modeling analysis was performed for formaldehyde and acetaldehyde. This modeling demonstration is required under North Carolina regulations to demonstrate compliance with acceptable ambient limits (AALs) (15A NCAC 2D. 1100). The analysis was performed using maximum potential emissions rates, along with optimization to approximately 95% of the regulated ambient air levels (AALs), and predicted ambient concentrations at and beyond the property line. All modeling was performed using updated dispersion models and wake effect and downwash programs and follows the guidance given in the NCDAQ's Guideline for Evaluating the Air Quality Impacts of Toxic Air Pollutants in North Carolina (Guideline).

Applicability of the North Carolina regulation was "triggered" by the proposed kiln and is discussed in greater detail in the next subsection. Subsequent subsections provide a detailed description of the modeling analysis including the area description, the dispersion models, the meteorological data, the maximum potential and optimized emission rates, the modeling methodology, the GEP analysis, receptor grids, the cavity effect analysis, and the modeling results for all toxics that exceeded their *de minimis* levels.

7.2 AIR TOXICS APPLICABILITY ANALYSIS

According to North Carolina regulation 15 NCAC 2D.0610, a permit to emit toxic air pollutants is required for any facility undergoing a modification that increases emissions of a TAP, and that subsequent to the modification, total maximum emission of that TAP from all sources at the facility exceed specified emission rates, often referred to as the modeling exemption emission rates (MEERs). Based on stack test information obtained from NCASI, only two pollutants classified as North Carolina toxic air pollutants are emitted from steam-heated lumber drying kilns, acetaldehyde and formaldehyde.[1]

To determine whether an air toxics permit was needed for this project. maximum emission rates of acetaldehyde and formaldehyde from all sources at the plant were totaled and compared to the MEERs. Other than the lumber kilns. the only other source at the facility emitting acetaldehyde or formaldehyde is the wood-fired boiler, which also emits both pollutants. Emission estimates for each source. presented in Table 7-1. were based on emission factor calculations using factors developed by NCASI and on the maximum production rate of each source.[1]

Comparison of the total maximum emission rates to the MEERs indicates that formaldehyde is subject to air toxics permitting, but that acetaldehyde is not. However, maximum emission estimates for all kilns are based on average hourly emissions over the entire kiln drying cycle and, although the expected fluctuation in the emission rates of acetaldehyde during the lumber drying cycle are anticipated to remain well below the MEERs, International Paper is requesting permitting for acetaldehyde to ensure that an unintentional violation of the North Carolina air toxics regulations will not occur.

7.3 DISPERSION MODELS

The modeling analysis was performed using EPA computer models which evaluate the ambient impact of air pollution sources by simulating the processes of transport and diffusion of effluent into the atmosphere. Toxic emissions from the facility will occur from multiple source locations. Thus. Woodward-Clyde performed a modeling analysis for each applicable pollutant using the Industrial Source Complex Short Term (ISCST3) computer dispersion model. Version 96250. The ISCST3 model was used to model the sources and determine overall worst-case concentrations.

The modeling analysis was performed using hourly meteorological observations (8760 hours per year) to estimate maximum ambient concentrations for each pollutant subject to the modeling analysis. The ISCST3 modeling options selected for the analysis included:

TABLE 7-1
NORTH CAROLINA AIR TOXICS MODELING APPLICABILITY DETERMINATIONS
INTERNATIONAL PAPER ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

Emissions Unit	Activity Factor		Emission Factor			Nominal Emissions Rate (lb/hr)	
	Value	Units	Pollutant	Value	Units	Acetaldehyde	Formaldehyde
Proposed Drying Kiln	135	MBF/cycle[4]	Acetaldehyde	0.0078	lb/MBF[1]	2.93E-02	
	135	MBF/cycle[4]	Formaldehyde	0.0039	lb/MBF[1]		1.46E-02
Existing Drying Kilns (3 Kilns)	395	MBF/cycle[3]	Acetaldehyde	0.0078	lb/MBF[1]	1.62E-01	
	395	MBF/cycle[3]	Formaldehyde	0.0039	lb/MBF[1]		8.11E-02
Wood-Fired Boiler	10.33	ton wood/hr	Acetaldehyde	3.00E-03	lb/ton wood[2]	3.10E-02	
	10.33	ton wood/hr	Formaldehyde	6.60E-03	lb/ton wood[2]		6.82E-02
Totals from Project						2.22E-01	1.64E-01
Permitting Exemption Levels						6.80E+00	4.00E-02
Toxics Permitting Required?						**No**	**Yes**

Notes:

1. Reference: Compilation of Air Pollutant Emission Factors. AP-42. Section 10.1. Draft (1996). USEPA.
2. Reference: Compilation of Air Pollutant Emission Factors. Volume I. Fifth Edition. AP-42. USEPA. Table1.6-5 (average factor). January 1995
3. Batch cycle time = 19 hours
4. Batch cycle time = 36 hours

- Calculation of average concentrations
- Rural dispersion coefficients
- Regulatory default options
- Final plume rise
- Stack-tip downwash
- Buoyancy-induced dispersion
- Calms processing routine
- Default wind profile exponents
- Default vertical potential temperature gradients
- "Upper Bound" Values for supersquat buildings
- No exponential decay

Maximum 1-hour emission estimates were used in modeling to predict 1-hour ambient concentrations.

An evaluation of building cavity effects for each source was performed using the EPA SCREEN3 model (Version 96043). The SCREEN3 model was used to evaluate the building cavity region to determine the cavity distance from the edge of the structure causing the maximum GEP stack height. Section 7.5.4 describes the cavity effect analysis.

7.4 METEOROLOGICAL DATA

Following the North Carolina Air Toxic Guidelines and NCDEM recommendations, the dispersion modeling analysis was performed using one to five years (1987-1991) of Wilmington surface meteorological data (NWS. No. 13748) and Charleston, SC. mixing height data (NWS No. 13880) derived from upper-air sounding data recorded at the Charleston, SC. International Airport.

An anemometer height of 10 meters was used in the modeling analysis for each year of data. The processed meteorological data set consists of 8760 hourly observations of the following parameters:

- wind speed
- wind direction
- ambient temperature
- atmospheric stability
- mixing heights

Data are used to calculate hourly plume rise and downwind concentrations at downwind receptor locations for a period up to a year. Using these meteorological data and the ISCST3 model, each year is processed individually and maximum predicted concentrations for each year for five years are reported in the modeling results table for comparison to the NC AAL standards.

