CLEAN AIR REQUIREMENTS FOR A PROTECTED ATMOSPHERE FURNACE

By

DON R. REID

Bachelor of Science

University of Tulsa

Tulsa, Oklahoma

1972

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
May, 1997

CLEAN AIR REQUIREMENTS FOR A PROTECTED ATMOSPHERE FURNACE

Thesis Approved:

____
Thesis Advisor

____

____

____
Dean of the Graduate College

CLEAN AIR REQUIREMENTS FOR A PROTECTED ATMOSPHERE FURNACE

Thesis Approved:

Arled H. Johannes

Thesis Advisor

W. M. Veant

William F. McTernan

Thomas C. Collins

Dean of the Graduate College

ACKNOWLEDGMENTS

All of the council I have received from my OSU professors has kept me focused on finishing this program. A special thanks is due my advisor Dr. A.J. Johannes who more than anyone pointed me out the bases. When advise or help was needed, he always came through. In this same vein, I must thank Joe Gilliland, an OSU alumnus.

It would have been impossible to write about a clean air furnace without support from my company, Fintube LP. They very graciously paid for tuition and allowed some time off to attend classes. In addition, they are a pro-active environmental company ahead of the compliance curve. So thanks for paying my way, allowing me the time, and having the problem in the first place!

I am thankful that OSU offered the program at University Center at Tulsa. This allowed me to set a strong, action example on the importance of education for my own college age kids. And of course, of course, I am grateful to my confidant, companion, and wife for her unwavering support and love.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

NOMENCLATURE AND ACRONYMS

ISO	**A European quality certification organization known by its initials**
kWh	**Measure of electrical energy**
MCF	**Thousand of cubic feet**
NAAQS	**National ambient air quality standards**
NESHAP	**National environmental standard for HAPs**
NOX	**Any of the nitrogen oxide compounds**
NSPS	**New source performance standards**
PEMS	**Predictive emissions monitoring software**
PPM	**Parts per million by volume contaminant measurement**
PSD	**Prevention of significant deterioration**
PTE	**Potential to emit**
SCFM	**Standard cubic feet per minute (pressure and temperature)**
SIC	**Standard industrial classification**
SIP	**State implementation plan**
SOX	**Any of the sulfur oxide compounds**
TPY	**Tons (2000#) per year**
VOC	**Volatile organic compound**

CHAPTER I

INTRODUCTION

Overview

The idea of a clean environment continues to enjoy popular support. Cleaner ambient air is an important nationwide accomplishment. Table I is adapted from Pollution Engineering (PE 1996) and illustrates the progress made in health criteria pollutants from 1985-1994, a period of economic growth.

TABLE I

SUMMARY OF NATIONAL AIR EMISSIONS
Thousand Short Tons

Year	Carbon Monoxide	Nitrogen Oxide	VOC	Sulfur Oxide	Lead
1985	114,690	22,860	25,798	23,230	20,124
1986	109,199	22,348	24,991	22,242	7,296
1987	108,012	22,403	24,778	22,204	6,857
1988	115,849	23,618	25,719	22,647	6,513
1989	103,144	23,222	23,935	22,785	6,034
1990	100,650	23,038	23,599	22,433	5,666
1991	97,376	22,672	22,877	22,068	5,279
1992	94,043	22,847	22,420	21,836	4,899
1993	94,133	23,276	22,575	21,517	4,938
1994	98,017	23,615	23,174	21,118	4,956

Prior to 1970 there were significant increases in these same pollutants. The importance of clean air is apparent when considering the daily intake of a 150 pound working man: 3 pounds of food, 6 pounds of water and, 100 pounds of air (Canter 1996).

While cost to benefits analysis is often difficult in environmentalism, many aspects of the air regulations do have favorable ratios. Over the last 25 years reductions in the air pollutant sulfur dioxide, for example, have resulted in major human health benefits. The annual estimated industrial costs of the SOX regulation is placed as 2 billion dollars for 1997 while the annual estimated benefits are 10 billion as shown on Table II adapted from Environmental Protection Agency (EPA) data (Chestnut 1995). The 20^{th} percentile column gives values that correspond to ones where 20 percent of scientists estimate these values or lower. The uncertainty is demonstrated by examining the three column values.

Several of the eleven Titles of the Clean Air Act 1990 Amendments (CAAA) have begun implementation. Title IV on Acid Deposition Control and Title VI on Stratospheric Ozone Protection are programs well underway. The permit program is Title V, Operating Permit Provisions, and is to be the single enforcement document for all CAAA requirements. Permitting activities are turned over to the states once their air programs have the necessary scope and features. Oklahoma received interim approval of its State Implementation Plan (SIP) in March of 1996. A schedule of compliance by industry is shown in Appendix B.

TABLE II

Estimates Of Annual Human Health Benefits Of Title IV For The Eastern (31) United States For 1997 (Millions Of 1994 Dollars)

Health Effect	20th Percentile	Mean	80th Percentile
Premature Mortality	\$1,428.0	\$9,307.2	\$19,999.0
Chronic Bronchitis	\$507.5	\$974.0	\$1,377.5
Respiratory Hospital Admissions	\$5.7	\$11.3	\$17.1
Cardiac Hospital Admissions	\$4.6	\$9.4	\$13.9
Asthma Symptom Days	\$20.9	\$56.9	\$93.2
Restricted Activity Days	\$70.6	\$147.0	\$228.6
Days With Lower Respiratory Symptoms	\$31.8	\$56.7	\$90.0
Total Health Benefit	\$3,219.	\$10,562.	\$20,684.

Objectives Of Study

The purpose of this study is to examine operating air permit requirements for a protected atmosphere, heat treatment furnace. Air emission data has not been published or previously taken on such a furnace to my knowledge. Neither has the

federal and state permitting requirements , if any, been determined. Study objectives are 1) to inventory emissions and improve environmental operations, 2) to evaluate air permit regulations pertaining to this type furnace and, 3) to determine potential furnace alternatives for continued operating compliance. The study is focused on an operating furnace with plant personnel affected all physical changes of instrument connections and maintenance as well as completing the area wide emissions inventory. I performed the first CO stack sampling and analysis and outlined the plan for the independent consultant stack sampling. Objectives 2) and 3) were studied without plant assistance or their inconvenience.

Tektube is one of my employer's companies manufacturing steel boiler tubes using a protected atmosphere furnace. Located in Tulsa, Oklahoma the facility that was used for this study is a 7 tons per hour, boiler tube annealing furnace originally manufactured by Surface Combustion Inc. in 1969. The protective atmosphere is produced by sub-stoichiometrically burning of natural gas with further conditioning. This atmosphere is necessary to avoid the scaling and oxidation of steel associated with annealing temperatures. There is nothing unique about this furnace or its application. In fact, a current brochure from Surface Combustion promises a nearly identical product. Reviewing a governmental "Industrial Plant Handbook" shows almost 15% of furnace classifications to be of the protected atmosphere variety (Defense Logistics Agency 1978).

Impact Or Scope

The EPA has estimated that a major source under Title V will need 1200 man hours (estimated in 6/92) in applying for a permit or 660 man hours for a non major source. The EPA further estimates (8/95) the regulatory impact of Title V, State Operating Programs (40CFR part 70) for each of the first five years as the EPA $14 million, the states $160 million, and the sources $512 million (U.S. Senate Committee On Environment And Public Works 1995). Source user fees are intended to cover the state's costs of administration. The company Enviroplan, Inc. estimates (8/95) that capital costs for continuous emissions monitoring (CEM) per Title V, one stack, two pollutants is $123,300 with annual operating costs of $24,300. For those not needing a Title V permit, Oklahoma still requires an air permit for sources with almost no exceptions (Oklahoma Administrative Code 1995). So, air permitting can be expensive, its requirements are new to business and the State of Oklahoma, and it will impact many businesses

CHAPTER II

LITERATURE REVIEW

Federal Clean Air Requirements

The 1990 Clean Air Act Amendments continues our legislative history of federal management with state implementation featuring a forward looking timetable of compliance. Although the Act introduced sweeping changes throughout eleven Titles it is the permit program that is the focus of this study. The EPA rules for Title

V are codified in the yearly issues of the Code of Federal Regulations, Title 40 (40CFR). Part 70 deals with state operating permits while Part 71 is for federally operated air programs and applies to states failing to adopt approved programs (40 CFR 70 1996). The EPA allows considerable flexibility in state programs but all follow the minimum elements outlined in 40 CFR Part 70. The goals then of the Title V program are: 1) to integrate all air requirements of all titles into one operating permit document, 2) to upgrade various state air programs lacking features, and 3) to facilitate enforcement actions (U.S. Senate Committee On Environment And Public Works 1995).

The Environmental Protection Agency is the major executive power of our government having environmental responsibility. Some of the other branches sharing responsibility include the Department of Interior, Department of Agriculture, Department of Commerce, and the Department of Transportation. But the EPA is the largest, administrating 10 major statutes, employing over 18,000 employees and having a yearly budget of $6.5 billion. Organizationally, each of 10 geographic regions reports directly to the Administrator. Oklahoma is part of Region 6 headquartered in Dallas, Texas. While the environmental laws are written by Congress it is the EPA that implements them, acting under the Administrative Procedures Act of 1946. Rule making and order making decisions follow a pre-established, public format. The rule making, or quasi-legislative process, can be formal if required by statute or informal and follows in four distinct, often contentious phases. These phases are generally described as start-up, development, preparation of proposed rule making package, and preparation of final rule making package. This process is seldom completed on an original schedule and often needs "supplemental proposals" or "reproposals". The three attributes of a successful program are 1) flexibility, 2) simplicity and, 3) rigor. These are somewhat mutually exclusive and any two will handicap the third.

Order making is a quasi-judicial process in which the EPA acts somewhat like a court, hearing evidence and issuing findings in individual cases. This action might involve permitting or imposing sanctions.

A Title V operating permit is required when a facility in an attainment area (Oklahoma) has "potential" emissions from stationary sources and answers yes to any one of the following questions (Canter 1996):

1) Is the facility a major source of air toxics? That is, do emissions total 10 tons per year (tpy) of any one of the 189 HAPs, or 25 tpy for all HAPs combined?
2) Is the facility a major source of criteria pollutants? That is, do emissions total 100 tpy for either carbon monoxide, particulate matter under 10 microns, VOCs, or NOX.
3) Is the facility subject to Title IV on acid deposition control?
4) Is the facility subject to Title VI on stratospheric ozone protection?
5) Is the facility subject to NSPS?
6) Is the facility subject to either NESHAPS or MACT?

The "potential to emit" (PTE) can be contrasted to actual emissions which are normally much less. The EPA considers PTE as (Novello 1995):

> the maximum capacity of a stationary source to emit any air pollutant under its physical and operational design. Any physical or operational limitation on the capacity of a source to emit an air pollutant, including air pollution control equipment and restrictions on hours of operation or on the type or amount of material combusted, stored or processed, shall be treated as part of its design if the limitation is enforceable by the Administrator.

By limiting its PTE a source can become a "synthetic minor" and avoid obtaining a Title V permit. The requirement that the limitations must be federally enforceable is being litigated in court. Since a source's objective in becoming a synthetic minor is to avoid a permit, the EPA demands strict accountability. They have identified several ways to limit PTE but probably the most direct is to demonstrate that actual emissions are below 50% of major source status (Novello 1995). There is some discussion to move more to actual as contrasted to potential emissions in permit determination.

The EPA has granted a temporary permitting exemption for all non-major sources. This was done as a concession to cost effectiveness and to ease the expected state administrative burden. The best estimates are that there are 350,000 non-major and 50,000 major sources nationwide(U.S. Senate Committee On Environment And Public Works 1995). States remain free to not defer non-major permitting obligations and such is the case with Oklahoma. Oklahoma estimates it will issue 1400 air permits using 25 engineers over 3 years (Environmental Federation Of Oklahoma 1996). By comparison, the Ohio EPA Air Division has testified before the US Senate Committee on Environment and Public Works that they have 20,000 facilities requiring an air permit. On the expensive continuous emissions monitoring requirement, they estimate 75% of the monitors will measure 3.4% of the total SOX emissions. The same numbers for carbon monoxide are 82.5% and `1.7%. In view of this extremely poor benefit to cost comparison, they suggested the EPA entirely fund the CEM or any enhanced monitoring system.

The 1990 Clean Air Act allows the EPA to prescribe methods and procedures for compliance other than continuous emission monitoring systems. The EPA has received much criticism and many comments during the rule making process on monitoring (EPA Website 1996). As just illustrated, harsh criticism was leveled at the cost effectiveness of using CEM. While large facilities such as power plants have experience with CEM and work the costs into their product's price base, most of industry has no such experience and can not raise prices. The helpful comments emphasized the indirect way of emissions monitoring. The old enhanced monitoring rule, 40 CFR 64, recognized three acceptable monitoring technologies (White 1995):

1) Direct measurement of pollutants with CEM.

2) Using software modeling to estimate emissions (PEMS).

3) Using a monitored process parameter to demonstrate emissions compliance (DCPL).

