BIOMASS HEATING PRELIMINARY ASSESSMENT

for

Pinehurst Elementary School
Pinehurst, Idaho

November 28, 2003

CTA
ARCHITECTS
ENGINEERS

FOREST SERVICE
U S
DEPARTMENT OF AGRICULTURE

JOB NAME: BRBIOMAS PINEH

Preliminary Assessment for Integration of Biomass Energy Systems

at

Pinehurst Elementary School, Pinehurst, Idaho

November 28, 2003

Presented by

CTA Architects Engineers
Dan Stevenson

For

United States Department of Agriculture
Forest Service
Region One

In partnership with:

Pinehurst Elementary School
Bitter Root Resource and Conservation Development Area, Incorporated

CTA Project: BRBIOMAS-PINEH, Pinehurst

Table of Contents

EXECUTIVE SUMMARY 1

RESULTS OF EVALUATION 1

PURPOSE OF ASSESSMENT 3

PURPOSE OF ASSESSMENT 3

RESOURCE INVENTORY SUMMARY 3

BIOMASS SYSTEM DESCRIPTION 4

EVALUATION OF THE BIOMASS BOILER SYSTEM 6

SYSTEM INTEGRATION SUMMARY 6

HEAT LOAD CALCULATION SUMMARY 9

HEAT LOAD CALCULATION SUMMARY 10

OPERATIONS AND MAINTENANCE SUMMARY 11

PINEHURST FACILITY SUMMARY 12

APPENDIX

Budget Estimates
Cash flow Analysis
Data and Photos
Biomass Information
Energy Data and Load Projection Appendix

Executive Summary

The following assessment was commissioned to determine the technical and economic feasibility of integrating a biomass heating system with the existing facility at Pinehurst Elementary School, in Pinehurst, Idaho. This assessment is funded through the USDA Forest Service, Region One, as part of the Fuels for Schools program. Primary objectives of this program are to:

1. Develop fuel markets for non-merchantable wood residue resulting from fuel reduction treatment on federal, state, and private forestland.

2. Partner with communities, and their school systems, to integrate benefits of fuel reduction treatment into the community. Benefits of sustainable biomass heating systems to communities include:

    a. Stable long term fuel costs;
    b. Low fuel costs compared to other conventional fuels;
    c. Locally produced fuel infuses capital back into the community;
    d. An integrated approach with fuel reduction treatment of forest land results in reduced slash pile disposal fires, improving air quality while heating the school facility and reducing slash fire hazards;
    e. Sustainable biomass is a renewable energy resource;
    f. Sustainable biomass is near zero net carbon emission;

3. Develop practical, cost effective, application models for biomass heating systems into systems representative of a larger application group (schools and commercial buildings).

4. Identify, evaluate, and assist in developing biomass-heating projects in schools throughout Region One. This study is among the first in the effort to identify and evaluate potential projects.

The existing school facility is approximately 57,500 square feet in area and is heated by two 2,479 MBH steam boilers located in the basement near central part of the building (see Site Plan). One boiler is currently inoperable. The proposed location for the new 3200 MBH (output) biomass boiler plant is on the south side of the maintenance building (see Site Plan).

Biomass Boiler System budget estimate was obtained from two systems manufacturers. A concept and budget estimate was developed for a central boiler plant to serve the Elementary School. The fuel investigated was wood chips derived from forest residue at 40% moisture content.

Based on preliminary discussions with the State of Idaho Department of Environmental Quality, it is likely that an air quality permit will be required for biomass heating projects. This will require an application and then a public review and public comment periods. See the Biomass Information section of the appendix for further information.

<u>Results of Evaluation</u>

The results of this analysis are summarized in the Economic Analysis Summary table below. A detailed report of the results is provided in the Cash Flow Analysis Appendix.

One important variable in this analysis is the cost of biomass fuel. The pricing for wood chips in this analysis is based on conversations with providers, other supply contracts, and cost history of the fuel.

As indicated in the Economic Summary chart below, the evaluated option achieves a positive accumulated cash flow (PAC) in 25 years without subsidy and in 14 years with subsidy. Accumulated cash flow is the primary evaluation measure that is implemented in this report and is similar to simple payback with the exception that accumulated cash flow takes the cost of financing and fuel escalation into account. For many school districts and municipalities, a positive accumulated cash flow of about 10 years maximum is considered for implementation. Based on this standard, the amount of project subsidy required to achieve a 10-year PAC is $490,000.

The approach in analyzing the Biomass Boiler system has been to remain conservative, yet realistic about the performance of biomass heating plants and the cost of their installation. Due to the preliminary nature of this assessment, it is possible that the construction cost estimates could be reduced as additional information relative to the construction is gathered, favorably affecting the economic analysis. The economic analysis has been performed using precontingency budget estimates. This value is the best estimate of project cost with the given information. When considering the economic performance of the project, including contingency in the project cost weights against the project, possibly unnecessarily. In planning for construction, a pre-design project contingency of 15% is recommended. Post-design, this can be reduced to 8%.

Economics Summary Chart

Option Title	Initial Cost	Year Positive Cashflow Occurs at 5.21% APR 100% Financed	Year Positive Cashflow Occurs at 5.21% APR 80% Boiler Building Subsidy	Year One Energy Savings	Project Subsidy Required for 10 year Payback
Elementary School	$656,542	25	14	$12,936	$490,000

Purpose of Assessment

The intent of this assessment is to provide an initial evaluation tool for a potential biomass-heating project. Major components of this assessment include:

- Identification of the peak instantaneous and annual consumption heating demand of existing and proposed facility. (See Heat Load Calculation Summary.)
- Development and description of Biomass Boiler System. (See Biomass System Description.)
- Identification of technical details related to the integration of a Biomass Boiler system with the existing and proposed facility. (See Evaluation of the Biomass Boiler System/ System Integration Summary.)
- Estimate Preliminary Project Budget for the Biomass Boiler system. (See Cash flow Analysis and Budget Estimates Appendix.)
- Estimate Energy Savings corresponding to the use of Biomass Energy. (See Heat Energy Summary Table.)
- Identification of Operating and Maintenance considerations. (See Operations and Maintenance Summary.)
- Consolidation of the above information into Project Economic Analysis for the Biomass Boiler system. (See Evaluation Procedure.)
- Summary of potential project financing. (See Evaluation of the Biomass Boiler System/ Financing Options and Financing Portion.)
- Finally, a recommendation to the School, Forest Service, and listed partners. (See Executive Summary.)