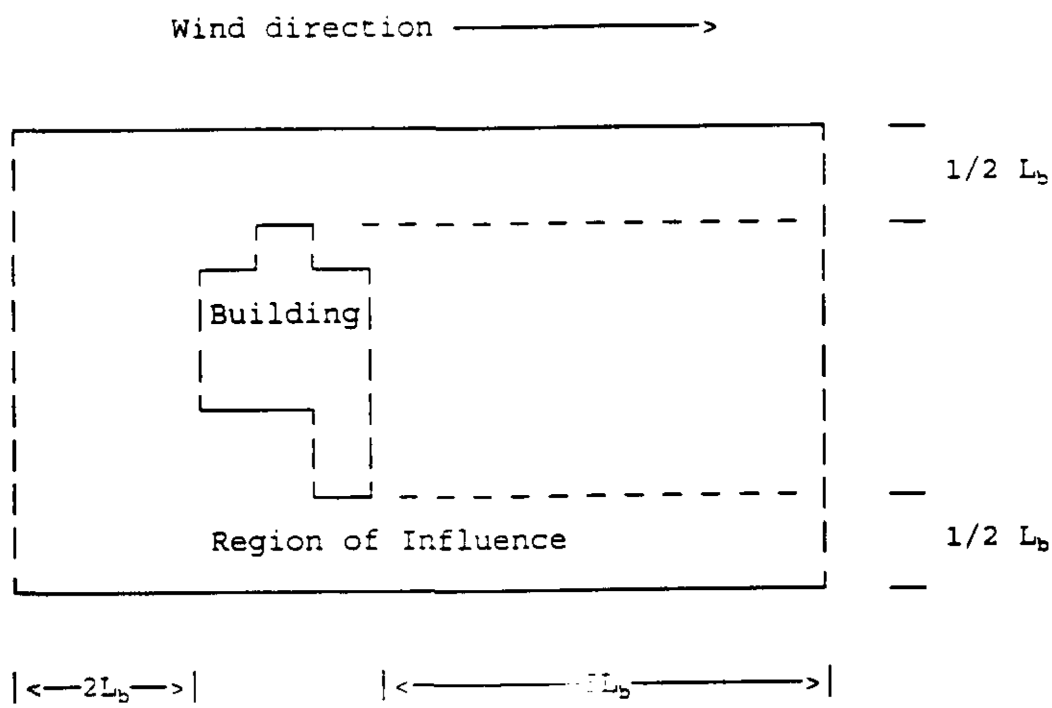
7.5 MODELING METHODOLOGY

A dispersion modeling analysis was performed for all impacted emission sources at the plant site and the maximum predicted concentration was compared to the respective AAL standard. The following subsections describe the GEP analysis, the receptors, the modeled sources, and the cavity effect analysis.

7.5.1 Good Engineering Practice (GEP) Stack Height Analysis

Based on the North Carolina Air Toxics Guidelines, a GEP analysis is required for all emission sources subject to a modeling analysis in order to determine if wake effects and downwash options need to be selected in the computer models. Thus, a GEP analysis was performed following the procedures outlined in the EPA documents Guideline For Determination of Good Engineering Practice Stack Height (Technical Support Document For the Stack Height Regulations) Revised (EPA-450/4-80-023R), the User's Guide to the Building Profile Input Program (October 1993), and the Bowman Engineering "GEP" program (Version 5.1).

The building wake and downwash effect analysis was applied to each air emission source. For each building, an area of wake and downwash effects extends outward to a distance of five times L (the lesser of the maximum projected width or height of the building) directly downwind from the leeward side of the building. Wake effects were assumed to occur if the emission source is located within a rectangle composed of two lines perpendicular to the wind direction, one at 5L downwind of the building and the other at 2L upwind of the building, and by two lines parallel to the wind direction, each at 0.5L away from each side of the building. The following presents an example of the wake effect and downwash region of influence.



As the wind direction rotates, the wake and downwash effect region of influence changes and is combined to form a GEP 5L region of influence in all wind directions. Any emission source within the region of influence is affected by wake and downwash effects. For buildings close to an emission source, wake and downwash effects were considered where the distance between the emission source and the nearest part of the building is less than or equal to 5L. Wake and downwash effects from buildings that are closer than the greater of either building's maximum projected width or height are considered to have one region of influence.

When an emission source height is less than the GEP height and is located within the region of influence, direction-specific building dimensions are included in the modeling analysis and either the Schulman-Scire or the Huber-Snyder equations are used for calculating the wake and downwash concentrations.

The ISCST3 model uses the Schulman and Scire method when the physical stack height is less than 1.5 times the height of the building causing the maximum GEP height. The Schulman and Scire equations reduce plume rise due to initial plume dilution, enhance vertical plume spread as a linear function of the effective plume height, and include appropriate building dimensions as a function of wind direction.

The ISCST3 model also accepts direction-specific building dimensions for emission source between 1.5 times the height of the building causing the maximum GEP height and the actual GEP height. In this case, the Huber-Snyder downwash equations are used for the wake and downwash calculations.

The GEP analysis was completed for the International Paper facility using the latest version of the Bowman GEP program to demonstrate compliance with stack height regulations (40 CFR Part 51) and to determine which emission sources are impacted by building wake and downwash effects. The building heights and projected widths, for 10 structures, were input into the model for each ten degrees of wind direction. These building heights and projected widths are the same as are used for the GEP stack height calculation. The x, y coordinates used in the analysis were taken from a map in which Plant North represent True North coordinates in the GEP and ISC models. All coordinates (stack locations, building corners, and property line receptors) used in this analysis reflect True North.

Table 7-2 presents the buildings/structures and associated heights used in the GEP analysis. Figure 2-2 shows the facility layout and buildings used in the GEP analysis. Appendix B contains the results of the GEP analysis including the direction specific building dimensions.