This rule has been redrafted and renamed the compliance assurance monitoring (CAM) rule, drafted August '96, and expected to become final sometime after June '97 (EPA Website 1996). With this change the focus moves from enforcement to pollution prevention and control. With CAM rules there are 1) active controls on emissions such as scrubbers and incinerators and 2) documented work practices. Either of these will provide reasonable assurance of initial compliance as well as the follow up maintenance and operation. Industry will have more flexibility and the public will have greater assurance of compliance to air standards.

A Title V permit application needs to be complete but the EPA has suggested that some early major source applications were more than complete. Texas Instruments said before Congress it spent $250,000 per permit which would indicate about two person years in preparation effort or about three times the EPA estimate. For a major source, all relevant CAAA requirements must be reported not just those necessitating the permit. A non-major need only show those emission units causing it to be subject to permitting. In any event, the EPA asserts that Title V will increase compliance as a result of placing the obligations in writing with initial as well as annual certification. Absent these documents and duties, sources yield to competitive pressures at the expense of air quality.

State Clean Air Requirements

Oklahoma has combined environmental responsibility under its Department of Environmental Quality (DEQ). Previously, several departments held some responsibility that for air pollution being the Air Quality Division. To help administer this responsibility, employment has at least tripled in the last two year to over 120 employees with some outside consulting being utilized. In Oklahoma City, there is a group of employees that form the Customer Assistance Program complete with a 800 number phone service. In Tulsa, there is a full service branch which includes permit writing assistance (Environmental Federation Of Oklahoma 1996).

Past Oklahoma air regulations featured construction permits and operating permits. In addition there was a prevention of significant deterioration (PSD) requirement. All of these features have been retained and the Part 70 or Title V features added. The Oklahoma Administrative Code Title 252 Chapter 100 codifies the rules, regulations, and permit fee schedules. The most current Code is the 1996 Annotated Oklahoma Administrative Code Chapter 100 1996). Here, Oklahoma's authority to regulate air pollution sources is set out as is the registration of even very minor sources. The Code states that emission data is never considered proprietary and is "available at all times to the public during normal working hours". A personal check of one Tulsa, Oklahoma area industry did reveal emission data.

Generally speaking, a construction permit is required before commencing any new or modifying construction. The exceptions to this requirement are:

1) Any one criteria pollutant will not exceed one pound per hour emission.
2) Toxic emissions do not exceed de minimis requirements.
3) The construction is not subject to NSPS or NESHAP regulation.

In addition to the Part 70 requirements the State requires major sources to do BACT determination, air modeling and provide other potential site and sampling point information. State and federal air definitions are identical including distinctions between major and minor sources. Fees are scaled from $2000 for a major to as little as $200 for the one pound per hour level (Oklahoma Administrative Code Chapter 100 1995).

A minor operating permit is required no later than 180 days from initial operation, issued for 10 years and is renewable. Actual testing of new sources may be required by the DEQ. An annual emissions inventory is also required. Initial fees are $250 for more than 25 tons/year of any one pollutant or $100 if less. In addition annual operating fees are scaled with emissions except that carbon monoxide is exempt from fees:

1) 10 - 24.99 tons/year $100/year
2) 25 - 49.99 tons/year $250/year
3) 50 - 74.99 tons/year $500/year
4) 75 - 99.99 tons/year $750/year

A major operating permit is issued for a fixed 5 year term at $15.19 per ton exempting carbon monoxide, HAPs and, Title VI ozone depletion substances. Municipal waste incinerators have longer terms. The initial processing fee is $2000 (the construction permit) with renewals $1000. Other activities, such as relocating a source, have established fee schedules.

All areas in Oklahoma except the Wichita Mountains are Class II Areas. The PSD program for Class II Areas addresses three pollutants: particulate matter, sulfur dioxide, and nitrogen dioxide. The idea here is to not let any one new economic activity foul the ambient air to its legal ceiling. The annual arithmetic means in micrograms per cubic meter for PM, SOX, and NOX are 17, 20, and 25, respectively. These values are about 25% of Oklahoma's Primary Ambient Air Quality Standards which are the same as the National Ambient Air Quality Standards (NAAQS) (Canter 1996).

Oklahoma has prepared a "Title V Permit Application Guide". The author has purchased a copy of this Guide and some of the blank forms are located in Appendix A. Other useful information from this Guide including the application submittal schedule is located in Appendix B. This Guide further states that the DEQ has 60 days to determine administrative completeness after which time it is "deemed complete". If determined to be Title V, the Tektube furnace has SIC 3443 and would have a submittal date of March 6, 1999.

Protected Atmosphere Furnaces

Boiler tubes form a part of a pressure vessel and are commonly manufactured to standards set forth in American Society For Testing And Materials (ASTM Standards 1995). Flat, carbon steel sheet is cold rolled into a round tube and seam welded by a non contact, high frequency, electrical power source (ERW). This welding process gives the steel undesirable properties. The in line, follow up heat treatment process is annealing. Figure 1 is a phase diagram for plain carbon steel Doyle 1962). Carbon steel boiler tubes range in carbon content from 0.06% to 0.18% (low carbon) and are given a full anneal. That is, they are heated above 900 degrees C but below 955 degrees C. The tube material is soaked at temperature for an appropriate time and then cooled in air. This treatment will restore ductility, mechanical properties, and relieve rolling stresses. A photograph of the Tektube heat treatment line is shown in Figure 2. Workflow is from the right to the left.

Normal combustion of natural gas with excess air produces heat and has gas constituents of nitrogen, oxygen, carbon dioxide, water vapor, and traces of argon. Oxygen, carbon dioxide and water vapor react with carbon steel producing unacceptable rusting and decarburizing. The gas constituents are much improved with insufficient air for complete combustion or sub-stoichiometric combustion. This eliminates the oxygen, reduces the percentage carbon dioxide and introduces the reducing constituents, carbon monoxide and hydrogen. Water vapor may be condensed and removed by cooling of the combustion gases, typically to 4 degree C.

FIGURE 1

IRON-CARBON EQUILIBRIUM

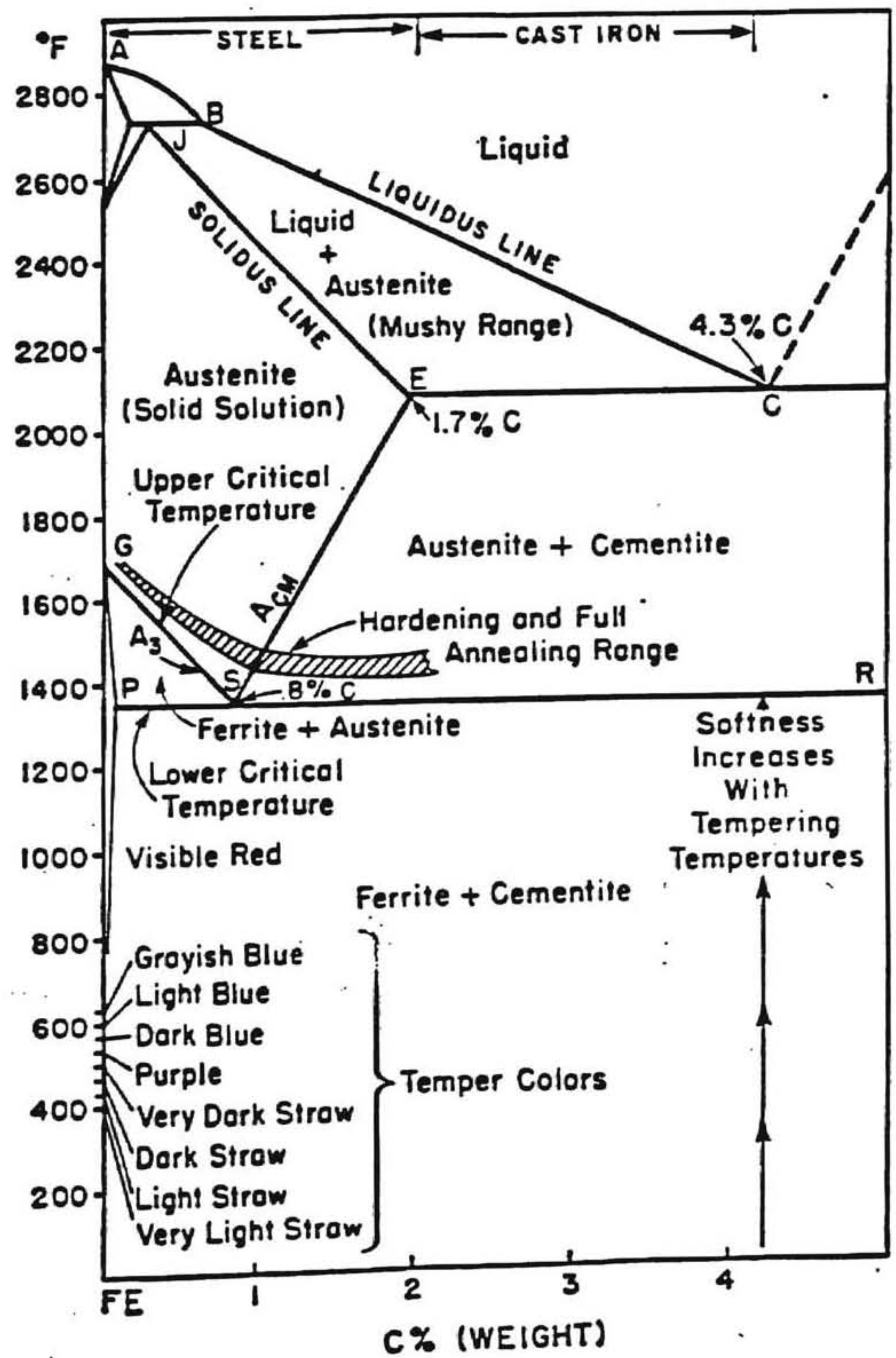


FIGURE 2

TUBE FACILITY

Carbon dioxide is not easily removed but is not a problem in annealing low carbon steel and in the percentages present. The decarburizing effect at austenitizing temperatures where surface carbon is (C) is:

$$(C) + CO_2 = 2\,CO$$

The scaling reaction important at high furnace temperature and carbon dioxide content is:

$$Fe + CO_2 = FeO + CO$$

The American Gas Association has classified six groups of commercially important furnace atmospheres (American Society For Metals 1981). This study is focused on Class 102 which is defined as an exothermic base formed by partial combustion of a rich gas-air mixture where the water vapor may be removed to a desired dew point. Classification and application of principal furnace atmospheres are given in Table III adapted from ASM 1981.

TABLE III

CLASSIFICATION AND APPLICATION OF FURNACE ATMOSPHERES

Class	Description	Application	Nominal Composition, vol% N2	CO	CO2	H2	CH4
101	Lean exothermic	Oxide coating steel	86.8	1.5	10.5	1.2	...
102	Rich exothermic	Bright annealing, copper brazing	71.5	10.5	5.0	12.5	0.5
201	Lean prepared nitrogen	Neutral heating	97.1	1.7	...	1.2	...
202	Rich prepared nitrogen	Annealing, brazing stainless steel	75.3	11.0	...	13.2	0.5
301	Lean endothermic	Clean hardening	45.1	19.6	0.4	34.6	0.3
302	Rich endothermic	Gas carburizing	39.8	20.7	...	38.7	...
402	Charcoal	Carburizing	64.1	34.7	...	1.2	...
501	Lean exo-endothermic	Clean hardening	63.0	17.0	...	20.0	...
502	Rich exo-endothermic	Gas carburizing	60.0	19.0	...	21.0	...
601	Dissociated ammonia	Brazing, sintering	25.0	...	...	75.0	...

Tube material continuously travels through the annealing furnace with the protected atmosphere leaking out past the inlet and outlet curtains. Rich exothermic gas is produced inexpensively by using about 7 volumes of air to each volume of natural gas burned. One thousand cubic feet of rich exothermic gas is produced with the following economics:

Natural gas	144 cubic feet
Power	0.4 kW-h
Cooling water	300 gallon
Power for drying	0.5 kW-h

Assumptions on operating hours and utility costs are given later in this report under "Analysis of Options". Using current prices a 30,000 cubic foot per hour generator has an operating expense of about $13.77/hour.

CHAPTER III

METHODOLOGY

Manufacturing Process

The CAAA requirements are new to most medium size industrial plants. For this new requirement, representative air emissions data is needed. A thorough plant-wide air emissions inventory is required for permit preparation. To facilitate this a drawing of the Tektube equipment layout was done as shown on Figure 3. This was used to prepare a block diagram, Figures 3a and 3b, of all the plant processes and their representative air emissions, if any. These emissions were gathered by the best means including measurements, engineering judgments and equipment manuals. There are quite a few potential sources for air emissions, all of which will need to be included in a Title V permit application. But only the tube annealing furnace had significant emissions and these were stack CO from the protective atmosphere. This furnace is indirectly heated by gas fired radiant tubes exhausting inside the building. I measured average low CO levels (<10 PPM) with the portable monitor around the furnace and confirmed expected low levels from burner equipment manuals. Instrument models are given later in this report.

The tube annealing furnace itself is 8 feet tall by 10 feet wide by 50 feet long. The tube in and out racks and cooling section add another 160 feet to the furnace length. For worker safety, the hood over the racks and cooling section collect the CO fumes and evacuate them through the roof, inspirating a great deal of dilution air. To the best of my knowledge, this is a common arrangement for continuous, steel annealing.