This assessment uses *preliminary* energy savings calculations, project budget estimating, and fuel resource inventory investigation. Preliminary techniques involve cursory field investigation and conceptual level design development and budget estimating. As such, final project economics may vary from those indicated within this document.

Biomass energy is derived from the conversion of any organic material into useful energy, typically thermal, electrical, or chemical energy. This assessment focuses on the implementation of biomass thermal energy at the Pinehurst Elementary School in Pinehurst, Idaho. Although biomass energy can be generated from a variety of feedstocks, the focus of this assessment is on the utilization of forest fuel reduction residue and forest product residue. Biomass energy is commonly applied in the timber industry for process heat, such as drying kilns. Modern, efficient, and clean commercial and institutional applications of biomass energy are quite common in the New England States and Northern Europe, but their expansion to the Western United States has been limited. With increased energy costs, price volatility, and interest in local economic development the interest in biomass energy in the West has been growing very rapidly.

Resource Inventory Summary

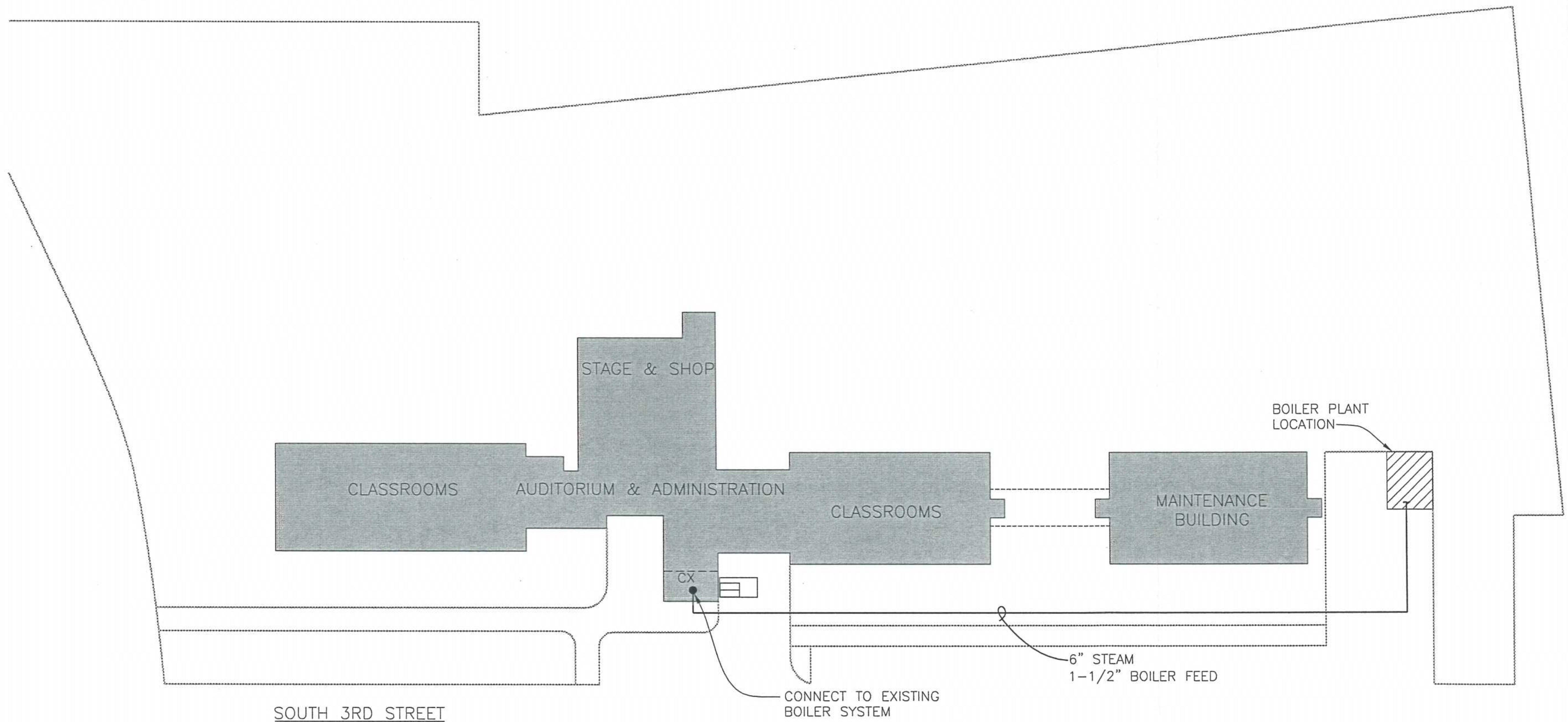
The primary source of biomass for this project is non-merchantable timber and slash resulting from hazard mitigation projects on private and state lands being funded by National Fire Plan grants under the supervision of the Idaho Departments of Lands. In North Idaho there are numerous hazard mitigation projects on private and state lands, ensuring an adequate supply of biomass fuels for the foreseeable future.

Biomass System Description

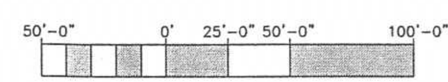
Only one biomass option was evaluated because of the site restrictions and the presence of the existing steam heating system to interconnect to. Appropriate technology for the option was investigated and *preliminary* pricing was secured from Messersmith Manufacturing and King Coal Corporation.

It's important to understand that the concepts developed are for the sole purpose of determining the project magnitude. The Conceptual Site Plan indicates locations, site information, and other assumptions used in this analysis.

This option included installing a 3200 MBH (output) steam plant south of the Maintenance Building (see Site Plan) and running a steam main and boiler feed line to and from the existing boiler room to the boiler plant. The steam main would connect to the existing steam header. A new boiler feedwater pump would be added in the existing boiler room. A steam to water heat exchanger would also be added so the biomass boiler could heat the domestic hot water.