TABLE NO. 7-2
BUILDINGS/STRUCTURES USED IN MODELING ANALYSIS
INTERNATIONAL PAPER COMPANY-ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

Buildings	Height		Width		Length	
	(ft)	(m)	(ft)	(m)	(ft)	(m)
Warehouse #1	33.00	10.06	120.00	36.58	200.00	60.96
Warehouse #2	33.00	10.06	100.00	30.48	200.00	60.96
Planer Bldg.	33.00	10.06	200.00	60.96	410.00	124.97
Shavings Bin	125.00	38.10	20.00	6.10	40.00	12.19
Kiln Bldg. #1	25.00	7.62	40.00	12.19	70.00	21.34
Kiln Bldg. #2	25.00	7.62	75.00	22.86	65.00	19.81
Kiln Bldg. #3	26.00	7.92	60.00	18.29	70.00	21.34
Boiler Bldg.	40.00	12.19	40.00	12.19	75.00	22.86
Sawmill Main Bldg.	40.00	12.19	250.00	76.20	150.00	45.72
Sawmill Bldg. #1	33.00	10.06	65.00	19.81	140.00	42.67
Sawmill Bldg #2	33.00	10.06	60.00	18.29	100.00	30.48
Sawmill Bldg. #3	33.00	10.06	20.00	6.10	40.00	12.19
Sawmill Bldg. #4	33.00	10.06	30.00	9.14	45.00	13.72
Sorter	33.00	10.06	40.00	12.19	560.00	170.69

TABLE NO. 7-3
POINT SOURCE INFORMATION
INTERNATIONAL PAPER COMPANY-ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

Stack ID	Source Description	UTM		Stack parameters									Exhaust	Rain
		East	North	Height		Flow Rate	Velocity		Diameter		Temperature		Direction	Cap
		(m)	(m)	(ft)	(m)	(acfm)	(fps)	(m/s)	(ft)	(m)	(°F)	(°K)	(Hor. or Vert)	
Boiler	Wood Fired Boiler	753594.22	3802953.83	78.00	23.77	64,250	85.26	25.99	4.00	1.22	170.00	349.81	Vert	N

7.5.2 Point & Volume Sources

Point Sources

The ISCST3 model uses a steady-state Gaussian plume equation to model emissions from point sources such as stacks and vents. One point source, the wood-fired boiler was included in this modeling analysis. This source was modeled using actual (nominal) stack exhaust parameters.

Volume Sources

The ISCST3 model can be used to simulate the effects of emissions from volume sources such as fugitive emissions from enclosed building areas. Four lumber drying kilns (one new and three existing) were simulated as volume sources.

For each volume source modeled at International Paper, an initial lateral (σ_{yo}) and vertical (σ_{zo}) dimension were calculated. For elevated volume sources, an effective emission height (center of the volume) was determined. The following presents the methodology that was used to calculate the σ_{yo} and σ_{zo} for volume sources included in the International Paper modeling analysis.

The σ_{yo} for each single volume source was determined by dividing the minimum horizontal dimension of the volume (side of volume) by 4.3. The (σ_{zo}) for each single volume source with an effective emission height of zero or with an elevated effective emission height on or near a building was determined by dividing the vertical dimension of the volume by 2.15.

Tables 7-3 and 7-4 present the point and volume source parameters used in the modeling analyses. Figure 2-3 presents the location of all the sources used in the model in the facility layout drawing.

TABLE NO. 7-4
VOLUME SOURCE INFORMATION
INTERNATIONAL PAPER COMPANY-ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

Stack ID	Source Description	UTM East (m)	UTM North (m)	Source Height (ft)	Source Height (m)	Release Height (ft)	Release Height (m)	Source Width (ft)	Source Width (m)	Aj/Close Bldg Height (ft)	Aj/Close Bldg Height (m)	Source Sigma Y (m)	Source Sigma Z (m)
Kiln1&2	All of Kiln 1 and 1/2 of Kiln 2	753540.21	3802998.28	25.00	7.62	25.00	7.62	54.00	16.46	33.00	10.06	3.84	4.68
Kiln2&3	All of Kiln 3 and 1/2 of Kiln 2	753556.77	3802991.39	25.00	7.62	25.00	7.62	54.00	16.46	33.00	10.06	3.84	4.68
NewKiln	Proposed New Kiln	753574.25	3802984.10	26.00	7.92	26.00	7.92	54.00	16.46	33.00	10.06	3.84	4.68

7.5.3 Receptors

The dispersion modeling receptor grids were developed following procedures outlined in the North Carolina Air Toxics Modeling Guidelines. A discrete cartesian receptor grid system was created to adequately assess air quality impacts at the International Paper property line. Discrete receptors were placed along the property line at 100 meter intervals and then a cartesian grid system was extended outward from the property line at 100 meter intervals. to find the maximum modeled concentration. Receptors were also placed with 100 meter spacing along a railroad line that traverses the northern side of the property. Terrain elevations were not included in the modeling analysis. Figures 7-1 and 7-2 show the facility sources and property line and the expanded receptor grid used in the analysis.

7.5.4 Cavity Effect Screening Analysis

For the point source modeled (the wood-fired boiler), all buildings causing wake and downwash effects for any wind direction were determined. The building dimensions of the primary controlling structure was used in the SCREEN3 model to determine the maximum cavity effect concentration for the boiler. The cavity effect analysis methodology is described below.

1. The GEP analysis results were used to determine. for each source wind direction. the buildings causing the maximum GEP stack heights.
2. The SCREEN3 model was run for the controlling building at the site.
3. The cavity length for the controlling building was compared to the distance from the leeward side of the building to the property line in the direction in which the source is impacted by the building. If the cavity length did not extend beyond the property line, then no cavity concentration was calculated.
4. When the cavity height is less than stack height or cavity length does not extend off property the cavity concentration is 0 ug/m^3.

FIGURE 7-1
PROPERTY LINE RECEPTORS AND SOURCE LOCATIONS
INTERNATIONAL PAPER - ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