Upon close examination, the tube manufacturing is actually three mismatched industrial processes : welding, annealing, and finishing. All three need to be simultaneously running since there is no material storage between processes. Welding never limit manufacturing while finishing usually does, perhaps 70% of the time. And so the annealing furnace is often under utilized, the importance here being that its "potential to emit" will likely be overstated as compared to its actual.

As depicted in the plant equipment layout, there is a batch annealing process in four separate furnaces. Here the protective atmosphere is provided by tank (liquid) nitrogen. These furnaces represent significant combustion processes exhausting inside the building. But again, I measured very low reading near the furnaces with the portable CO monitor.

FIGURE 3

Standard Tube Process
Revised 02–27–96

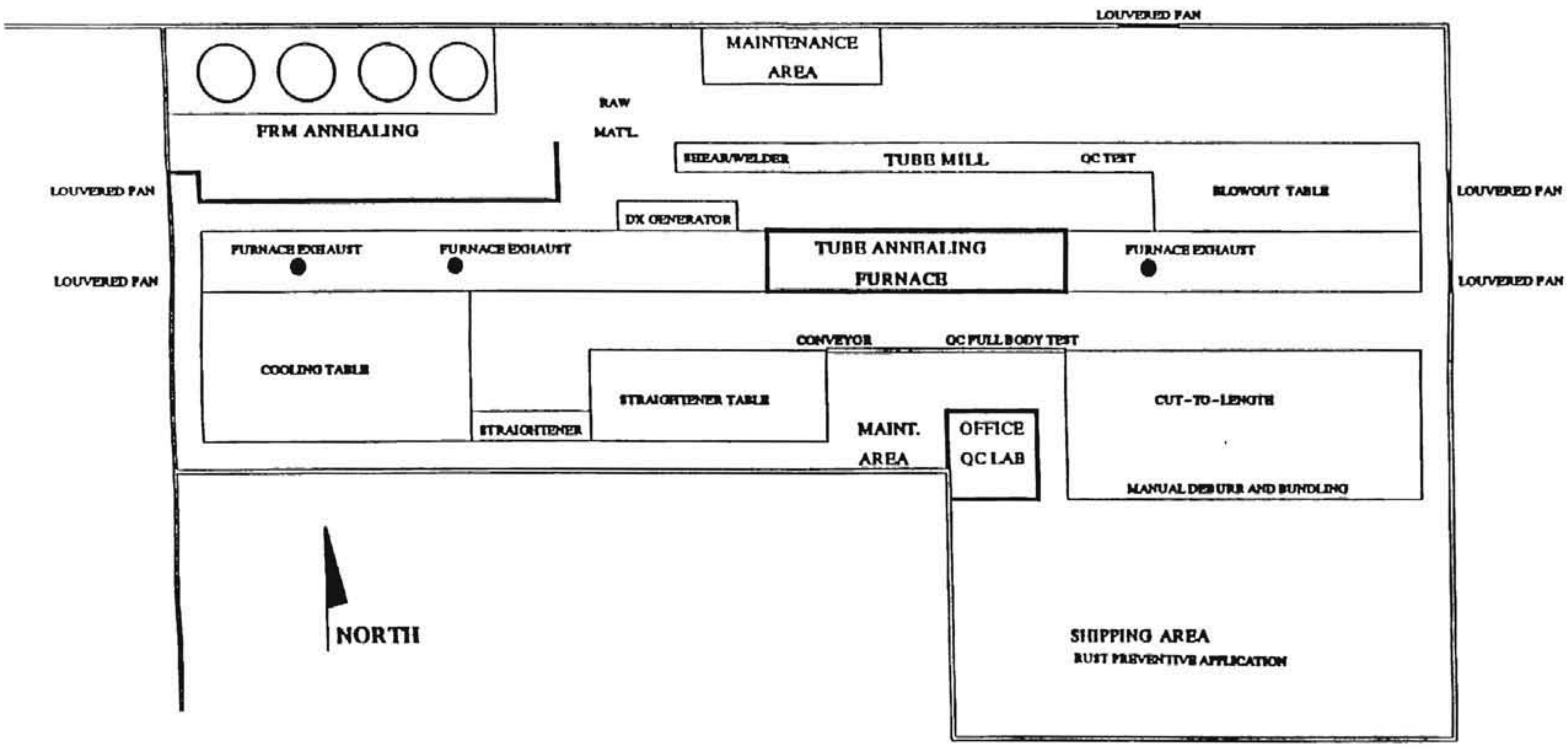


FIGURE 3a

Standard Tube Process

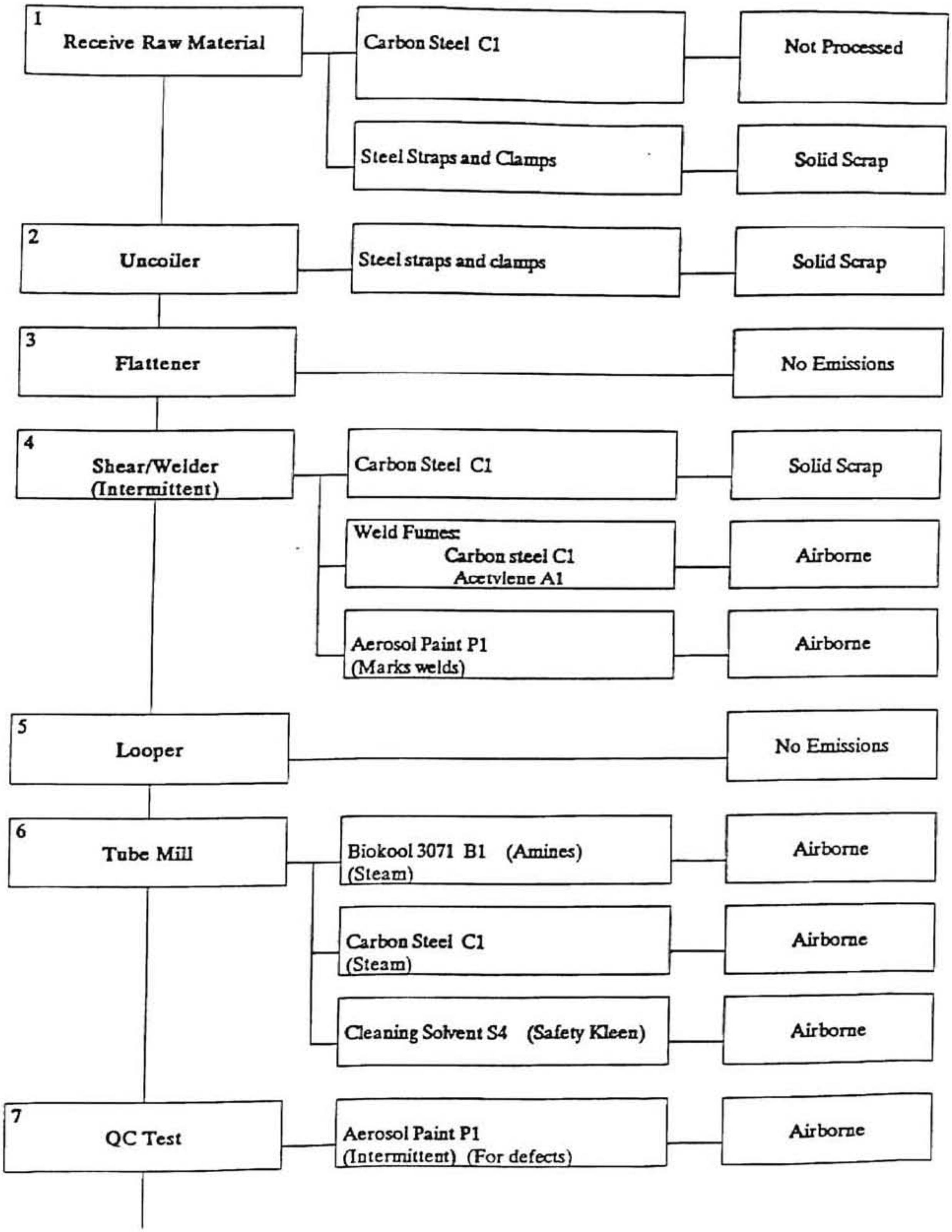
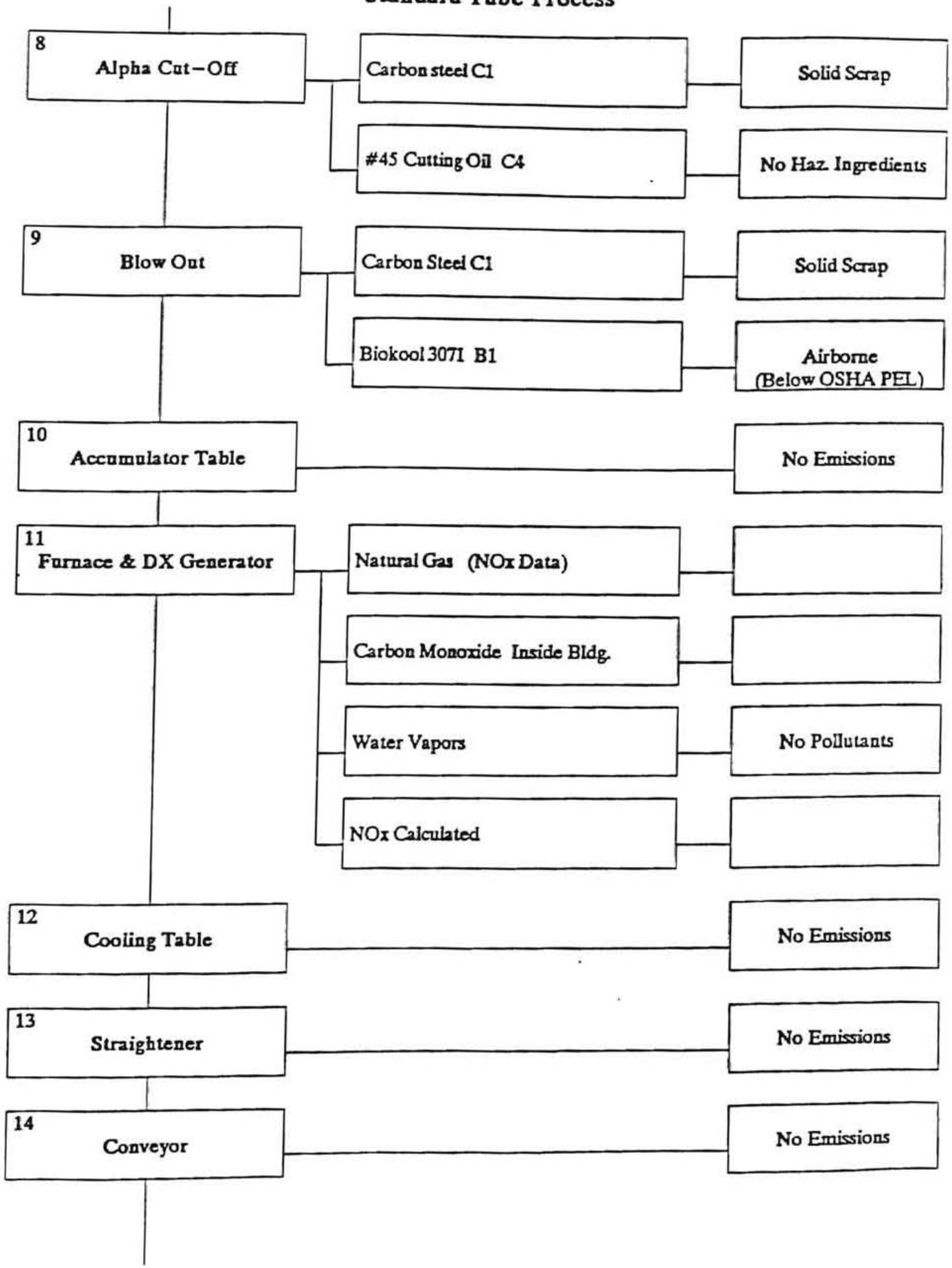


FIGURE 3b

Standard Tube Process



Business Budget

A rough representative budget will be developed now to drive the economic choices presented later. Some expenditure for CAA compliance is expected but not above a higher threshold. If compliance costs are much above this high threshold, then market disruptions would imply some other solution path. Tube making is a very competitive, quality driven business. Raw materials typically make up 85% of the products total cost (Weimer 1997). For $10 million annual sales an additional compliance cost of $150,000 annually means an increase of 10% in (all) non material costs. A representative budget for compliance is $150,000 per year.

Air Measurement Equipment

The following equipment was used in air measurements:

1) For the DX generator gas, a portable combustibles analyzer is used, Teledyne Model 980.
2) For the furnace atmosphere, stack gas measurements of 4/28/95 a Quintox combustion analyzer KM9006 was used. Printouts of NOX, SOX, and CO were available from all three stacks.
3) Furnace atmosphere stack gas temperature and velocity measurements of 4/28/95 were made using an Omega kit Model HHF710.
4) Furnace atmosphere stack gas measurements of 7/5/95 were made by a professional consulting service with a continuous recorder. Two of the three stacks were monitored. The model of instrumentation is not recorded.