BIOMASS HEATING ASSESSMENT
APPROXIMATE SITE PLAN



PINEHURST, IDAHO

Evaluation of the Biomass Boiler System

The Biomass Boiler system was evaluated using a 30-year cash flow analysis. Several factors affect the economic analysis of these options:

Project Initial Capital Cost

The initial cost of any of the options can be separated into three components:

- Boiler System Costs
- Boiler Plant Building and Site Development
- System Integration.

Budget Estimate Summary Table

Title	Fuel Type	Estimated Boiler Systems Cost	Estimated Building and Site Cost	Estimated Integration Cost	Estimated Precontingency Project Total Cost
Boiler Plant	Wood Chip	$304,560	$209,016	$142,966	$656,542

Boiler Plant Wood Chip

The breakdown for the Biomass Boiler system into these project components is included in the Budget Estimate Appendix. In addition to these components, the project initial costs will depend on a few specific items. Below a few factors that effect initial cost are discussed.

System Integration Summary

1. The cost of System Integration has an especially important role in the initial cost of a biomass project. The boiler and plant building costs are usually clearly identifiable and able to be estimated. In this assessment, the Biomass Boiler

system evaluated includes a central boiler and building, or prepackaged systems that combined the boiler and building costs. Less obvious are the costs of integrating the system with the existing facilities. Often integration costs are the determinant of a project's economic feasibility. The Conceptual Site Plan provides an idea of the required integration for the described options. Examples of the cost integrating a new heating plant with an existing facility include:

- Underground steam piping. The costs for underground piping alone can be very significant components of project costs. Steam underground piping is significantly more expensive than heating water because of different insulation and construction techniques. Steam adds additions complexity when traveling long distances underground because of the condensate that is generated because of heat loss. Generally, minimizing the amount of underground piping required is good practice. Site restrictions require that the biomass boiler building be located in an unappealing location especially for a steam system. This location will require that underground steam piping be routed approximately 600 feet to connect to the existing boiler room.

- Interconnection with the existing systems. The actual interconnection at the building is unique in each case. Steam interconnection typically involves intercepting the steam distribution main parallel to the existing steam boiler. This is the proposed action for this school. The steam system will require some basic controls to enable the biomass plant. Beyond that, the biomass plant controls are programmable logic (PLC) based and self-contained.

2. Biomass systems need to have a back up thermal source for instances when the biomass plant is out of service. Under this proposal the existing boilers would remain to serve as a back-up system.

3. At low loads, the biomass plant will not be able to sufficiently turn down to operate efficiently. During these times, the existing boilers would operate to maintain higher efficiencies. It is estimated the biomass system will provide 90% of the facilities heat.

Fuel Costs and Escalation Rates

Fuel costs and escalation rates used in the analysis are:

1. Wood Chips (40% MC-5400 btu/lb HHV) - $20/ton delivered inside storage.

2. Natural Gas - $6.81/mmbtu

3. Escalation rate for natural gas was estimated at 6% annually.

4. Escalation rate for electricity was estimated at 4% annually.

5. Escalation rate for wood based fuels was estimated at 2% annually.

Operation and Maintenance Costs

1. Based on discussions with other biomass system users, system manufacturers, and estimates of operator time required, additional operation and maintenance time of 80 to 160 hours per year at $15/hour were assumed.

2. There was a credit is taken in this analysis for displacement system maintenance, repair, or replacement. Both of the school's boilers have exceeded their life expectancy and would need to be replaced in the near future.

Financing Options and Financed Portion

1. Several options exist to finance this project. Below are a few sources that have been identified. Special focus should be given to the State of Idaho Low Interest Energy Loan programs, third party financing, and possibly low interest financing by system manufacturers. All project options can be funded in part by the resultant energy savings. The cash flow analysis used in this assessment uses 5.21% APR, assuming the use of third party financing available at this rate. Possible financing mechanisms include:

   - School District financing of project through Idaho Low Interest Energy Loan. An information sheet regarding the program is included in the Financing Appendix.

   - Private sector financing. Options for low interest financing through some system manufacturers exists.

   - RC&D Grant Programs

   - Possible State DEQ support

   - Possible Electrical Utility support

Evaluation Procedure

The Biomass Boiler system was developed around the reference fuel of 40% moisture content wood chips with a higher heating value (HHV) of 5400 btu/lb. Option cash flow sheets were developed with the following permutations:

1. Project fully financed by the School District on a 10-year term.

2. Project partially financed by the School District and partially funded by a Fuels for Schools grant, which would pay for 80% of the boiler plant, and building related costs (excludes the cost of mechanical integration).

3. Project partially financed by the School District and partially funded by a Fuels for Schools grant to the level required to achieve a 10 year positive accumulated cash flow.

A very large number of permutations of the financial and technical options for this project are possible. The above were chosen to provide a preliminary comparison and evaluation tool. If the Elementary School chooses to further pursue a biomass project, detailed cash flow analysis and sensitivity analysis should be completed.

Congress is presently considering a ten-year term subsidy for the use of forest residue in the form of a $20 per green ton of forest residue utilized. If passed this subsidy would equate to roughly $6,240 per year to the School. As it is speculative at this point, the effect of this subsidy is not included in this analysis.

Results of Evaluation

The results of this analysis are summarized in the Economic Analysis Summary table below. A detailed report of the results is provided in the Cash Flow Analysis Appendix.

One important variable in this analysis is the cost of biomass fuel. The pricing for wood chip fuel in this analysis is based on conversations with providers, other supply contracts, and cost history of these fuels. Variation in their costs may change the recommended fuel. *The finding that can be derived from this is that biomass heating should be implemented with fuel flexibility built in if possible.*

As indicated in the Economic Summary chart below, the evaluated option achieves a positive accumulated cash flow (PAC) in 25 years without subsidy and in 14 years with subsidy. Accumulated cash flow is the primary evaluation measure that is implemented in this report and is similar to simple payback with the exception that accumulated cash flow takes the cost of financing and fuel escalation into account. For many school districts and municipalities, a positive accumulated cash flow of about 10 years maximum is considered for implementation. Based on this standard, the amount of project subsidy required to achieve a 10-year PAC is $490,000.