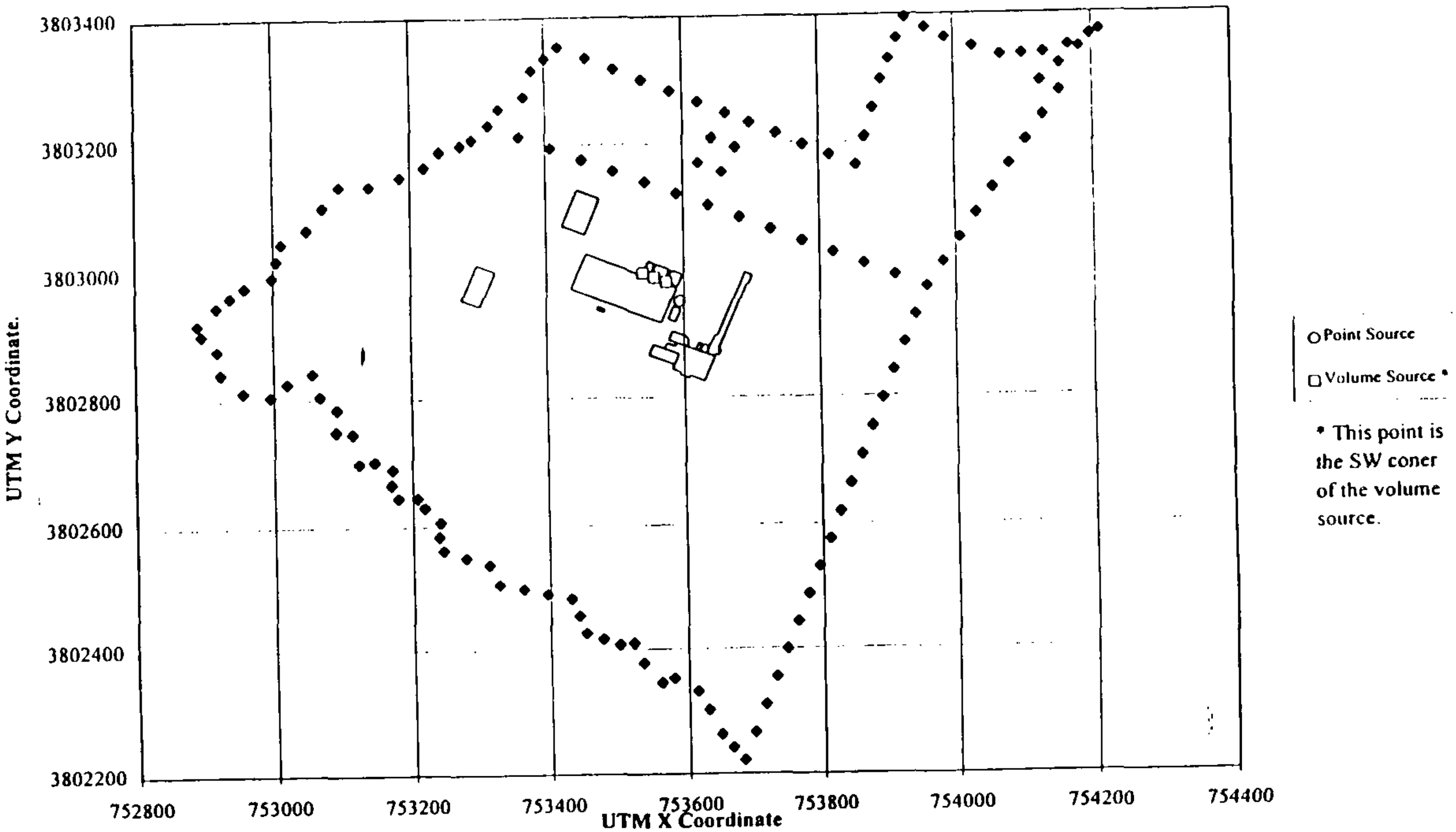
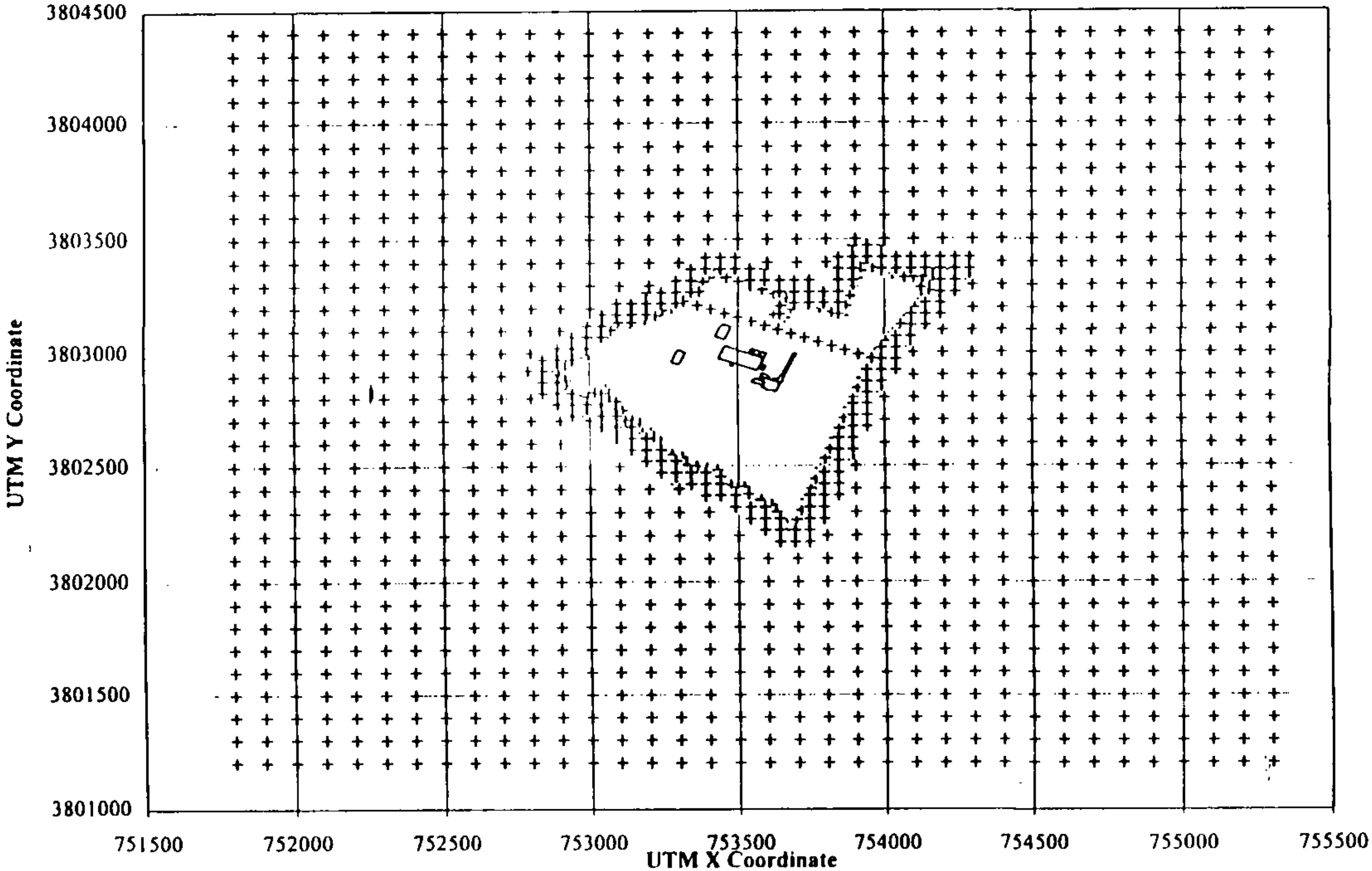


FIGURE 7-2
EXPANDED RECEPTOR GRID
INTERNATIONAL PAPER COMPANY - ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129



The cavity effect analysis indicates that the cavity wake effect region for each building does not extend beyond the International Paper property line. and thus. further analyses are not required. The SCREEN3 output for the cavity analysis is in Appendix B.