5) A commercial CO monitor with alarm is located on the factory floor, GasTech model GX-82.

Activity Cycles

Even in the very mature field of tube manufacturing there are continuous changes in the equipment: some maintenance, some de-bottlenecking, some process upgrades. Competition and business cycles also result in quick and sudden changes. These historical cycles are certain to repeat themselves in some fashion.

Oklahoma Construction And Operating Permit

As already discussed, Oklahoma requires a two part permit for new facilities. Here is an example of that permitting and regulatory delay. I applied for these two permits on a new construction, high temperature wind tunnel. This wind tunnel is physically very close to the protected atmosphere annealing furnace. The State gave a timely opinion that permits were required.

The application for a construction permit was completed May 1, 1993 indicating an expected completion date of July 1, 1993. Although the exhaust stack was six feet in diameter and the tunnel had a 20 MM Btu/hour burner, expected emissions were very low. For example, carbon monoxide was expected to average 8 PPM or 5pound per test day. A permit was granted August 18, 1995 while completion was as per the original schedule.

The application for an operating permit was completed October 11, 1996 which requested an increase in operating hours to 960 hours per year. The permit was granted December 6, 1996.

There was a great deal of corporate anxiety over the State's inaction for 27 months on the construction permit. It confirms the uncertainty in dealing with permits and could also come into play in asking for permit variances or review of major equipment modifications. With its increased personnel Oklahoma should be more responsive in permit review. A copy of the construction and operating permits are enclosed in Appendix D.

CHAPTER IV

RESULTS

Emissions Testing

There are a number of natural gas burners operating on the factory floor. Heating requirements for the tube annealing furnace are 3.3 million Btu/hour for banking or "idle" and 10.6 million Btu/hour for full production. Heating requirements for each of four independently fired, batch annealing furnaces is four hours at 4.0 million, seventeen hours at 0.8 million Btu/hour and then about eighteen hours of cooling and unloading/loading of the charge (batch). These burners exhaust inside the building. Carbon monoxide reading I took averaged about 3 PPM. An operator keeps a time log of these readings to compare against the occupational standard of

25 PPM. These readings are not significant but would need reporting on a Title V permit.

The tube annealing furnace atmosphere is exhausted through three stacks labeled east (24" ID), middle (18" ID), and west (24" ID). On 4/28/95 I took exhaust stack gas measurements at two, single point locations approximately ten minutes apart and then averaged:

- West stack at 537 PPM CO at 2576 FPM and 87F or 18 #/hour
- Middle stack at 5496 PPM CO at 1330 FPM and 99F or 55#/hour
- East stack at 2766 PPM CO at 1946 FPM and 82F or 70#/hour

Two other potential sources for CO besides the protective atmosphere are from burn off of tube lubricant and steel surface decarburization. Here are example calculations for the stack CO and checking the feasibility of other carbon sources.

SAMPLE CALCULATIONS

- East Stack CO Emissions (4/19/95)

Measured

CO PPM = 2766
Stack Velocity = 1946 fpm
Stack Temp = 82 F
Stack Area (24"ID) = 3.14 Ft^2

Calculated

$\rho = mw(psia)/(10.72*T_{abs})$
$= 0.0708$ #/Ft^3
Volume = Velocity * Area
= 6113 ACFM
= 5773 SCFM
= 911 Moles/Hr
CO = 0.00276*911 = 2.51MPH
Weight of CO = 70 PPH

- **Carbon Present In Material Flow**

Assume	**Calculate**
1) 7 Tons/hour product	14 PPH C
2) Steel 0.10% C	32.6 PPH CO

Conditions in furnace do not favor decarb.
Not feasible that we could lose any significant C without showing in chemical and mechanical reports.

- **Carbon Present In Lubricant Flow**

Assume	**Calculate**
1) 2" tubes at 7 tons/hour	Surface flow = 4600 Ft^2/Hr
2) 3 mils cling to OD and ID	Potential C = 6.44 PPH
3) Lubricant 10% C and 56 #/Ft^3	Potential CO = 15.0 PPH

These CO values surprised me so I wanted to get a recording of CO levels with time. An independent consultant recorded exhaust gas measurements on 7/5/95 about every two minutes over nearly two and one-half hours on the middle and west stack. They were limited in their access and unable to make recordings on the east stack. Emissions for NOX, SOX, and CO were recorded as shown in Tables IV, V, and VI. Only the CO was significant with the following averages:

- **West stack at 201 PPM or 6.7 #/hour**
- **Middle stack at 3837 PPM or 38 #/hour**

The wide variation of measurements with time is shown on Figures 4,5, 6, and 7.

The PTE calculation is uncertain because of both total operating time as well as what emissions level to use. As already mentioned, the business cycle and in some instances the maintenance requirements clearly make the actual and potential emissions unrelated. It could be argued that the furnace could operate around the clock, seven days a week, except for some maintenance and unscheduled downtime. The choices for emission levels could be maximums measured, high averages measured, or quantities coming from the atmosphere generating unit. Combustibles were reported by an operator as 16% during this time period. Doing a materials balance on this unit (DX gas) at 16% dry combustibles indicates a total of 175 #/hour of exhaust gas, carbon monoxide. Using 6800 operating hours per year and 143 pounds per operating hour (the levels measured 4/28/95) the PTE is 486 tpy. It does not seem probable that the emissions can be reduced to minor status, that is under 100 tpy.

TABLE IV

EMISSIONS TESTING
KENTUBE FACILITY - MIDDLE STACK
JULY 5, 1995

Time	NO Level (ppm)	NO_2 Level (ppm)	SO_2 Level (ppm)	CO Level (ppm)
11:01	11	0	0	4955
11:01	11	0	0	4955
11:01	11	0	0	4880
11:10	5	0	3	1555
11:15	11	0	0	5040
11:17	11	0	0	5040
11:19	11	0	0	4455
11:21	10	0	0	4015
11:25	7	0	0	2685
11:26	6	0	0	2395
11:28	6	0	0	2235
11:29	6	0	0	2525
11:32	5	0	0	1835
11:35	12	0	0	6185
11:37	12	0	0	5700
11:38	11	0	0	5580
11:40	11	0	0	5215
Average	9.24	0	0.18	4073.5

TABLE V

EMISSIONS TESTING
KENTUBE FACILITY - MIDDLE STACK
JULY 7, 1995

Time	NO Level (ppm)	NO_2 Level (ppm)	SO_2 Level (ppm)	CO Level (ppm)
13:02:48	6	0	0	2575
13:04:54	6	0	0	2065
13:09:08	5	0	0	1810
13:12:09	9	0	0	3230
13:15:17	9	0	0	3705
13:17:16	9	0	0	3585
13:19:24	10	0	0	4240
13:21:33	9	0	0	3480
13:23:43	9	0	0	3530
13:26:45	8	0	0	3225
13:29:03	8	0	0	3080
13:32:07	8	0	0	3200
13:35:03	10	0	0	4265
13:36:53	11	0	0	4645
13:38:49	11	0	0	5120
13:42:18	10	0	0	4585
13:46:19	10	0	0	4895
Average	8.7	0	0	3602

TABLE VI

EMISSIONS TESTING
KENTUBE FACILITY - WEST STACK
JULY 7, 1995

Time	NO Level (ppm)	NO_2 Level (ppm)	SO_2 Level (ppm)	CO Level (ppm)
09:44:18	2	0	0	0
09:52:41	0	0	0	215
09:56:20	1	0	0	405
09:59:45	0	0	0	5
10:01:45	0	0	1	0
10:05:17	0	0	1	10
10:07:06	1	0	0	240
10:08:25	0	0	1	180
10:10:30	1	0	1	285
10:11:51	1	0	1	235
10:14:40	0	0	1	10
10:15:38	0	0	1	0
10:19:02	0	0	1	5
10:20:39	1	0	1	240
10:22:24	1	0	1	240
10:24:38	1	0	1	460
10:25:54	1	0	1	460
10:27:57	2	0	0	1045
10:31:15	1	0	1	0
10:39:30	0	0	1	0
10:42:52	0	0	1	0
10:45:19	1	0	1	20
10:47:07	1	0	1	110
10:49:42	1	0	2	150
10:51:09	1	0	1	315
10:53:44	2	0	0	815
10:54:36	1	0	1	525
10:55:46	1	0	1	60
10:57:00	1	0	1	5
10:57:53	0	0	1	0
Average	0.733	0	0.8	201.17