The approach in analyzing the Biomass Boiler system has been to remain conservative, yet realistic about the performance of biomass heating plants and the cost of their installation. Due to the preliminary nature of this assessment, it is possible that the construction cost estimates can be reduced as additional information relative to the construction is gathered, favorably affecting the economic analysis. The economic analysis has been performed using precontingency budget estimates. This value is the best estimate of project cost with the given information. When considering the economic performance of the project, including contingency in the project cost weights against the project, possibly unnecessarily. In planning for construction, a pre-design project contingency of 15% is recommended. Post-design, this can be reduced to 8%.

Option Title	Initial Cost	Year Positive Cashflow Occurs at 5.21% APR 100% Financed	Year Positive Cashflow Occurs at 5.21% APR 80% Boiler Building Subsidy	Year One Energy Savings	Project Subsidy Required for 10 year Payback
Elementary School	$656,542	25	14	$12,936	$490,000

Heat Load Calculation Summary

Heat loads for the Elementary School were extracted from a preliminary energy model that was created using Trace 700. Trace 700 is an energy-modeling program created by the Trane Corporation. Once the model was created the results were then compared with the actual utility records. From the model the peak-heating load for the high school was determined. The following Heat Energy Summary Table summarizes the projected heating demand and consumption requirements. Complete Energy Data and Trace 700 Calculations are given in the Appendix.

Heat Energy Summary Table

Existing Heating System

Building	Floor Area	Estimated Building Heating Load (BTU/Hr)	Design Plant Capacity Factor for Safety and Expansion	Design Plant Capacity (BTU/Hr)	Building heat type	Fuel Type	Existing Heating Plant Estimated Efficiency (%)	Existing Annual Fuel Consumption (BTU)
Elementary School	42000	2975144	10%	3272658.4	Steam	Natural Gas	78%	3356300000

Proposed Wood Chips

Building	Estimated Wood Chip Plant Efficiency	Estimated Biomass plant Input (BTU)	Wood Chips 50% MC (BTU/LB)	Wood Chip Eqvlnt Mixed conifer chip (lbs)	Annual Wood Chip Fuel Consumption (tons)	Projected Monthly Maximum Heat Consumption (BTU)	Required Monthly Chip Storage (tons)	Chip density (lb/ft3)	One Week Chip Storage (ft3)
Elementary School	70%	3739877143	5400	623313	312	762300000	71	22	1604

Operations and Maintenance Summary

Biomass Systems do have specific and unique maintenance requirements. However, with proper training and a well-developed maintenance program, the time and cost associated should not be a significant factor in the economic feasibility of the project. General maintenance requirements for a biomass boiler system are listed below. Requirements will vary with system type and manufacturer:

- Ash Removal – grates and under grates. Some systems are very automated, requiring little handling of ash. Other systems are more manual. Modern biomass systems produce little ash, requiring ash removal approximately once per week.
- Soot Blowers- Soot blowers are compressed air nozzles that blow the soot from the surface of the boiler's tubes to keep effective heat transfer. They can be automatic, or manual and should be operated at least once per day. The system sizes discussed in this assessment lend themselves best to manual soot blowers.
- Particulate Removal Systems.
- Tube Cleaning.
- Cleaning of firebox and heat exchange surfaces.
- Lubrication - Material handling components and blowers.
- Inspections of drive chains, belts, and gearboxes.
- Inspection of refactory.
- Inspection/testing of safety devices.
- Combustion calibration (combustion air/fuel feed rate).
- Periodic cleaning of boiler rooms.

Pinehurst Facility Summary

Information included in this part of the assessment is based on general observations from a site visit on October 06, 2003. Mechanical plans for the entire campus were made available at the time of the visit. The observations are very cursory in nature, many undiscovered conditions may exist that could effect the construction of any biomass plant option. The observations are also focused on the heat generation facilities at each building and not on the building themselves. The purpose of this assessment is to review the potential for integrating biomass heating, as such little time was spent investigation the buildings' condition, nor the mechanical systems that distribute the heat.

Pinehurst Elementary School consists of one building that was originally constructed in 1954 and is primarily wood and masonry construction. A classroom wing was added at a later date and is of similar construction. The building is approximately 57,502 square feet and is comprised of classrooms, a cafeteria, a gymnasium, and an administrative area. The heat source for the building is two 2,479 MBH natural gas fired steam boilers, however one boiler is currently not operable. The majority of the building utilizes steam fintube heaters to heat the individual spaces. Outside air is drawn through the exterior windows by way of exhaust fans that take air out of the corridor. There are currently two gas fired tank type domestic water heaters in the mechanical room that serve the school. The later classroom addition is not longer used for student education and now serves as the maintenance office and storage areas. The elementary school uses approximately 61,561 btu/sf of heating energy on an annual basis.

Detailed energy use information is provided in the Energy Data and Trace 700 Calculations Appendix.

Appendix

BUDGET ESTIMATES

Pinehurst Elementary School Biomass Heating Economic Analysis

Conversion Proforma for Pinehurst Elementary School - 5.21% APR 100% Financed - 10 Year Term

November 28, 2003
Revision:
Analyst: Edden-CTA

Project Capital Cost	$656,542
Boiler and Boiler Building Cost	$513,576
Mechanical Integration Costs	$142,966

Project Financing Information	
Percent Financed	100%
Amount Financed	$656,542
Amount of Grants	$0
Interest Rate	5.21%
Term	10
Annual Finance Cost (years)	$85,894

Year One Fuel Price:	
Wood Chips	$20.00 /ton
Pellets	$70.00 /ton
Fuel Oil	$0.97 /gallon
Propane	$0.09 /gallon
Natural Gas	$6.81 /mmbtu
Electric	$0.0390 /kwh

Escalation factors	
Elec. Escalation factor	1.04
Natural Gas Escalation factor	1.06
Fuel Oil Escalation factor	1.04
Pellet Escalation factor	1.03
Green Chip Escalation factor	1.02
Maint. Escalation factor	1.03