7.6 AIR TOXICS MODELING ANALYSIS

7.6.1 Baseline Modeling Analysis

For completeness. the ISC3 model was executed with all meteorological data (1987 - 1991). Baseline results for the modeled toxics indicated concentrations of acetaldehyde and formaldehyde of approximately 0.2 percent and 13 percent. respectively, of their AALs.

7.6.2 Optimization Modeling Analysis To Determine Maximum Allowables

The results of the baseline air quality dispersion modeling analysis demonstrates that calculated potential emissions from International Paper will not result in any ambient concentrations that exceed the applicable AALs. Therefore, International Paper is requesting emission limitations which correspond more closely to those ambient levels allowed in 15 NCAC 2D .1104. Optimization (i.e. increase) of emissions from several sources to determine allowable emissions was performed. thereby allowing additional operating flexibility while at the same time complying with all applicable AALs.

The optimized allowable emission rates are not intended to provide authorization to operate existing equipment in a manner that contravenes standards for currently regulated pollutants. such as criteria pollutants. nor are they intended to provide authorization to modify existing equipment or install new equipment beyond the scope of the plans presented in this analysis. Rather. optimized emission rates are intended to minimize future compliance demonstration iterations by allowing for some variability in emissions as more data become available. This approach provides a window of operating flexibility for the facility that is well within compliance requirements of the North Carolina Toxic Air Pollutant Regulations. without being unduly restrictive.

Optimized emission rates were developed using a mathematical technique known as linear optimization. This technique provides a mathematical method for solving practical problems by means of linear function where the variables involved are subject to constraints. There were two primary constraints applied to this analysis:

- The optimized emission rate could not be lower than the emission rate used in the baseline analysis;
- The ambient impact resulting from the optimized emissions could not exceed a predetermined percent of the applicable AAL (discussed below).

Emission rate limitations that result in ambient impacts equal to approximately 95 percent of the AAL were established for both formaldehyde and acetaldehyde.

The compliance demonstration for the optimized emission rates was based on a refined-level simple terrain dispersion modeling analysis. The compliance demonstration was based on five years of meteorological data (1987-1991).

Based on the maximum modeled results. the optimized emission rates (Table 7-5) for all emission sources show that ambient concentrations at the property-line and beyond are maintained below each respective AAL. The results of the five year optimized modeling analyses are presented in Table 7-6.

Input and output computer files are being supplied on diskettes with this report. The modeling demonstrated compliance for all proposed air toxic emission rates.

7.7 CONCLUSIONS

Dispersion modeling was conducted to demonstrate compliance with air toxics limits for formaldehyde and acetaldehyde. This modeling analysis evaluated the impacts of pollutants emitted from sources located across the facility at the property line and beyond. Modeling results show that concentrations in simple terrain and within building cavities for acetaldehyde

TABLE NO. 7-5
COMPARISON OF MAXIMUM POTENTIAL AND OPTIMIZED EMISSION RATES
INTERNATIONAL PAPER COMPANY-ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

Stack ID	Source Description	Emission Rates			
		Acetaldehyde		Formaldehyde	
		Baseline (lb/hr)	Optimized (lb/hr)	Baseline (lb/hr)	Optimized (lb/hr)
Boilers	Wood Fired Boiler	3.10E-02	19.61	6.82E-02	0.48
Kiln1&2	All of Kiln 1 and 1/2 of Kiln 2	8.10E-02	50.70	4.06E-02	0.29
Kiln2&3	All of Kiln 3 and 1/2 of Kiln 2	8.10E-02	50.70	4.06E-02	0.29
NewKiln	Proposed New Kiln	2.93E-02	18.34	1.46E-02	0.10
	TOTAL	0.22	139.35	0.16	1.15

TABLE NO. 7-6
REFINED MODELING RESULTS FROM OPTIMIZED EMISSIONS RATES
INTERNATIONAL PAPER COMPANY-ARMOUR FACILITY
WOODWARD-CLYDE PROJECT NO. 96R129

Pollutant	Averaging Period	Concentration (μg/m³)					AAL (mg/m³)	AAL (μg/m³)	MAX. Model Conc. (μg/m³)	UTM	
		1987	1988	1989	1990	1991				East (m)	North (m)
Acetaldehyde	1-Hour	25,639	25,343	21,566	20,976	22,916	27.00	27,000	25,639	753453.38	3803176.00
Formaldehyde	1-Hour	143	143	121	118	129	0.15	150	143	753453.38	3803176.00

and formaldehyde averaging periods are approximately 0.2 percent and 13 percent of their respective AALs.

7.8 REFERENCES

1. "Steam Fired Kilns. Summary of HAP Test Data." National Council of the Paper Industry for Air and Stream Improvement, Inc. January 1995. Draft AP-42 submittal to EPA.

SECTION A

FACILITY (General Information)

DECEIVED
OCT
AIR PERMITS

A1

REVISED 04/15/94 — AIR QUALITY SECTION - APPLICATION FOR AIR PERMIT TO CONSTRUCT/OPERATE

FACILITY NAME: Federal Paper Board, Inc., Armour Plant			
MAILING ADDRESS: P O Box 57		SITE ADDRESS: ~~Federal Road~~	
CITY: Riegelwood		CITY: Riegelwood	COUNTY: Columbus
STATE: NC	ZIP CODE: 28456	ZIP CODE: 28456	[redacted]
CONTACT PERSON: Michael Wilson		TITLE: Environmental Compliance Manager	
TELEPHONE: (910) 655-4106	FAX: (910) 655-9368		[redacted]
OWNER OF FACILITY: International Paper Company			
MAILING ADDRESS: Manhattanville Road			
CITY: Purchase	STATE: NY	ZIP CODE: 10577	
CONTACT PERSON: Michael Wilson		TITLE:	
TELEPHONE: (910) 655-4106	FAX: (910) 655-9368		
DESCRIBE TYPE OF OPERATION: Sawmill producing southern yellow pine dimensional lumber			
SIC CODE(S): 2421		DESCRIPTION OF PRIMARY SIC GROUP: Lumber, dry	

FACILITY COORDINATES		OR		
UTM EAST:	380350		LATITUDE:	[redacted]
UTM NORTH:	75132		LONGITUDE:	

HAVE YOU INCLUDED (X) CONSISTENCY DETERMINATION (X) SOURCE REDUCTION & RECYCLING FORM D3-3 AND (X) APPLICATION FEE?