FIGURE 4

KENTUBE

Carbon Monoxide Results - Middle Stack

July 5, 1995

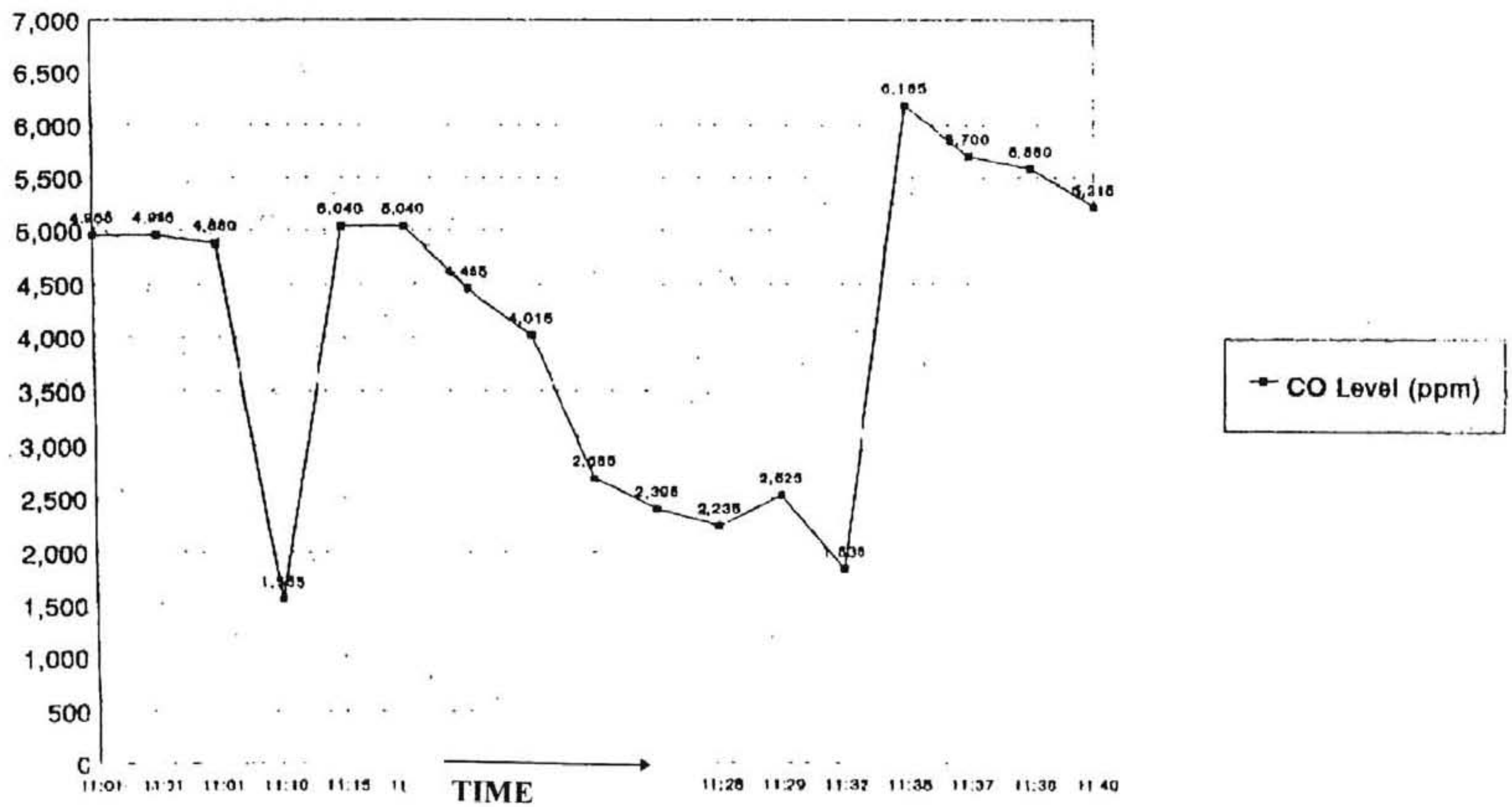


FIGURE 5

KENTUBE

Carbon Monoxide Results - Middle Stack

July 7, 1995

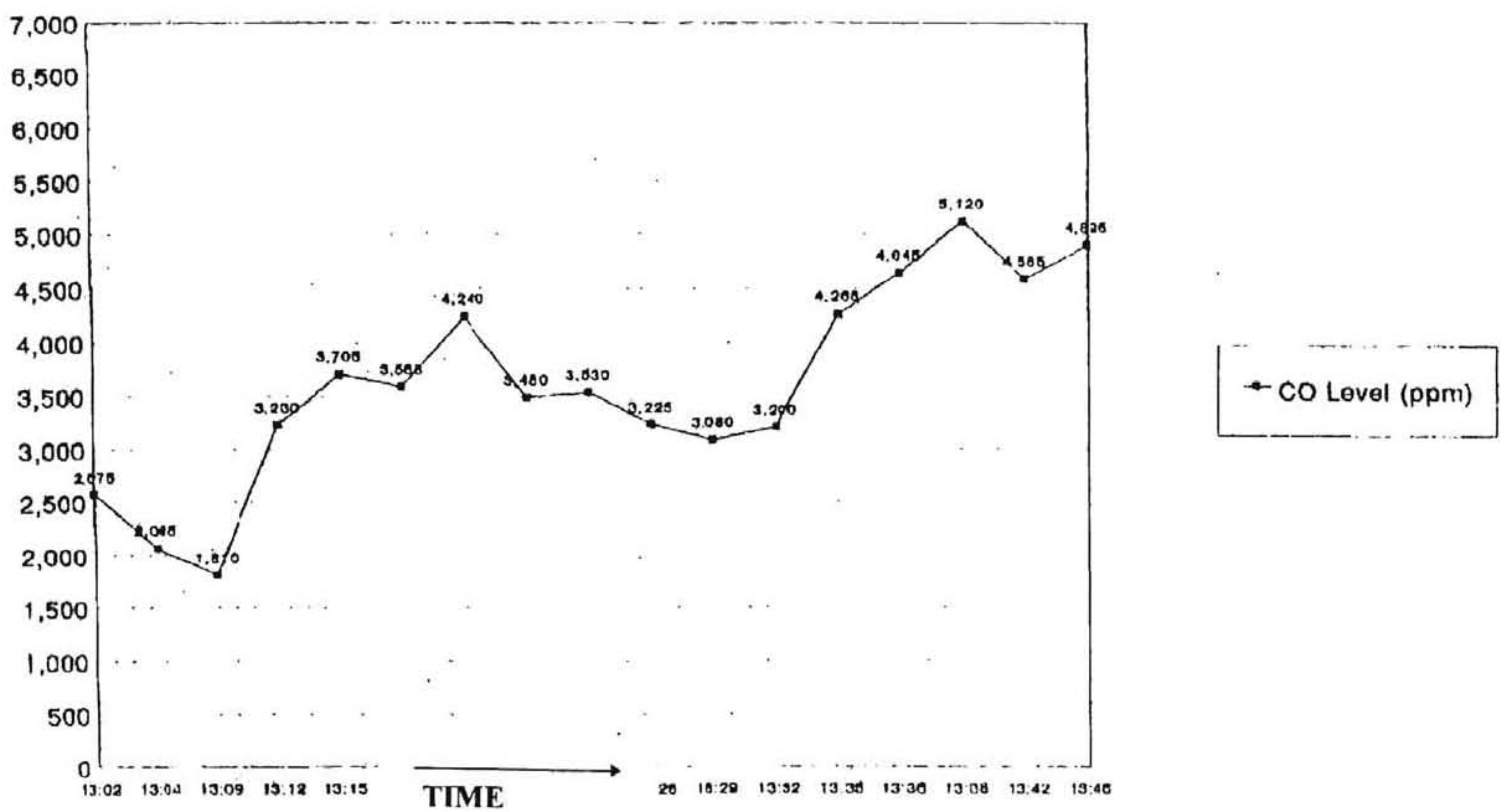


FIGURE 6

KENTUBE

Carbon Monoxide Results - West Stack

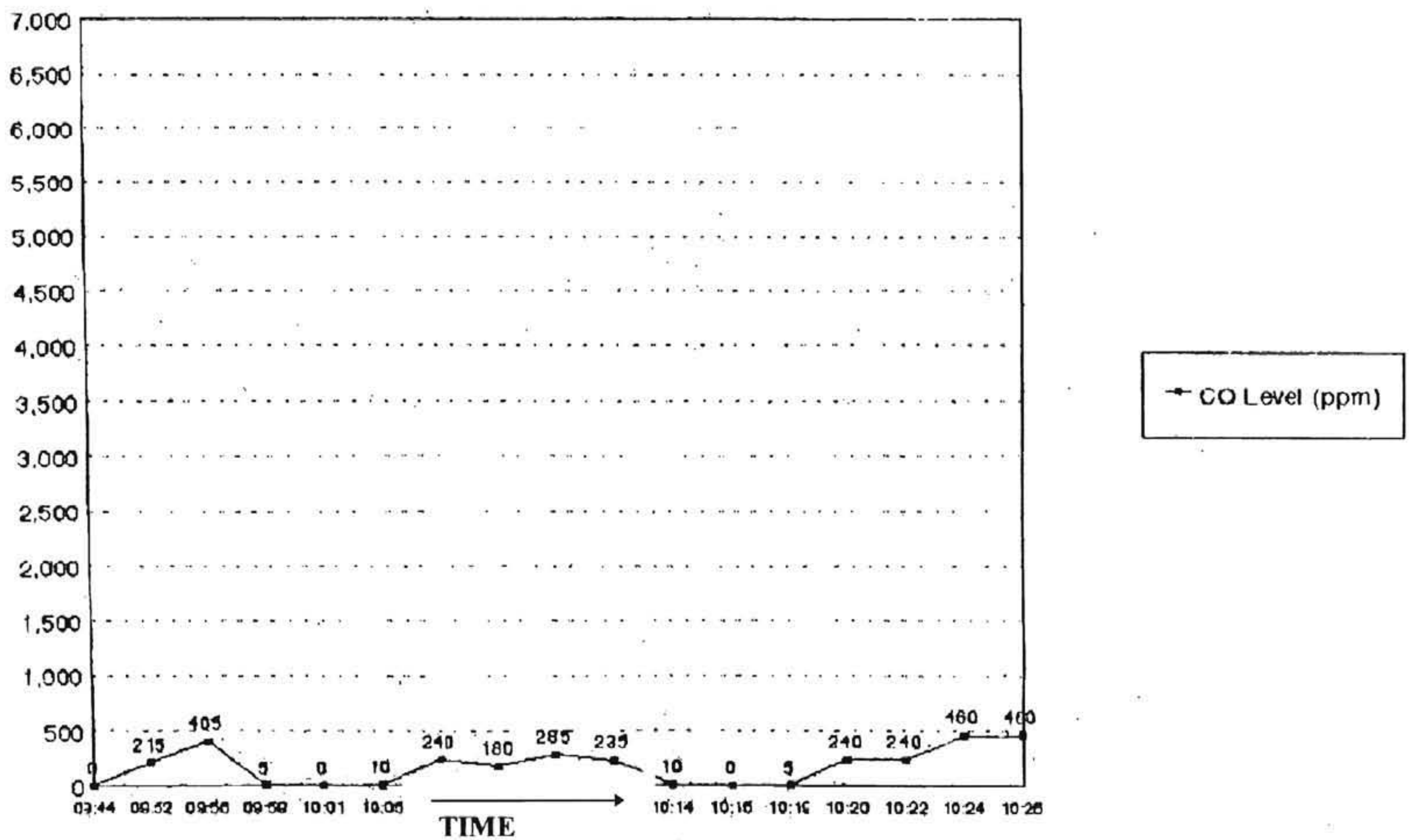
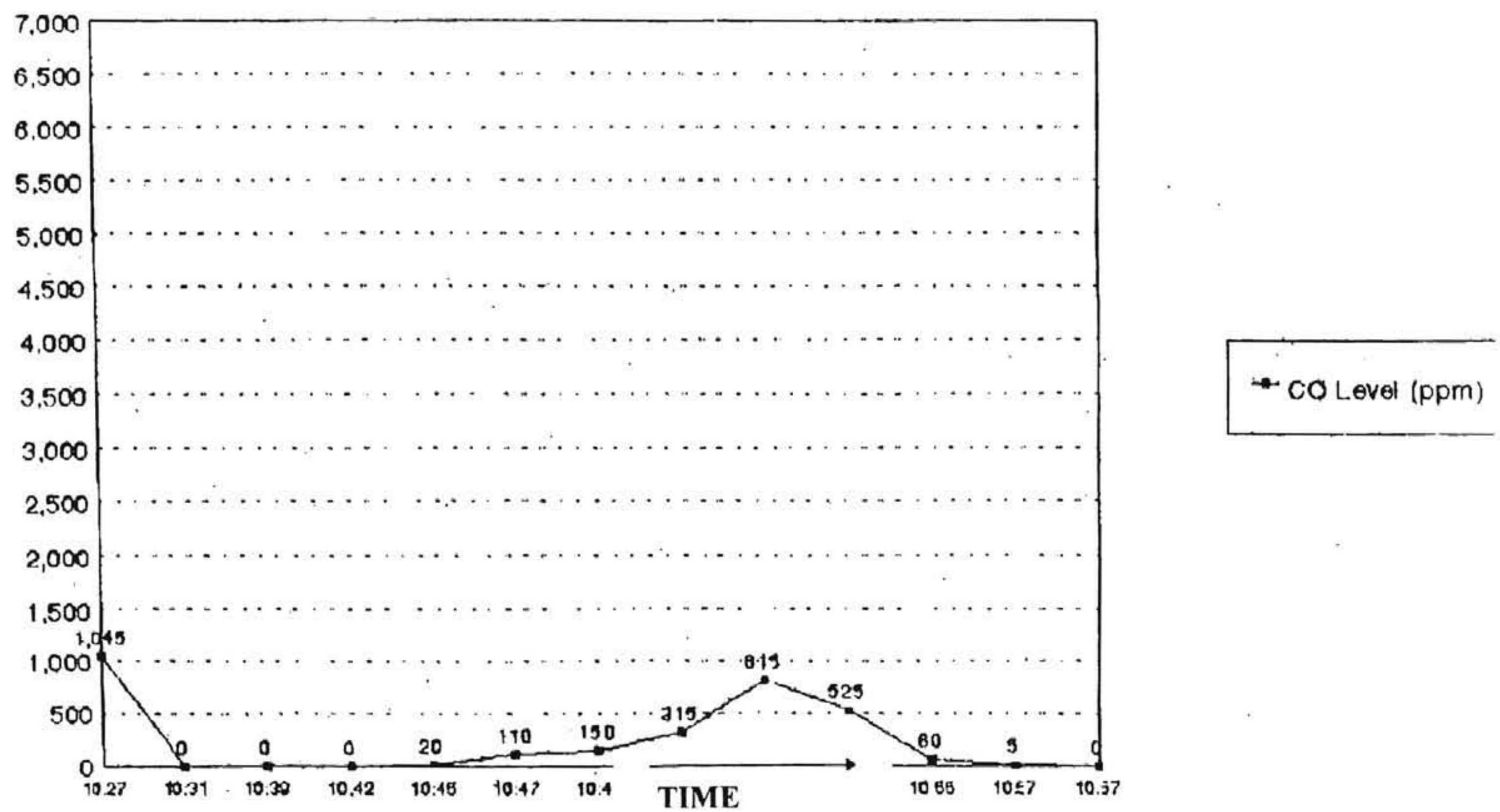


FIGURE 7

KENTUBE

Carbon Monoxide Results - West Stack

July 7, 1995



Continuous Emissions Monitor

Since continuous emissions monitoring is a fundamental method of complying with clean air regulation, quotations were solicited for the Tektube's annealing furnace exhaust stacks. Rosemount Analytical has a good reputation for emissions analyzers and responded with an equipment selection featuring its GMP 1000 package. The budget price for equipment only is $226,590.00. The proposal letter dated 10/25/96 and a GMP 1000 brochure are included in Appendix C.

A recent article in the magazine Hydrocarbon Processing emphasized the importance in evaluating total cost of ownership for CEMS where TCO = price + acquisition cost + life-cycle costs (Mandel 1997). The price of the equipment is presented as 23.5% of the TCO. For this study 50% was used. Instrumentation and computer based technology is rapidly obsolete : over 7 years this would be a $64,740 per year charge. Uptime and reliability for the CEM is absolutely essential and no one at the facility is presently instrument qualified. Request to the State's Customer Assistance Program using the 800 number for CEM were not helpful. They could not advise budget prices, conceptual equipment, or who to contact for more information.

Compliance Assurance Monitor

The CAAA of 1990 states that CEM may not be required if other methods or procedures provide reliable for determining compliance. The CAM approach is responsive therefore to the enforcement requirements. Its two essential parts are properly designed control procedures and measures insuring that the controls are operated and maintained. Control procedures include active devices that remove or destroy emissions as well as other measures such as documented work practices, material substitution, or process modifications. Several years ago the drive for quality resulted in eventual ISO 9000 Certification for the facility. There is considerable worker training and documented work practices. A CAM outline for the annealing furnace might include the activities listed together with documentation of compliance:

1) Maintenance on the furnace as well as the cooling section.
2) Records of operating hours on the atmosphere generator.
3) Periodic measurements of percentage and volume of combustibles in the DX line.
4) Description of tubular steel through the annealing furnace.
5) Inspection of exhaust hood gaps on tube in and out racks.

The EPA intends CAM to be gap filling in regulations but not replacing CEM. Calls to the Oklahoma DEQ generally seem to endorse the CAM approach.