Cashflow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
Existing Heating System Operating Costs																			
Displaced natural gas heating costs	$6.81		3356	MMBtu	22,856	24,228	25,681	27,222	28,856	30,587	32,422	34,368	36,430	38,615	40,932	43,388	45,992	48,751	51,676
Displaced Operation and Maintenance Costs					570	587	605	623	642	661	681	701	722	744	766	789	813	837	862
Biomass System Operating Costs																			
Green Chip Fuel ($/ton, delivered to boiler site, btu/lb) (90% of total heat rqmnt)	$20.00	90%	312	tons	6,233	6,358	6,485	6,615	6,747	6,882	7,020	7,160	7,303	7,449	7,598	7,750	7,905	8,063	8,224
Small load Natural Gas (10% of total heat rqmnt)	$6.81	10%	374	MMBtu	2,547	2,700	2,862	3,033	3,215	3,408	3,613	3,830	4,059	4,303	4,561	4,835	5,125	5,432	5,758
Operation and Maintenance Costs					1,710	1,761	1,814	1,869	1,925	1,982	2,042	2,103	2,166	2,231	2,298	2,367	2,438	2,511	2,587
Annual Operating Cost Savings					***12,936***	***13,996***	***15,125***	***16,329***	***17,610***	***18,975***	***20,429***	***21,976***	***23,623***	***25,376***	***27,241***	***29,225***	***31,336***	***33,581***	***35,969***
Financed Project Costs - Principal and Interest					***(85,894)***	***(85,894)***	***(85,894)***	***(85,894)***	***(85,894)***	***(85,894)***	***(85,894)***	***(85,894)***	***(85,894)***	***(85,894)***					
Displaced System Replacement Costs					***24,400***														
Special financing																			
USDA Green ton subsidy ($/ton, Green chip tons/year)	$0.00		312		0	0	0	0	0	0	0	0	0	0					
Net Annual Cash Flow					***(48,558)***	***(71,898)***	***(70,769)***	***(69,566)***	***(68,284)***	***(66,919)***	***(65,466)***	***(63,918)***	***(62,271)***	***(60,519)***	***27,241***	***29,225***	***31,336***	***33,581***	***35,969***
Cumulative Cash Flow					***(48,558)***	***(120,456)***	***(191,225)***	***(260,791)***	***(329,075)***	***(395,995)***	***(461,460)***	***(525,379)***	***(587,650)***	***(648,168)***	***(620,927)***	***(591,702)***	***(560,366)***	***(526,784)***	***(490,815)***

Cashflow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30
Existing Heating System Operating Costs																			
Displaced electric resistance heating costs	$6.81		3356	MMBtu	54,777	58,063	61,547	65,240	69,154	73,304	77,702	82,364	87,306	92,544	98,097	103,983	110,221	116,835	123,845
Displaced Operation and Maintenance Costs					888	915	942	970	999	1,029	1,060	1,092	1,125	1,159	1,193	1,229	1,266	1,304	1,343
Biomass System Operating Costs																			
Green Chip Fuel ($/ton, delivered to boiler site, btu/lb) (90% of total heat rqmnt)	$20.00	90%	312	tons	8,389	8,557	8,728	8,902	9,080	9,262	9,447	9,636	9,829	10,026	10,226	10,431	10,639	10,852	11,069
Small load Natural Gas (10% of total heat rqmnt)	$7.67	10%	374	MMBtu	6,104	6,470	6,858	7,270	7,706	8,168	8,658	9,178	9,728	10,312	10,931	11,587	12,282	13,019	13,800
Operation and Maintenance Costs					2,664	2,744	2,826	2,911	2,998	3,088	3,181	3,277	3,375	3,476	3,580	3,688	3,798	3,912	4,030
Annual Operating Cost Savings					***38,508***	***41,207***	***44,077***	***47,127***	***50,369***	***53,814***	***57,476***	***61,366***	***65,498***	***69,889***	***74,553***	***79,507***	***84,768***	***90,356***	***96,289***
Financed Project Costs - Principal and Interest																			
Displaced System Replacement Costs																			
Special financing																			
USDA Green ton subsidy ($/ton, Green chip tons/year)	$0.00		312																
Net Annual Cash Flow					***38,508***	***41,207***	***44,077***	***47,127***	***50,369***	***53,814***	***57,476***	***61,366***	***65,498***	***69,889***	***74,553***	***79,507***	***84,768***	***90,356***	***96,289***
Cumulative Cash Flow					***(452,307)***	***(411,100)***	***(367,023)***	***(319,896)***	***(269,527)***	***(215,712)***	***(158,237)***	***(96,871)***	***(31,373)***	***38,516***	***113,069***	***192,576***	***277,344***	***367,700***	***463,989***

Pinehurst Elementary School Biomass Heating Economic Analysis

Conversion Proforma for Pinehurst Elementary School - 5.21% APR, 10 Year PAC

November 28, 2003
Revision:
Analyst: Edden-CTA

Project Capital Cost	$656,542
Boiler and Boiler Building Cost	$513,576
Mechanical Integration Costs	$142,966

Project Financing Information	
Percent Financed	25%
Amount Financed	$166,542
Amount of Grants	$490,000
Interest Rate	5.21%
Term	10
Annual Finance Cost (years)	$21,788

Year One Fuel Price:	
Wood Chips	$6.57 /ton
Pellets	$70.00 /ton
Fuel Oil	$0.97 /gallon
Propane	$0.85 /gallon
Natural Gas	$6.81 /mmbtu
Electric	$0.039 /kwh

Escalation factors	
Elec. Escalation factor	1.04
Natural Gas Escalation factor	1.06
Fuel Oil Escalation factor	1.04
Pellet Escalation factor	1.03
Green Chip Escalation factor	1.02
Maint. Escalation factor	1.03