FACILITY IS: (X) TITLE V FACILITY ( ) NON-TITLE V FACILITY ( ) SYNTHETIC MINOR

IF TITLE V INDICATE APPLICABILITY 1 2 3 4 5 (CIRCLE ALL THAT ARE APPLICABLE)

APPLICATION IS BEING MADE FOR (CHECK ALL THE APPLY. NOTE: (TV) INDICATES APPLICABILITY TO TITLE V FACILITIES ONLY):

( ) NEW FACILITY	( ) INITIAL TITLE V PERMIT (TV)	( ) RENEWAL (TV)
(X) MODIFICATION	( ) NEW FACILITY (TV)	(X) PSD (TV)
(X) EXISTING EMISSION SOURCE(S)	( ) MINOR MODIFICATION (TV)	( ) NON-ATTAINMENT (TV)
	( ) SIGNIFICANT MODIFICATION (TV)	( ) 112 (g) (TV)

IF APPLICATION IS BEING MADE FOR ANY OF THE FOLLOWING, FORM A2 MUST BE ATTACHED TO THIS FORM:

( ) ADMINISTRATIVE AMENDMENT	( ) CHANGE OF OWNERSHIP	( ) RELOCATION (WITHIN FACILITY) (TV)
( ) ADMINISTRATIVE AMENDMENT (TV)	( ) CHANGE OF OWNERSHIP (TV)	( ) LIKE-FOR-LIKE REPLACEMENT
( ) RENEWAL	( ) RELOCATION (WITHIN FACILITY)	( ) LIKE-FOR-LIKE REPLACEMENT (TV)
		( ) 502(b)(10) NOTIFICATION (TV)

HAVE YOU INCLUDED: (X) FLOW CHART(S) (X) ROOF DIAGRAM (X) PLANT LAYOUT (X) PLOT PLAN (X) AREA DIAGRAM

CURRENT/PREVIOUS PERMIT NO: 2248R10	EXPIRATION/DISCONTINUED DATE:	[redacted]
DO YOU CLAIM CONFIDENTIALITY OF DATA ( ) YES (X) NO	*(SEE INSTRUCTIONS)*	

SIGNATURE OF RESPONSIBLE PERSON OR COMPANY OFFICIAL: TITLE: Plant Manager DATE:

X Daniel T. Alford 10/1/96

(TYPED) Daniel Thomas Alford

DEPARTMENT USE ONLY:	RECEIVED:	ASSIGNED TO:	PREMISE NUMBER:
APPLICATION NUMBER:	RETURNED:	COMPLETE:	REVIEW DATE:
PERMIT NUMBER:	DATE ISSUED:	[redacted]	

SECTION A

EMISSION SOURCE LISTING (EXISTING FACILITY)

A3

(New, Modified, Previously Unpermitted, Replaced, Deleted)

REVISED 04/15/94

AIR QUALITY SECTION

EMISSION SOURCE ID NO.	EMISSION SOURCE DESCRIPTION	CONTROL DEVICE ID NO.	CONTROL DEVICE DESCRIPTION	EMISSION POINT ID NO. or "FUGITIVE"
EQUIPMENT TO BE MODIFIED BY THIS APPLICATION				
N/A				
EQUIPMENT TO BE ADDED BY THIS APPLICATION (New, Previously Unpermitted, or Replacement)				
K1-4	Dry Kiln	N/A	N/A	K1-4
EQUIPMENT TO BE DELETED BY THIS APPLICATION				
N/A				
EQUIPMENT TO BE REPLACED BY THIS APPLICATION				
N/A				

SECTION D

TOXIC AIR POLLUTANT EMISSIONS SUMMARY

D2-1

REVISED 04/15/94

AIR QUALITY SECTION

EMISSION SOURCE ID NO: K1-4

SOURCE DESCRIPTION: Dry Kiln

CONTROL DEVICE(S): N/A

ID NO(S): N/A

		REQUESTED MAXIMUM EMISSIONS					
TOXIC AIR POLLUTANT (TAP)	TAP NO.	LB/YEAR	LB/DAY	LB/HOUR	LB/15 MIN	EMISSION POINT ID	EMISSION FACTOR TYPE
Acetaldehyde				0.10		K1-4	N/A[1]
Formaldehyde				18.34		K1-4	N/A[1]

READ INSTRUCTIONS PRIOR TO COMPLETING MODELING PARAMETERS SECTION

MODELING PARAMETERS

EMISSION POINT ID	EXHAUST TEMP. (F)	EMISSION POINT DIAMETER (FT)	EMISISON POINT HEIGHT (FT)	EXIT VELOCITY (FT/SEC)	RAIN CAP?
					Y N
					Y N
					Y N
					Y N
					Y N

COMMENTS:

1. Emission rates based on modeling (see Section 7.0 of accompanying report).
2. This source was modeled as a "volume source." See Table 7-4 of accompanying report for modeling parameters.

SECTION D

TOXIC AIR POLLUTANT EMISSIONS SUMMARY

D2-1

REVISED 04/15/94

AIR QUALITY SECTION

EMISSION SOURCE ID NO: BW

SOURCE DESCRIPTION: Wood-Fired Boiler

CONTROL DEVICE(S): Multicyclone followed by venturi scrubber and wet cyclone

ID NO(S): APC-1,2, and 3

REQUESTED MAXIMUM EMISSIONS

TOXIC AIR POLLUTANT (TAP)	TAP NO	LB/YEAR	LB/DAY	LB/HOUR	LB/15 MIN	EMISSION POINT ID	EMISSION FACTOR TYPE
Acetaldehyde				0.48		BW	N/A[1]
Formaldehyde				19.61		BW	N/A[1]

READ INSTRUCTIONS PRIOR TO COMPLETING MODELING PARAMETERS SECTION

MODELING PARAMETERS

EMISSION POINT ID	EXHAUST TEMP. (F)	EMISSION POINT DIAMETER (FT)	EMISISON POINT HEIGHT (FT)	EXIT VELOCITY (FT/SEC)	RAIN CAP?
BW	170	4	78	85.3	Y N
					Y N
			—		Y N
					Y N
					Y N

COMMENTS.

1. Emission rates based on modeling (see Section 7.0 of accompanying report).

SECTION D

TOXIC AIR POLLUTANT EMISSIONS SUMMARY

D2-1

REVISED 04/15/94

AIR QUALITY SECTION

EMISSION SOURCE ID NO: K1-1/K1-2

SOURCE DESCRIPTION: All of Dry Kiln K1-1 emissions and 1/2 of Dry Kiln K1-2 emissions.