Analysis Of Options

Until the 1999 deadline for permit application the best option is to continue process changes that improve air emissions. The regulations or the tube business may change and the furnace could claim grandfather status. After that date, some type of major source permitting seems likely unless either pretreatment or post treatment is utilized. Pretreatment would entail replacing all or some of the furnace atmosphere with prepared nitrogen moving the furnace atmosphere classification to Class 201 as shown on Table III. Post treatment would be active pollution control through some basic incineration technique. Because the pollutant is carbon monoxide with air dilution, simple after burning would not achieve reasonable destruction efficiencies. The following price options analysis captures the net change per year from present operations. It is reasonable to assume :

1) **No change in volume of protective atmosphere.**
2) **Hours of operation at 6000 per year with all dollars reported on an annual basis.**
3) **Post treatment equipment and installation is prorated over 10 years.**
4) **Catalyst will last 3 years.**
5) **Utility costs are \$2.50 per MCF for gas, \$0.06 per kWh-Hr for electricity, and \$0.30 per 1000 gallon for water. For the 500 CFM atmosphere generator, the present costs with the above assumptions, original combustibles level, are \$64,800 + \$9,720 + \$16,200 = \$90,700 in the order given above. The revised**

combustibles levels (post June 96) reduces fuel costs to 7/8 (see Figure 8) of original or to $56,700 for a total atmosphere cost of $82,600 per year.

6) Minor permit preparation man hours are 500 and major man hours are 1000 both at $60 per hour prorated over 5 years

7) For major permits the CEM Rosemount Analytical figures are used with a 7 year life and equipment costs 50% of TOC. For CAM $ 3,000 in outside services and $7,000 in additional inside annual services are used.

Minor Status

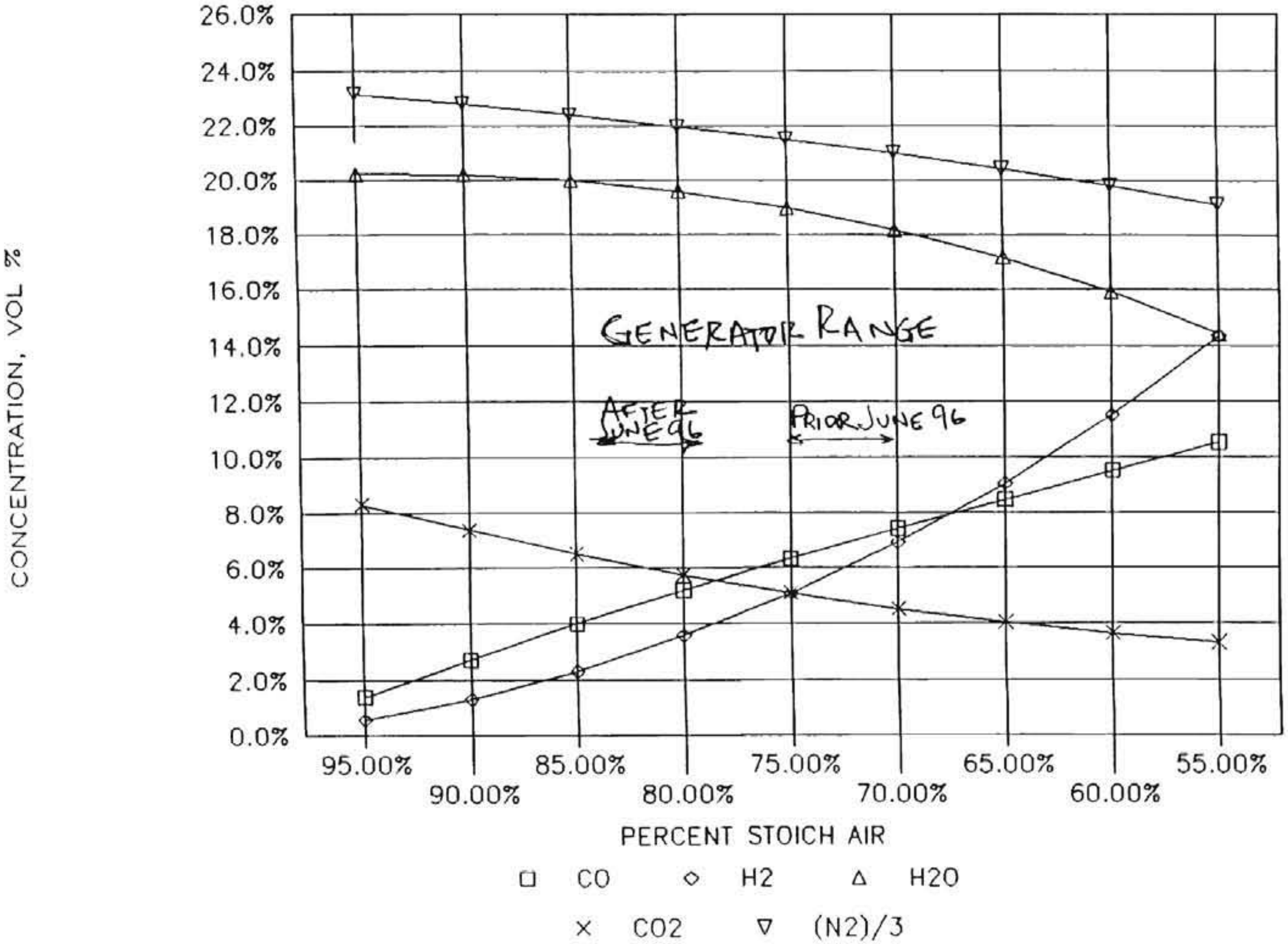
High purity, bulk liquid nitrogen is commercially available at $0.40 per 100 Ft^3 with the tanks and gasifying equipment supplied as part of this price structure. This information was supplied to me by a commercial supplier of nitrogen. Some small piping modification to the annealing furnace would put this option as:

Price of installation	$ 1,000.00	Engineering Estimate
Permit preparation	$ 6,000.00	100 hours/yr. @ $60/hr
Credit for DX gas	$ [82,600.00]	Above
Price of N_2	$ 720,000.00	Ft^3/Yr @ $/$Ft^3$
Total	$ 664,000.00	

As pointed out in a recent article in Chemical Engineering, relaxing the purity requirements would allow membrane air separation modules to be more economical (Michael 1997). About 95% purity should be adequate but the equipment would

FIGURE 8

FLUE GAS COMPOSITION WITH SUBSTOICH AIR



have to be leased and maintained giving an O_2 byproduct. This option is estimated as:

Price of installation	$ 2,500.00	Engineering Estimate
Permit preparation	$ 6,000.00	100 hours/yr. @ $60/hr
Credit for DX gas	$ [82,600.00]	Above
Price of N_2	$ 216,000.00	@ $1.20/mcf
Total	$ 141,900.00	

Three types of incineration are commercially available, thermal, catalytic, and regenerative. All would have to be owned and offer very high destruction efficiencies with high but varying fuel operating costs. Physically, the equipment would be difficult to site because of size. An estimate of the thermal incineration would require a plot of 10 feet by 24 feet. It seems reasonable to assume that the measured stack gas volume could be reduced by 20% through draft control and closer hood seal clearances. So the duty to heat to 1600 Fahrenheit is $Q = M\ (Cp)\ \Delta T = (16{,}000\ \text{SCFM} \div 1.2)(4.5)(0.25)(1600-90) = 22.6 \times 10^6$ Btu/hr. Prices for equipment are estimated from the indexes developed by Vatavuk (Vatavuk 1990) of the form $P = aQ^b$ where Q is in SCFM and for 50% heat recovery a = 4,920 and b = 0.389. These dollar amounts are escalated 3% annually and put on a 1996 basis and prorated for ten years. Installation is based on 61% of the equipment costs (Cooper 1994). Annual net change for thermal incineration are:

Price of equipment	**$ 23,600.00**	
Installation	**$ 14,400.00**	
Permit preparation	**$ 6,000.00**	**100 hour/yr. @ $60/hr**
Fuel	**$169,000.00**	**11.3 x 2.5 x 6000 hr.**
Total	**$ 213,000.00**	

Prices for catalytic incinerators, without catalyst, are reported by Vatavuk of the form $P = \exp(a + bQ)$ where Q is in thousand of SCFM and for 50% heat recovery a = 11.7 and b = 0.0354. Assuming a temperature of 600 F heat duty would be (7.63/2) x 10^6 and with 75 Ft^3 of precious metal catalyst at $3000/$Ft^3$:

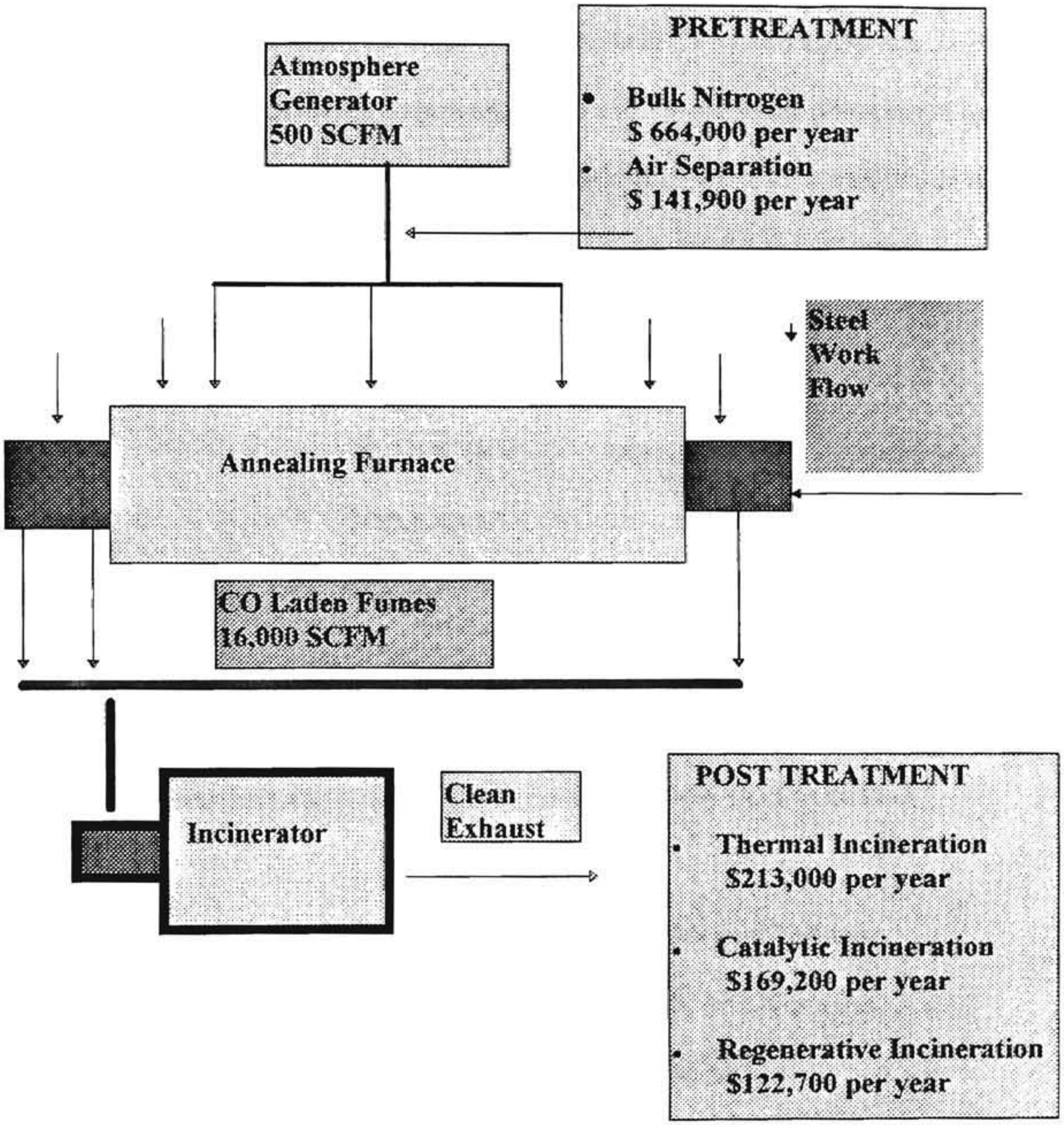
Price of equipment	**$ 19,300.00**	
Installation	**$ 11,700.00**	
Permit preparation	**$ 6,000.00**	**100 hour/yr. @ $60/hr**
Fuel	**$ 57,200.00**	**3.81 x 2.5 x 6000 hr**
Catalyst	**$ 75,000.00**	**75 x 3000 ÷ 3**
Total	**$169,200.00**	

Regenerative thermal incinerators are popular in high volume, lean fume ranges. This volume at 13,300 SCFM fits the lower end of RTO range with prices estimated from Smith Engineering Company (Cooper 1994) in 1992 dollars escalated 3% annually to 1996 and prorated over ten years. Heat recovery effectiveness is selected as 90%. Their presentation is in graphical form and puts most of the equipment and installation costs together.