Cashflow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
Existing Heating System Operating Costs																			
Displaced natural gas heating costs	$6.81		3356	MMBtu	22,856	24,228	25,681	27,222	28,856	30,587	32,422	34,368	36,430	38,615	40,932	43,388	45,992	48,751	51,676
Displaced Operation and Maintenance Costs					570	587	605	623	642	661	681	701	722	744	766	789	813	837	862
Biomass System Operating Costs																			
Green Chip Fuel ($/ton, delivered to boiler site, btu/lb) (90% of total heat rqmnt)	$20.00	90%	312	tons	6,233	6,358	6,485	6,615	6,747	6,882	7,020	7,160	7,303	7,449	7,598	7,750	7,905	8,063	8,224
Small load Natural Gas (10% of total heat rqmnt)	$6.81	10%	374	MMBtu	2,547	2,700	2,862	3,033	3,215	3,408	3,613	3,830	4,059	4,303	4,561	4,835	5,125	5,432	5,758
Operation and Maintenance Costs					1,710	1,761	1,814	1,869	1,925	1,982	2,042	2,103	2,166	2,231	2,298	2,367	2,438	2,511	2,587
Annual Operating Cost Savings					*12,936*	*13,996*	*15,125*	*16,329*	*17,610*	*18,975*	*20,429*	*21,976*	*23,623*	*25,376*	*27,241*	*29,225*	*31,336*	*33,581*	*35,969*
Financed Project Costs - Principal and Interest					*(21,788)*	*(21,788)*	*(21,788)*	*(21,788)*	*(21,788)*	*(21,788)*	*(21,788)*	*(21,788)*	*(21,788)*	*(21,788)*					
Displaced System Replacement Costs					*24,400*														
Special financing																			
USDA Green ton subsidy ($/ton, Green chip tons/year)	$0.00		312		0	0	0	0	0	0	0	0	0	0					
Net Annual Cash Flow					*15,548*	*(7,792)*	*(6,663)*	*(5,460)*	*(4,178)*	*(2,813)*	*(1,360)*	*188*	*1,835*	*3,587*	*27,241*	*29,225*	*31,336*	*33,581*	*35,969*
Cumulative Cash Flow					*15,548*	*7,756*	*1,093*	*(4,367)*	*(8,545)*	*(11,358)*	*(12,718)*	*(12,531)*	*(10,696)*	*(7,108)*	*20,133*	*49,358*	*80,694*	*114,276*	*150,245*

Cashflow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30
Existing Heating System Operating Costs																			
Displaced electric resistance heating costs	$0.000		3356	MMBtu	54,777	58,063	61,547	65,240	69,154	73,304	77,702	82,364	87,306	92,544	98,097	103,983	110,221	116,835	123,845
Displaced Operation and Maintenance Costs					888	915	942	970	999	1,029	1,060	1,092	1,125	1,159	1,193	1,229	1,266	1,304	1,343
Biomass System Operating Costs																			
Green Chip Fuel ($/ton, delivered to boiler site, btu/lb) (90% of total heat rqmnt)	$9.00	90%	312	tons	8,389	8,557	8,728	8,902	9,080	9,262	9,447	9,636	9,829	10,026	10,226	10,431	10,639	10,852	11,069
Small load Natural Gas (10% of total heat rqmnt)	$7.67	10%	374	MMBtu	6,104	6,470	6,858	7,270	7,706	8,168	8,658	9,178	9,728	10,312	10,931	11,587	12,282	13,019	13,800
Operation and Maintenance Costs					2,664	2,744	2,826	2,911	2,998	3,088	3,181	3,277	3,375	3,476	3,580	3,688	3,798	3,912	4,030
Annual Operating Cost Savings					*38,508*	*41,207*	*44,077*	*47,127*	*50,369*	*53,814*	*57,476*	*61,366*	*65,498*	*69,889*	*74,553*	*79,507*	*84,768*	*90,356*	*96,289*
Financed Project Costs - Principal and Interest																			
Displaced System Replacement Costs																			
Special financing																			
USDA Green ton subsidy ($/ton, Green chip tons/year)	$0.00		312																
Net Annual Cash Flow					*38,508*	*41,207*	*44,077*	*47,127*	*50,369*	*53,814*	*57,476*	*61,366*	*65,498*	*69,889*	*74,553*	*79,507*	*84,768*	*90,356*	*96,289*
Cumulative Cash Flow					*188,753*	*229,960*	*274,037*	*321,164*	*371,533*	*425,348*	*482,823*	*544,189*	*609,687*	*679,576*	*754,129*	*833,636*	*918,404*	*1,008,760*	*1,105,049*

Pinehurst Elementary School Biomass Heating Economic Analysis

Conversion Proforma for Pinehurst Elementary School - 5.21% APR, USDAFS 80% of Boiler & Building - 10 Year Term

November 28, 2003
Revision:
Analyst: Edden-CTA

Project Capital Cost	**$656,542**
Boiler and Boiler Building Cost	**$513,576**
Mechanical Integration Costs	**$142,966**

Project Financing Information	
Percent Financed	37%
Amount Financed	$245,681
Amount of Grants	$410,861
Interest Rate	5.21%
Term	10
Annual Finance Cost (years)	$32,142

Year One Fuel Price:	
Wood Chips	$6.57 /ton
Pellets	$70.00 /ton
Fuel Oil	$0.97 /gallon
Propane	$0.85 /gallon
Natural Gas	$6.81 /mmbtu
Electric	$0.039 /kwh

Escalation factors	
Elec. Escalation factor	1.04
Natural Gas Escalation factor	1.06
Fuel Oil Escalation factor	1.04
Pellet Escalation factor	1.03
Green Chip Escalation factor	1.02
Maint. Escalation factor	1.03