CONTROL DEVICE(S): N/A

ID NO(S): N/A

		REQUESTED MAXIMUM EMISSIONS					
TOXIC AIR POLLUTANT (TAP)	TAP NO	LB/YEAR	LB/DAY	LB/HOUR	LB/15 MIN	EMISSION POINT ID	EMISSION FACTOR TYPE
Acetaldehyde				0.29		K1-1, K1-2	N/A[1]
Formaldehyde				50.70		K1-1, K1-2	N/A[1]

READ INSTRUCTIONS PRIOR TO COMPLETING MODELING PARAMETERS SECTION

MODELING PARAMETERS

EMISSION POINT ID	EXHAUST TEMP. (F)	EMISSION POINT DIAMETER (FT)	EMISISON POINT HEIGHT (FT)	EXIT VELOCITY (FT/SEC)	RAIN CAP?
					Y N
					Y N
					Y N
					Y N
					Y N

COMMENTS.

1. Emission rates based on modeling (see Section 7.0 of accompanying report).
2. This source was modeled as a "volume source." See Table 7-4 of accompanying report for modeling parameters.

SECTION D

TOXIC AIR POLLUTANT EMISSIONS SUMMARY

D2-1

REVISED 04/15/94

AIR QUALITY SECTION

EMISSION SOURCE ID NO: K1-2/K1-3

SOURCE DESCRIPTION: All of Dry Kiln K1-3 emissions and 1/2 of Dry Kiln K1-2 emissions.

CONTROL DEVICE(S): N/A

ID NO(S): N/A

REQUESTED MAXIMUM EMISSIONS

TOXIC AIR POLLUTANT (TAP)	TAP NO	LB/YEAR	LB/DAY	LB/HOUR	LB/15 MIN	EMISSION POINT ID	EMISSION FACTOR TYPE
Acetaldehyde				0.29		K1-2/K1-3	N/A[1]
Formaldehyde				50.70		K1-2/K1-3	N/A[1]

READ INSTRUCTIONS PRIOR TO COMPLETING MODELING PARAMETERS SECTION

MODELING PARAMETERS

EMISSION POINT ID	EXHAUST TEMP (F)	EMISSION POINT DIAMETER (FT)	EMISISON POINT HEIGHT (FT)	EXIT VELOCITY (FT/SEC)	RAIN CAP?
					Y N
					Y N
					Y N
					Y N
					Y N

COMMENTS

1. Emission rates based on modeling (see Section 7.0 of accompanying report).
2. This source was modeled as a "volume source." See Table 7-4 of accompanying report for modeling parameters.

SECTION D

SPECIFIC EMISSION SOURCE (EMISSION INFORMATION)

D3-1

(*see note in instructions concerning state air toxics regulations)

REVISED 04/15/94

AIR QUALITY SECTION

EMISSION SOURCE DESCRIPTION: Dry Kiln

EMISSION SOURCE ID NO: K1-4 | IS THIS SOURCE A FUGITIVE SOURCE? ( ) YES (X) NO[1]

ALTERNATIVE OPERATING SCENARIO (AOS) NO:

POLLUTANT	EMISSION FACTOR TYPE	EMISSION RATE IN LBS/HR		EMISSION RATE IN LBS/YR	
		POTENTIAL	ACTUAL	POTENTIAL	ACTUAL[2]
VOC	1	21.45	11.8	188,520	94,260
Acetaldehyde	1	0.0293	0.0293	257	128
Formaldehyde	1	0.0146	0.0146	128	64

COMMENTS:

1 Approximately 5 percent of emissions from the kiln are fugitives.

2 Actual annual emissions are based on 50 percent utilization.

SECTION D

SPECIFIC EMISSION SOURCE (REDUCTION AND RECYCLING ACTIVITIES)

D3-3

REVISED 04/15/94

AIR QUALITY SECTION

EMISSION SOURCE DESCRIPTION: Dry Kiln

EMISSION SOURCE ID NO: K1-4

REGULATED POLLUTANT	ONGOING SOURCE REDUCTION ACTIVITIES (ENTER CODES)	QTY. EMITTED BEFORE REDUCTION (LBS/YR)	QTY. EMITTED AFTER REDUCTION (LBS/YR)	PLANNED SOURCE REDUCTION ACTIVITIES (ENTER CODES)
N/A				

COMMENTS:

No "source reduction activities" affecting air emissions from the kiln are planned for this source.

SECTION D

EMISSION POINT SUMMARY

D4

REVISED 04/15/94

AIR QUALITY SECTION

LIST ALL INFORMATION ASSOCIATED WITH EACH EMISSION POINT

EMISSION POINT ID NO.	EMISSION POINT HEIGHT (FT)	EQUIV. DIAM. (FT)	TEMP. (F)	VELOCITY (FT/SEC)	FLOW RATE (ACFM)	EMISSION POIN DIRECTION	RAIN CAP? (Y OR N)
K1-4	26	2.3 [1]	180	- [2]	- [2]	H	N

COMMENTS:

[1] Eight square vents on kiln roof. Equivalent diameter shown above.

[2] Flow rate and velocity through drying cycle are variable. Source modeled as a "volume source" in air toxics modeling.

DISPERSION MODELING BRIEFING SHEET

CHAMPION INTERNATIONAL CORPORATION
Pine Barren Sawmill
225 MMBF/YR Lumber Mill
Escambia County, Florida

- WOOD PRODUCTS NESHAP
- HAPs - NOT MAJOR FOR HAPs

- Pollutants Evaluated – NO_x ~~Only~~, PM_{10}
- Background Ambient Air Quality Data
  - *De Minimis* impact expected for NO_x, PM_{10}
  - Use Ozone Data from Pensacola Area for VOCs BACKGROUND MONITORING
- Modeled Sources – Steam Boiler Only
  - Less than PSD significant impact level expected for NO_x, PM_{10}
- Use Current Version of EPA ISCST3 Model
- Rural Dispersion Coefficients and Mixing Heights
- Assign Terrain Elevations to Each Receptor
- Evaluate Building Downwash Using Current Version of EPA BPIP Model
- Receptor Grids
  - Initial "Fenceline" Grid Around Main Process Area at 25-m Spacings
  - Near-Field Cartesian; 100 m from "Fenceline" Extending to 1 km at 100-m Spacings
  - Mid-Field Polar; From 1 km to 5 km at 500-m Spacings → 1 km - 2.5 250; 2.5 - 5 500
  - Far-Field Polar; From 6 km to 10 km at 1-km Spacings
- Meteorology
  - 5-Years (86-90) of Surface Data from Pensacola Regional Airport (Station 13899)
  - 5-Years (86-90) of Upper Air Data from Apalachicola Municipal Airport (Station 12832)