Price of equipment and installation	**$ 69,000.00**	
Foundations and ductwork	**$ 13,800.00**	
Permit preparation	**$ 6,000.00**	**100 hr/yr. @ $60/hr**
Fuel	**$ 33,900.00**	**2.26 x 2.5 x 6000 hr**
Total	**$122,700.00**	

FIGURE 9

Process Options Diagram



Major Status

Should a major source permit, Title V, be necessary both CEM and CAM are approved. Note that the Oklahoma operating fee of $15.19/ton of air pollutant is not thought to apply to CO and therefore omitted. Should this fee need to be include it would be $7382 per year. For CEM the analysis for yearly additional expenses is:

Price for CEM	**$ 64,740.00**	**226,000 x 2 ÷ 7yr**
Permit preparation	**$ 12,000.00**	**1000hr x $60/hr ÷ 5yr**
State fee	**$ 400.00**	**Permit fee**
Total	**$ 77,140.00**	

For the CAM method the assumption is that one-fourth of a person can check and document the necessary data inside the company and require about 50 hours per year of outside consulting analysis. The permit money reflects the 5 year issue period:

Price for CAM	**$ 10,000.00**	**Engineering Estimate**
Permit preparation	**$ 12,000.00**	**1000hr x $60/hr ÷5yr**
State fee	**$ 400.00**	**Permit fee**
Total	**$ 22,400.00**	

Revisions To Annealing Furnace Operations

Several changes were made during 1996 that favorable affect air emissions. To try and lower the CO readings, I persuaded operations to decrease combustibles from the DX unit. This percentage has been reduced to a reported 10% (dry) without affecting the quality of tubes produced. Figure 8 shows the old and new operating range of percentage combustibles on a wet basis. This graph was produced from data I ran on an Excel program capable of these calculations. Curtains on the furnace tube inlet and tube outlet were replaced to reduce atmosphere leakage out. And maintenance has improved the furnace air tightness and the rapid cooling section.

During February of 1997 the combustibles analyzer was install permanently on the DX line. Also, evaluations by operations indicated against reducing the percentage combustibles values.

CHAPTER V

SUMMARY AND RECOMMENDATIONS

Steps For Permitting

Recall that a series of steps were completed towards CAAA 1990 air permit compliance. A review of manufacturing operations in the steel processing plant and an inventory of emissions were made. This identified the protective atmosphere of a heat treatment, annealing furnace as the only operation with significant air emissions. Representative data was taken and subsequently changes made that lowered emissions of the pollutant, carbon monoxide. However, results of these changes are unverified and they are not likely to result in lowering the yearly emission levels below 100 tons/year. The study equipment as well as any protective atmosphere generator of 5,000 SCFH or more are major source permit candidates. The information collected should apply to a broad class of steel annealing furnaces.

The State of Oklahoma has reorganized its environmental air responsibility into the DEQ and has elected not to exempt minor air emissions sources from permitting. The EPA has approved Oklahoma's SIP. Improved DEQ staffing and sufficient report forms should make permit filing less arduous but still with uncertain timing and requirements. The EPA rule making process underlies much of the uncertainty and will greatly impact the cost of compliance. Their early strong endorsement of CEM for major status has given way to proposed rule making of the more cost effective CAM.

The variation of the stack CO levels with time appears mysterious. That is, why do individual stack readings fluctuate so much with time? The generator of the protective atmosphere runs at constant output. Steel product travels in batches through the furnace carrying significant liquid lubricant. This burn off of lubricant may contribute to emissions. Perhaps some steel surface decarburizing also occurs. But a very rough material balance exists between the generator and measured stack CO levels. Also, an engineering estimate shows slight potential CO from the lubricant and decarburizing. The limited 4/28/95 data measured 148 #/hour at a time the generator was predicted as making 175#/hour. Ideally, if continuous data on all three stacks could be taken simultaneously over a longer period of time also recording generator (DX) percentage combustible and product positioning then some clear prediction of CO levels could be made. The mystery might be that small furnace pressure swings created by the steel charge distributes a fixed amount of CO to time varying emissions in stacks.

Options For Change

Several economic options can be ruled out. Earlier, an upper threshold budget based on a 10% non material price increase was suggested at $150,000 per year. Bulk nitrogen pretreatment, thermal and catalytic incineration post treatment exceed this amount. The other type of incineration passes the dollar amount test but would be an additional process in line that must be running when the annealing furnace is. It would also be necessary to install a second level indoors to site the regenerative incinerator. So, incineration is not a very reasonable choice.

The obvious good choice is for a major source permit utilizing CAM. It is by far the least costly and has some endorsement by the Oklahoma DEQ. This facility is ISO qualified and practiced at procedures and documentation. CAM should be available whenever the annealing furnace runs and not limit production. But the rules here are still being developed by the EPA. The EPA may also question these permits more often using their philosophy of any creditable evidence of non compliance.

Clearly, some additional test data must be taken to develop a CAM program. A partial list of CAM features for a protected atmosphere furnace was previously given.

Two of the other economic options detailed have successful potential. A major source permit with CEM might be a choice if it did not limit tube production. With three stacks very much mismatched on emissions, perhaps the permit could be written where in the event of instrument failure the annealing furnace did not have to shut down. For example, since the west stack is very low in emissions by comparison with the other two then a failure in instrumentation there would be allowed to go with emissions unreported. Or a failure in either of the other two would be replaced by scavenging instrumentation from the west stack. The second possible option is as minor source with membrane air separation. This is the only apparent option avoiding the requirement of a major source permit.

Permit Flexibility

The high challenge in flexibility is to write the permit with future, and therefore unknown, maintenance and process changes so that business choices are not delayed or prohibited. Certainly, you could spell out twice the expected equipment maintenance or repair as well as foreseeable process changes. It might be possible to describe only atmosphere generator modifications increasing the combustibles as modifications adversely affecting emissions and therefore the permit. The number of operating hours and the emission levels should put much higher than actually expected, perhaps by as much as 100%. Maximum flexibility calls for broad language and worst case scenarios.

Both Oklahoma and federal regulations give some instructions towards permit flexibility. Oklahoma will generally say that if there are no increase in emissions, the permit needs no revision. They also encourage writing realistic alternative operating scenarios or other processes or ways equipment may be used. The EPA has operating scenarios and provisions for 1) minor permit modifications, 2) off permit changes, and 3) operational flexibility. Revisions in permits needs to be kept to a minimum.

REFERENCES

1) American Society For Metals. Volume 4 Heat Treating. Metal Park, OH, ASM, 1981.

2) ASTM Standards. Steel- Piping, Tubing, Fittings. Philadelphia, PA, Vol. 01.01, 1995.

3) Canter, Larry W. Principles Of Air Quality Management. Lancaster, PA Technomic Publishing, 1996.

4) Chen, Jim. "Lower Operating Temperatures Oxidize VOCs." Pollution Engineering. Vol. 28 No 13, December 1996.

5) Chestnut, Lauraine G. Human Health Benefits From Sulfate Reductions Under Title IV Of The Clean Air Act Amendments. USEPA Acid Rain Division No 68-D3-0005, November, 1995.

6) Code of Federal Register 40 CFR 70. "State Operating Permit Programs." Bureau of National Affairs, 1996.

7) Code of Federal Register 40 CFR 71. "Federal Operating Permit Programs." Bureau of National Affairs, 1996.

8) Cooper, C. David and Alley, F.C. Air Pollution Control. Prospect Heights, IL, Waveland Press, 1994.

9) Defense Logistics Agency. Industrial Plant Handbook. Cameron Station Virginia Department of Defense, 1978.

10) Doyle, Lawrence E., et al. Manufacturing Process and Materials For Engineers. Englewood Cliffs, NJ, Prentice-Hall, 1962.

11) Environmental Federation of Oklahoma. "Oklahoma's New Title V Permit Application Guide." Technical Seminar UCT , Tulsa, 1996.

12) EPA Website HTTP://TTNWWW.RTPNC.EPA.GOV. "Compliance Assurance Monitoring Rule ; Discussion and Rulemaking." September 1996.

13) Karstadt, Myra. The Plain English Guide To The Clean Air Act. USEPA Air And Radiation Division, No 400-K-93-001 April ,1993.

14) Mandel Stephen B. "Continuous Emission Monitoring Systems : An Overview." Control Engineering, April 1996.

15) Mandel Stephen B. "What Is The Total Cost For Emissions Monitoring." Hydrocarbon Processing, January 1997.

16) Michael, Keith. "Industrial Gas : Surveying Onsite Supply Options." Chemical Engineering, January 1997.

17) Novello, David P., et al. Clean Air Operating Permits. Air And Waste Management Pittsburgh, PA, 1995.

18) Oklahoma Administrative Code Chapter 100. Air Pollution Control., 1995 Amendments.

19) Oklahoma Administrative Code Chapter 100. Air Pollution Control., 1996 Annotated.

20) Pollution Engineering. "A Guide To Reducing Environmental Compliance Costs." Special Supplement. PE Vol. 28 No 12 November, 1996

21) U.S. Senate Committee On Environment And Public Works. "CAA Industrial Permitting Requirements." Hearing From 104 Congress, August 1995.

22) Vatavuk, W.M. Estimating Costs Of Air Pollution Control. Chelsea, MI, Lewis Publishing, 1990.

23) Weimer, George A. "The Tube Industry Discusses Its Future." The Tube & Pipe Journal, Vol. 8 No 3, January/February 1997.

24) White, John R. "Technology For Enhanced Monitoring." Pollution Engineering Vol. 27 No 6, June 1995.

APPENDIX A

OKLAHOMA DEQ FORMS

BLANK FORMS

Please refer to Part B "Instructions for Forms" prior to completing the enclosed forms. These forms may be duplicated as needed. If an appendix is referenced on a form, make sure that a separate name is identified clearly on the form and the corresponding appendix.

The forms included are as follows:

Forms required for administrative completeness

- FORM 1 Facility General Information
- FORM 1a Emissions Inventory
- FORM 1b Insignificant Activities
- FORM 2 (Reserved)
- FORM 3 Emissions Unit Group Description
- FORM 4 (Reserved)
- FORM 5 Emissions Unit Group Compliance Demonstration
- FORM 5a Schedule of Compliance
- FORM 6 (Reserved)

Optional forms

- FORM 5b Emissions Unit Nonapplicable Requirements
- FORM 1c Shield Request
- FORM 5c Proposed Change Request

FORM 1

General Information

O K L A H O M A
DEPARTMENT OF ENVIRONMENTAL QUALITY

1	COMPANY NAME	

2	TYPE OF APPLICATION AND FEE		$

3	CONFIDENTIAL INFORMATION IN APPENDIX		CONTACT	

4 OWNER/OPERATOR	Name		Phone	
Street Address				
City	State		Zip	

5 TECHNICAL CONTACT	Name		Phone	
Company Name				
Street Address				
City	State		Zip	

6 FACILITY INFORMATION	Name			
Primary SIC Code				
Secondary SIC				
Legal Description				
Nearest Town				
Contact Person			Phone	
Driving Directions				
Physical Address				
City	County		Zip	
Mailing Address				
City	State		Zip	

7	LIST ALL CURRENT AIR QUALITY PERMITS, ETC.	

8	APPLICATION CERTIFICATION

Based on information and belief formed after reasonable inquiry, I certify that the statements and information contained in this application are true, accurate, and complete. Except for applicable requirements identified on FORM 5 for which a compliance plan is provided on FORM 5a, I hereby certify that, based on information and belief formed after reasonable inquiry, the air contaminant source identified in this application is in compliance with all applicable requirements. I will comply with all Federal and State regulations and adhere to all standard and specific conditions. I understand that I must comply with all requirements which become effective in the future and that I must submitt a compliance certification report no less than annually unless required to do so more frequently by an applicable requirement or permit condition.

Responsible Official (signature)

FORM 1a

Emissions Inventory

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

1	COMPANY NAME, FACILITY NAME AND COUNTY	

2 — ANNUAL EMISSIONS INVENTORY

The following annual emissions inventory represents the emissions from the facility and should be used in the AQD evaluation and preparation of the permit. **Check only one in Box 2 or see Box 3.**

☐ Use the annual emissions inventory as it appears in the most recent "Turn Around Document" dated ______________ which is on file with AQD. The inventory is accurate, complete, and uses the same numbering and naming conventions as presented in this Title V Permit Application and includes supporting information to document emissions calculations pursuant to OAC 252:100-7-4(d)(2).

☐ Use the annual emissions inventory as it appears in the attached new or revised "Turn Around Document" dated ______________. This inventory is accurate, complete, and uses the same numbering and naming conventions as presented in the Major Source Operating Permit Application Guide and includes supporting information to document emissions calculations pursuant to OAC 252:100-7-4(d)(2). This information is included in Appendix________.

3 — ALTERNATE METHODS TO INVENTORY EMISSIONS

The following alternate method represents the emission from the facility and should be used in the AQD evaluation and preparation of the permit. **Check as appropriate.**

☐ Referenced emissions listed in a current permit, permit number(s) ____________________ ____________________________________, which have been summarized in Appendix _____ using the same numbering and naming conventions as presented in the Major Source Operating Permit Application Guide.

☐ A worksheet developed by the Agency for specific industries included in Appendix ______ using the same numbering and naming conventions as presented in the Major Source Operating Permit Application Guide.