Cashflow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
Existing Heating System Operating Costs																			
Displaced natural gas heating costs	$6.81		3356	MMBtu	22,856	24,228	25,681	27,222	28,856	30,587	32,422	34,368	36,430	38,615	40,932	43,388	45,992	48,751	51,676
Displaced Operation and Maintenance Costs					570	587	605	623	642	661	681	701	722	744	766	789	813	837	862
Biomass System Operating Costs																			
Green Chip Fuel ($/ton, delivered to boiler site, btu/lb) (90% of total heat rqmnt)	$20.00	90%	312	tons	6,233	6,358	6,485	6,615	6,747	6,882	7,020	7,160	7,303	7,449	7,598	7,750	7,905	8,063	8,224
Small load Natural Gas (10% of total heat rqmnt)	$6.81	10%	374	MMBtu	2,547	2,700	2,862	3,033	3,215	3,408	3,613	3,830	4,059	4,303	4,561	4,835	5,125	5,432	5,758
Operation and Maintenance Costs					1,710	1,761	1,814	1,869	1,925	1,982	2,042	2,103	2,166	2,231	2,298	2,367	2,438	2,511	2,587
Annual Operating Cost Savings					***12,936***	***13,996***	***15,125***	***16,329***	***17,610***	***18,975***	***20,429***	***21,976***	***23,623***	***25,376***	***27,241***	***29,225***	***31,336***	***33,581***	***35,969***
Financed Project Costs - Principal and Interest					***(32,142)***	***(32,142)***	***(32,142)***	***(32,142)***	***(32,142)***	***(32,142)***	***(32,142)***	***(32,142)***	***(32,142)***	***(32,142)***					
Displaced System Replacement Costs					***24,400***														
Special financing																			
USDA Green ton subsidy ($/ton, Green chip tons/year)	$0.00		312		0	0	0	0	0	0	0	0	0	0					
Net Annual Cash Flow					***5,194***	***(18,146)***	***(17,017)***	***(15,813)***	***(14,532)***	***(13,167)***	***(11,713)***	***(10,166)***	***(8,519)***	***(6,766)***	***27,241***	***29,225***	***31,336***	***33,581***	***35,969***
Cumulative Cash Flow					***5,194***	***(12,952)***	***(29,968)***	***(45,782)***	***(60,314)***	***(73,480)***	***(85,194)***	***(95,360)***	***(103,879)***	***(110,645)***	***(83,404)***	***(54,179)***	***(22,842)***	***10,739***	***46,708***

Cashflow Descriptions	Unit Costs	Heating Source Proportion	Annual Heating Source Volumes	Heating Units	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Year 27	Year 28	Year 29	Year 30
Existing Heating System Operating Costs																			
Displaced electric resistance heating costs	$0.000		3356	MMBtu	54,777	58,063	61,547	65,240	69,154	73,304	77,702	82,364	87,306	92,544	98,097	103,983	110,221	116,835	123,845
Displaced Operation and Maintenance Costs					888	915	942	970	999	1,029	1,060	1,092	1,125	1,159	1,193	1,229	1,266	1,304	1,343
Biomass System Operating Costs																			
Green Chip Fuel ($/ton, delivered to boiler site, btu/lb) (90% of total heat rqmnt)	$9.00	90%	312	tons	8,389	8,557	8,728	8,902	9,080	9,262	9,447	9,636	9,829	10,026	10,226	10,431	10,639	10,852	11,069
Small load Natural Gas (10% of total heat rqmnt)	$7.67	10%	374	MMBtu	6,104	6,470	6,858	7,270	7,706	8,168	8,658	9,178	9,728	10,312	10,931	11,587	12,282	13,019	13,800
Operation and Maintenance Costs					2,664	2,744	2,826	2,911	2,998	3,088	3,181	3,277	3,375	3,476	3,580	3,688	3,798	3,912	4,030
Annual Operating Cost Savings					***38,508***	***41,207***	***44,077***	***47,127***	***50,369***	***53,814***	***57,476***	***61,366***	***65,498***	***69,889***	***74,553***	***79,507***	***84,768***	***90,356***	***96,289***
Financed Project Costs - Principal and Interest																			
Displaced System Replacement Costs																			
Special financing																			
USDA Green ton subsidy ($/ton, Green chip tons/year)	$0.00		312																
Net Annual Cash Flow					***38,508***	***41,207***	***44,077***	***47,127***	***50,369***	***53,814***	***57,476***	***61,366***	***65,498***	***69,889***	***74,553***	***79,507***	***84,768***	***90,356***	***96,289***
Cumulative Cash Flow					***85,216***	***126,424***	***170,500***	***217,628***	***267,997***	***321,811***	***379,287***	***440,652***	***506,151***	***576,040***	***650,593***	***730,099***	***814,867***	***905,223***	***1,001,513***

CASHFLOW ANALYSIS

CONSTRUCTION COST ESTIMATE | DATE PREPARED 11/28/03 | SHEET 1 OF 1

PROJECT
Pinehurst Elementary & Middle School

Option

Edden

CTA Architects Engineers
1500 Poly Drive, P.O. Box 1439, Billings, MT 59103
406. 248. 7455 800. 780. 7455 Fax: 406. 248. 3779
1-800-780-7455
http://www.ctagroup.com E-mail: info@ctagroup.com