- COPY FOR NPS/FWS
- COPY FOR EPA

AIR PERMITTING ISSUES BRIEFING SHEET

CHAMPION INTERNATIONAL CORPORATION
Pine Barren Sawmill
225 MMBF/YR Lumber Mill
Escambia County, Florida

- Estimated Maximum Annual Emissions – Point Sources (Preliminary)
  - o 10 tpy PM/PM_{10} — PM_{10} > 15 TPY
  - o <1 tpy SO_2
  - o 70 tpy NO_x
  - o 45 tpy CO — 18-24 HRS PER DRYING CYCLE
  - o 300 tpy VOC — NCASI EMISSION FACTORS FOR KILNS; SEPT '98 BACT DETERMINATION FROM TEXAS; L-P BACT IN NORTH CAROLINA
- PSD Applicability — -METHANOL -TERPENES -PINENES
  - o Major Source for VOCs (Exceeds 250 tpy)
  - o Significant for NO_x (Steam Boiler) and VOC (Drying Kilns) — LAER DETERMINATIONS?
- Phased Construction
  - o Initially 3 Kilns, Additional 4th in 2-4 Years — PERMIT ALLOW - 18 MO. RESTR.
- Steam Boiler Options
  - o Two, Smaller Units (< 100 MMBtu/hr each) — NSPS Dc BACT FOR NO_x 0.12 LB/MMBTU
  - ~~o Relocated Unit(s)~~
- Preliminary BACT Analysis
  - o Steam Boiler NO_x: Low-NO_x Burners, Approx. 0.12 lb/MMBtu
  - o Drying Kilns VOC: No Controls

PROJECT BRIEFING SHEET

CHAMPION INTERNATIONAL CORPORATION
Pine Barren Sawmill
225 MMBF/YR Lumber Mill
Escambia County, Florida

- Location
  - 12 Miles North of Cantonment, Escambia County
  - Fenced Access From U.S. Highway 29
  - 32 Acre Site — MILL FOOTPRINT ON 1000 AC
  - Nearest Residential Housing – Approximately 1.2 mi (2 km) S of Site
  - Nearest Town, McDavid – Approximately 5 mi (8 km) N of Site
  - Nearest Class I Area, Breton NWR – Approximately 95 mi (155 km) SW of Site

    APPROX 22 MI FROM PENSACOLA

- Process Description
  - Log Processing 2 155' LOG CRANES, RING DEBARKERS, 2 BUCKING STATIONS
  - Sawmill 2 DIFF SIZE BLOCKS – SMALL & LARGE
  - Kiln Drying LOADED W/ FORKLIFT.
  - Finishing
  - Shipping 250-300 TRUCK-TRIPS 150 LOG, 35-40 BYPRODUCTS, BAL. LUMBER RAIL LINE – CSX 20-40% OF LUMBER

- Project Emission Points
  - Natural Gas-Fired Steam Boiler; Nominal 125 MMBtu/hr MAYBE 2 PKG. BOILERS NSPS Dc
  - MAJOR — Indirect (Steam) Heated Lumber Kilns VOC EMISSIONS – 2 FROM VENTILATION POINTS PERMIT 4 KILNS
  - MAJ. — Cyclone/Baghouse for Planer Building PM Fugitives PM
  - MAJ. — Small Baghouse for Machine Shop (Saw Sharpening)
  - EXEMPT — Log Processing, Sawmill, Storage/Shipping PM Fugitives
  - FUG — Truck Traffic (Paved Roads) PM Fugitives

- Schedule
  - File Air Permit Application by May 28, 1999 105 DAYS FOR APPLIC. REVIEW
  - Start Construction by September 10, 1999
  - Operational by June, 2000

MEETING AGENDA

CHAMPION INTERNATIONAL CORPORATION
Pine Barren Sawmill
225 MMBF/YR Lumber Mill
Escambia County, Florida

Florida DEP, Tallahassee, Florida
Wednesday, April 14, 1999

- Introductions

- Project Overview – (See Project Briefing Sheet)
  - Location
  - Process Description
  - Project Emission Points
  - Schedule

- Air Permitting Issues – (See Air Permitting Issues Briefing Sheet)
  - Estimated Annual Emissions (Preliminary)
  - PSD Applicability
  - Phased Construction
  - Steam Boiler Options
  - Preliminary BACT Analysis
  - Dispersion Modeling (see Dispersion Modeling Briefing Sheet)
  - FDEP Permit Application Processing Schedule

4/14/99 MTG. W/ ENTERPRISE FL & CHAMPION INTL.

NAME	COMPANY	PHONE
Joseph Kahn	FDEP - New Source Rev.	850-921-9519
Roger Miller	Enterprise Fla, Inc	850-922-8751
Pat Evans	OTTED / EOG	850-487-2974
Tom Davis	ECT	352 332-0444
Dave Stevens	Champion	850-937-4849
Terry Kassabaum	Champion	409-398-7252
Andra S. Cornelius	Enterprise Florida	850/487-2157
John Barone	champion	203/358-7676
Clair Fancy	FDEP - BAR	8509219503
Cleve Holladay	FDEP-BAR/NSRS	850-921-8986

SECTION D

FACILITY EMISSIONS SUMMARY

AIR QUALITY SECTION

D5

REVISED 04/15/94

TOTAL FROM SPECIFIC EMISSION SOURCE SUMMARIES

POLLUTANT	CAS NO.	ANNUAL EMISSIONS IN LBS/YR	
		ACTUAL	POTENTIAL
PM[1]	[redacted]	10,066	21,429
VOC	[redacted]	623,710	782,431
Acetaldehyde[2]	[redacted]	1,616	1,937
Formaldehyde[3]	[redacted]	1,177	1,402

TOTAL FACILITY FIRING RATE FOR FOSSIL AND WOOD-FIRED BURNERS: ______ MILLION BTU/HR

TOTAL REACTIVE VOC's FROM THE FACILITY: ______ LBS/DAY or ______ % Total Control or OTHER (specify) ______

COMMENTS:

[1] Actual and potential emissions of PM were calculated by adding 50 percent and 100 percent of the maximum emission increases, respectively, to the estimated facilitywide totals reported in the Armour Title V application.

[2] VOC emissions were calculated by adding annual emission estimates shown on Form D3-1 to emission estimates included in the Title V application.

[3] Potential emissions of acetaldehyde and formaldehyde are based on calculated maximum emissions and not modeled rates.