☐ Other method(s) to be approved by DEQ with all associated justifications, documentation, and calculations pursuant to OAC 252:100-8-5(d)(3) located in Appendix ______ using the same

FORM 5

Emissions Unit Group Compliance Demonstration

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

1	COMPANY AND FACILITY NAME	

2	EU #		EUG #		SCENARIO	

		DESCRIPTION	Appendix
3	Citation/Method		
4	Initial Compliance Limits, Demonstration, and Status		
5	Proposed Compliance Assurance Certification and Reporting		
6	Other Requirements		
3	Citation/Method		
4	Initial Compliance Limits, Demonstration, and Status		
5	Proposed Compliance Assurance Certification and Reporting		
6	Other Requirements		
3	Citation/Method		
4	Initial Compliance Limits, Demonstration, and Status		
5	Proposed Compliance Assurance Certification and Reporting		
6	Other Requirements		

APPENDIX B

OKLAHOMA PERMIT APPLICATION SCHEDULE

APPLICATION SUBMITTAL SCHEDULE

The schedule of administratively complete permit application submittal is as follows. It is highly recommended that permit applications be submitted at least sixty days prior to the actual deadline. The deadline dates listed are for receipt of applications from the effective date of program delegation (March 6, 1996).

- 6 months (September 6, 1996)
  One-third of the facility applications from the Oil and Gas Industry and Electric Utilities (SIC 1311, 1321, 4911, 4961, 4922, 4923, 5171)

- 12 months (March 6, 1997)
  Remaining two-thirds of the above groups, and
  Metals (SIC 3312, 3315, 3321, 3379, 3341, 3351, 3411, 3412, 3432, 3466) 3443
  Brick Plants (SIC 3251, 3297)
  Commercial Printing (SIC 2752, 2761)

- 28 months (July 6, 1998)
  Refineries (SIC 2911)
  Cement Plants (SIC 3241)
  Chemical/Carbon (SIC 2819, 2821, 2851, 2861, 2869, 2891, 2895, 2899, 2999, 3053, 3086, 3089)
  Petroleum Transportation/Terminals/Storage (SIC 4612, 4613)
  Food Products (SIC 2013, 2074, 2095)

- 36 months (March 6, 1999)
  All remaining Sources

APPENDIX C

CEM EQUIPMENT

Rosemount Analytical

Rosemount Analytical Inc.
1201 North Main Street
P O. Box 901
Orrville OH 44667-0901 USA
Toll Free 1 (800) 433-6076
Tel 1 (330) 682-9010
Fax 1 (330) 684-4434

October 25, 1996

FINTUBE LP
7130 S. Lewis
Suite 400
Tulsa, OK 74136
Telephone No. (918) 488-6206
FAX No. (918) 491-9999

Attn: Mr. Don Reid

Subject: Budgetary Pricing to Furnish Continuous Emissions Monitoring Systems (CEMS) for FINTUBE LP
Rosemount Analytical Budgetary Proposal 7012

Dear Mr. Reid:

It was a pleasure speaking to you on the telephone the other day concerning your application. Per your request, Rosemount Analytical is pleased to respond to your request for budgetary pricing for Continuous Emissions Monitoring Systems. Based upon the requirements in the analytical application systems data sheet, we are quoting three (3) "pre-engineered" GMP 1000 gas monitoring systems for the application of monitoring CO, O_2 and NO_x. The budgetary price for each system described is approximately $ 75,530.00. The approximate total price for all three (3) CEMS is $ 226,590.00. Each CEMS will come equipped with a gas sample probe. Each system will be able to perform automatic calibration. Each measurement will have a 4-20 mA output signal from the CEMS. The system will be located in a NEMA 12 cabinet with HVAC and includes a sample conditioning system and temperature controllers for the sample probe and heated sample line. A six pen strip chart recorder, Rosemount Model 4200, will be installed in each CEMS. Heated sample line is not included in the base price and can be purchased at $ 35.00 per foot. To upgrade the NEMA 12 cabinet with HVAC to a NEMA 4 cabinet with HVAC, add approximately $1,725.00 to each system.

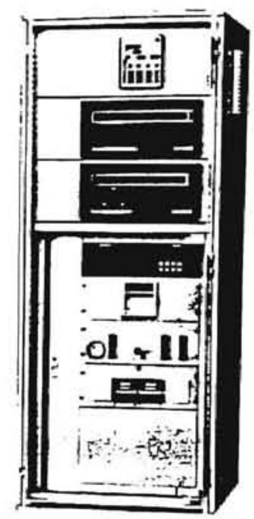
The Rosemount Analytical CEMS manufacturing facility in Orrville, Ohio has received ISO 9001 Quality Certification. This prestigious quality certification is awarded by the International Quality Agency, Det Norske Veritas, after a rigorous analysis of a manufacturing facility's operations and procedures.

Rosemount Analytical is recognized as the premier supplier of Continuous Emissions Monitoring Systems (CEMS). As reported by Control magazine in the January 1996 issue, Rosemount was the number 1 choice among its readers for Stack Gas\Emissions Analyzers.

Product Data
103-101
October, 1995

Continuous Emissions Monitoring (CEMS) Package

- Packaged approach to measuring one, two, or three gases plus opacity
- Measurement options: O_2, CO, CO_2, SO_2, NO_x, NH_3, THC, Opacity
- Field proven Rosemount Analytical analyzer technologies
- Fully pre-engineered; designed for maximum uptime
- Self diagnostics
- Manufactured under ISO 9001 certified quality standards
- Optional installation, startup, certification, and on-going service programs available



WORLD CLASS TECHNOLOGY FROM YOUR ONLY SINGLE SOURCE CEMS SUPPLIER

Rosemount Analytical offers a cost-effective, pre-engineered Continuous Emissions Monitoring (CEMS) package for those applications where one, two, or three gases, and possibly opacity, must be monitored for U.S. EPA compliance purposes.

The GMP 1000 CEMS package provides the same field-proven Rosemount Analytical analyzer technologies coupled to the most ruggedly constructed and dependable sample extraction and conditioning systems in the industry. The GMP 1000 package is backed by the SINGLE SOURCE capability of Rosemount Analytical so you can depend on the best and most comprehensive support services for CEMS in the industry. Optional services can include installation, startup, certification testing, in-house training and on-going maintenance contracts. Or, you can choose to purchase the pre-engineered, stand-alone GMP 1000 package for cost effective, dependable continuous emissions monitoring.

THE GMP 1000 PACKAGE

The basic GMP 1000 Package includes:

- Rosemount Analytical analyzers
- Heated sample probe.
- Temperature controllers for both probe and heated sample line.
- Thermoelectric sample conditioner containing integral pre-cooler, sample pump, condensate removal system, and water intrusion monitor for sample pump shutdown in the unlikely event of a conditioner failure; provides unsurpassed analyzer protection.
- Local/remote calibration capability for diagnostic testing of analyzers, and compliance with the EPA's 40 CFR 60, Appendix F and 40 CFR 75.
- Calibration drift and pollutant exceedence alarms.
- "Fast Loop" and analyzer flow control.
- Optional HVAC and/or probe blowback for enhanced performance over a wider range of applications.

ROSEMOUNT ANALYTICAL [illegible]

[illegible] Managing [illegible]

[illegible]edes Product Data P[illegible] 01
[illegible]-8, dat[illegible] ebruary 1

APPENDIX D

OKLAHOMA APPLICATION FOR

CONSTRUCTION AND OPERATING PERMIT

PC-GEN APRIL 1989

Tulsa City-County Health Department
Air Quality Control Programs
Attention: Air Permits
4616 East 15th Street
Tulsa, Oklahoma 74112-6122
(918) 744-1000, Extension 3811

FOR TCCHD USE ONLY

Permit Number ______
Received ______
Fee Attached Yes ______ No ______
Amount of Fee ______
Check Number ______
Receipt Number ______
Typed ______ Mailed ______

APPLICATION FOR PERMIT TO CONSTRUCT
(Submit In Duplicate)

The FINTUBE LIMITED PARTNERSHIP

proposes the: construction [X] modification [ ] of (describe sou...

RESEARCH/EXPERIMENTAL FACILITY FOR PERFORMANCE TESTING OF FINNED TUBES UNDER ACTUAL PROCESS CONDITIONS.

to be located at 4150 S. ELWOOD, TULSA, OK
(AT OUR KENTUBE DIVISION FACILITY)

and, as required by the referenced Regulations, hereby makes application Tulsa City-County Health Department for approval of a Permit to Construct Plans, specifications, description and engineering calculations and data accompany the application.

Estimated Date(s) Of Construction Start 5/01/93 Completion 7/01/93

Total Estimated Capital Costs Of The Construction Project $100,000

Application shall be signed by (1) **OWNER** of facility or his designated legally responsible representative, (not the contractor), and (2) the **ENGINEER** or **CONTRACTOR** responsible for completion of the application, plans, specifications and engineering data.

(1)		(2)
[signature]	SIGNATURE	[signature]
LARRY J. SIMS	Name	DON R. REID, PE
PRESIDENT	Title	ENGINEERING MANAGER
FINTUBE LTD.	Company	FINTUBE LTD. PARTNERSHIP
7130 S. LEWIS SUITE 400	Address & Zip	7130 S. LEWIS, SUITE 400
TULSA, OK 74136	Telephone	TULSA, OK 74136

CONSTRUCTION SHALL NOT BEGIN UNTIL PERMIT TO CONSTRUCT IS RECEIVED!

PERMIT

AIR QUALITY DIVISION
STATE OF OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY
4545 N. LINCOLN BLVD., SUITE 250
OKLAHOMA CITY, OKLAHOMA 73105-3483

Date August 17, 19 95 Permit No. 93-043-C

Fintube Limited Partnership, having complied with the requirements of the law, is hereby granted permission to construct a research/experimental facility for performance testing of finned tubes under actual process conditions at their Fintube Division at 4150 South Elwood, Tulsa, Oklahoma.

subject to the following conditions, attached:

- ☒ Standard Conditions
- ☒ Standard Conditions for EPA New Source Performance Standards
- ☒ Specific Conditions

Director, Air Quality

Executive Director

No. ______

APPLICATION FOR PERMIT

Submit in Triplicate

AIR QUALITY PROGRAM
STATE OF OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY
4545 NORTH LINCOLN BOULEVARD, SUITE 250
OKLAHOMA CITY, OKLAHOMA 73105-3483

The Fintube Limited Partnership proposes the construction operation of Test Facility

and, as required by OAC 252:100-7 promulgated in accordance with Sections 2001-2003, Title 63, Oklahoma Statutes 1971, hereby makes application to the State of Oklahoma Department of Environmental Quality for approval of plans and for a permit to proceed with construction or operation. For a construction permit, all accompanying plans, specifications, descriptions and engineering data must be submitted in triplicate. For operating permit, the start up date must be specified.

Estimated date of Construction Start 5 / 1 / 93 Completion 7 / 1 / 93

Operational start up date 8 / 1 / 93 SIC CODE 3443

Total estimated cost of this project is $ 100,000

Permit fee enclosed: $ 100.00. Make check or money order (no cash will be accepted) payable to Oklahoma Air Quality Control.

Remarks ______

Application should be signed by (1) owner of facility or designated legally responsible representative and (2) the person familiar with and responsible for completion of the application, plans, specifications and engineering data.

Signature (1) [signature]	Signature (2) [signature]
Name Larry J. Sims	Name Don R. Reid, PE
Title President Div. Fintube Corp., the Gen. Part	Title Engineering Director
Company Fintube Limited Partnership, Managing Member of ~~TEKtube, L.L.C.~~	Company Fintube Limited Partnership
Address 7130 S. Lewis, Suite 400	Address 7130 S. Lewis, Suite 400
Tulsa, OK 74136	Tulsa, OK 74136
Telephone No. 918-488-6202	Telephone No. 918-488-6206

Date: 10/9/96

DEQ Form No. 884 Revised April, 1994

PERMIT

AIR QUALITY DIVISION
STATE OF OKLAHOMA
DEPARTMENT OF ENVIRONMENTAL QUALITY
4545 N. LINCOLN BOULEVARD, SUITE 250
OKLAHOMA CITY, OKLAHOMA 73105-3483

Date December 6, 1996 **Permit No.** 93-043T-O

Fintube Limited Partnership, **having complied with the requirements of the law, is hereby granted permission to** operate a finned tubes test facility.

subject to the following conditions, attached:

[X] Standard Conditions

[X] Standard Conditions for EPA New Source Performance Standards

[X] Specific Conditions

______________________ **Director, Air Quality**

DEQ Fpr, Mp/ 995
Revised 7/93

VITA

Don R. Reid

Candidate for the Degree of

Master of Science

Thesis: CLEAN AIR REQUIREMENTS FOR A PROTECTED ATMOSPHERE FURNACE

Major Field: Environmental Science

Biographical:

Personal Data: Born in Anadarko, Oklahoma the son of Raymond and Flossie Godard. Adopted by Carl and Jewell Reid. Capably reared by Grady and Pauline Ballard.

Education: Graduated from Webster High School, Tulsa, Oklahoma in 1961, received a Bachelor of Science in Mechanical Engineering from Tulsa University, Tulsa, Oklahoma in 1972. Completed the requirements for the Master of Science degree in Environmental Science in May 1997.

Experience: Active since 1966 in some facet of engineering, sales, or management of several companies including a company of my own. A Professional Engineer since 1977. Presently Engineering Director of Fintube LP in Tulsa, Oklahoma.

Professional Memberships: American Society of Mechanical Engineers and American Society For Testing And Materials.