ESTIMATOR
Ratz

Pinehurst Elementary & Middle School

	QUANTITY		MATERIAL		LABOR			
	No. Units	Unit Meas.	Per Unit	TOTAL	Per Unit	TOTAL	TOTAL COST	PROJECT COMPONENT COST
BIOMASS BOILER SYSTEM								
Steam Boiler Plant (3.2 MMBtu Output)	1	assy	$200,000.00	$200,000.00	$75,000.00	$75,000.00	$275,000.00	
State Air Quality Permit Application	1	ls			$1,000.00	$1,000.00	$1,000.00	
Subtotal							*$276,000.00*	
Design Services	*6%*						*$16,560.00*	
Idaho State Tax (On Material Only)	*6%*						*$12,000.00*	
TOTAL- BIOMASS BOILER SYSTEMS								**$304,560.00**
BOILER BUILDING COSTS								
Elementary & Middle School								
Boiler Plant Building - CMU Construction (Slab on Grade)	1280	sf	$40.00	$51,200.00	$15.00	$19,200.00	$70,400.00	
Domestic Water System								
1-1/2" Copper CW Service, insulated	50	lf	$7.95	$397.50	$10.55	$527.50	$925.00	
1-1/2" HDPE CW Service from m.s. boiler room	600	lf	$1.00	$600.00	$5.00	$3,000.00	$3,600.00	
3/4" Copper (CW & HW)	175	lf	$4.77	$834.75	$8.06	$1,410.50	$2,245.25	
Emergency Shower and Mixing Valve	1	assy	$1,500.00	$1,500.00	$300.00	$300.00	$1,800.00	
Electric Water Heater	1	ea	$400.00	$400.00	$200.00	$200.00	$600.00	
Service Sink	1	ea	$900.00	$900.00	$700.00	$700.00	$1,600.00	
D-W-V System								
Sewage Ejector	1	ea	$1,850.00	$1,850.00	$470.00	$470.00	$2,320.00	
2" PVC (pressure) to sewer connection in school	600	lf	$3.90	$2,340.00	$12.40	$7,440.00	$9,780.00	
2" PVC D-W-V	120	lf	$3.60	$432.00	$12.45	$1,494.00	$1,926.00	
3" PVC D-W-V	40	lf	$5.24	$209.60	$13.61	$544.40	$754.00	
Floor Drains	3	ea	$540.00	$1,620.00	$60.00	$180.00	$1,800.00	
Miscellaneous Plumbing	1	ls	$500.00	$500.00	$500.00	$500.00	$1,000.00	
HVAC								
Combustion Ductwork	600	lbs	$0.66	$396.00	$4.59	$2,754.00	$3,150.00	
Louvers	56	sf	$40.00	$2,240.00	$12.50	$700.00	$2,940.00	
Control Dampers	4	ea	$400.00	$1,600.00	$90.00	$360.00	$1,960.00	
Unit Heater	2	ea	$550.00	$1,100.00	$100.00	$200.00	$1,300.00	
Steam & Condensate Piping								
Condensate Return Unit (Simplex)	1	ea	$3,500.00	$3,500.00	$500.00	$500.00	$4,000.00	
1" Insulated Black Steel	60	lf	$6.10	$366.00	$10.70	$642.00	$1,008.00	
1-1/2" Insulated Black Steel	75	lf	$7.40	$555.00	$12.20	$915.00	$1,470.00	
6" Insulated Black Steel	45	lf	$30.10	$1,354.50	$38.65	$1,739.25	$3,093.75	
12" Insulated Black Steel	8	lf	$88.13	$705.04	$78.12	$624.96	$1,330.00	
6" Check Valve	1	ea	$641.00	$641.00	$324.00	$324.00	$965.00	
F&T Steam Traps	3	ea	$115.00	$345.00	$25.00	$75.00	$420.00	
Miscellaneous Steam Piping Components	1	ls	$500.00	$500.00	$500.00	$500.00	$1,000.00	
Temperature Controls	1	ls	$5,000.00	$5,000.00	$2,500.00	$2,500.00	$7,500.00	
Plant Electrical Work	1	ls	$17,000.00	$17,000.00	$8,000.00	$8,000.00	$25,000.00	
Subtotal							*$153,887.00*	
General Conditions & General Contractor Markup	*20%*						*$30,777.40*	
Design Services	*12%*						*$18,466.44*	
Idaho State Tax (On Material Only)	*6%*						*$5,885.18*	
TOTAL- BOILER BUILDING COSTS								**$209,016.02**
MECHANICAL INTEGRATION COSTS								
Elementary & Middle School								
Underground Piping								
6" Steam main, insulated	600	lf	$40.00	$24,000.00	$35.00	$21,000.00	$45,000.00	
1 1/2" Boiler feed, insulated	600	lf	$16.50	$9,900.00	$10.50	$6,300.00	$16,200.00	
Excavate Trench (600 lf x 6 ft deep x 8 ft wide)	1100	cy			$4.50	$4,950.00	$4,950.00	
Bedding (2 ft - incl mat., comp., haul)	200	cy	$5.00	$1,000.00	$20.00	$4,000.00	$5,000.00	
Backfill with compaction	900	cy			$4.00	$3,600.00	$3,600.00	
Restore landscape (grass) & site repair	1	ls	$5,000.00	$5,000.00	$2,500.00	$2,500.00	$7,500.00	
Steam and Condensate Piping								
Boiler Feedwater Pump	1	ea	$2,500.00	$2,500.00	$450.00	$450.00	$2,950.00	
1-1/2" Insulated Black Steel	75	lf	$7.40	$555.00	$12.20	$915.00	$1,470.00	
6" Insulated Black Steel	45	lf	$30.10	$1,354.50	$38.65	$1,739.25	$3,093.75	
Double wall domestic water heat exchanger	1	ea	$6,500.00	$6,500.00	$1,000.00	$1,000.00	$7,500.00	
HX pump	1	ea	$400.00	$400.00	$100.00	$100.00	$500.00	
Domestic water heater piping modifications	1	ls	$500.00	$500.00	$1,000.00	$1,000.00	$1,500.00	
Mechanical room demolition and piping rework	1	ls	$2,500.00	$2,500.00	$2,500.00	$2,500.00	$5,000.00	
Subtotal							*$104,263.75*	
General Conditions & General Contractor Markup	*20%*						*$20,852.75*	
Design Services	*14%*						*$14,596.93*	
Idaho State Tax (On Material Only)	*6%*						*$3,252.57*	
TOTAL- MECHANICAL INTEGRATION COSTS								**$142,966.00**
PRECONTINGENCY PROJECT TOTAL								**$656,542.02**
CONTINGENCY	15%							$98,481.30
RECOMMENDED PROJECT BUDGET								**$755,023.32**

DATA AND PHOTOS

BOARD FEET CUT FROM PRIVATE LANDS
CALENDAR YEARS
1993-2002

County	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Beaverhead	2,773,916	4,781,694	1,935,405	2,038,730	3,425,439	563,129	1,108,075	1,276,332	892,326	4,636,222
Big Horn	8,553,050	12,155,764	8,279,442	6,977,863	7,360,852	7,045,872	6,301,891	7,006,823	9,507,276	5,525,523
Blaine	747,497	1,891,592	1,046,926	350,872	336,552	902,385	194,317	1,578,909	739,986	401,004
Broadwater	1,975,386	2,686,654	2,969,394	2,409,490	3,349,285	2,429,445	1,813,589	4,977,316	4,073,518	5,622,358
Carbon	33,027	354,867	521,063	1,420,207	577,946	320,788	22,084	223,200	315,462	293,410
Carter	3,109,569	1,773,385	3,200,038	2,909,197	1,914,872	3,172,216	5,878,117	3,128,470	1,470,830	685,231
Cascade	724,415	1,994,419	4,754,060	1,947,141	10,687,004	7,462,196	3,321,759	2,148,483	2,484,369	3,604,912
Chouteau	1,659,231	3,115,067	2,226,178	2,419,463	1,790,886	1,243,726	1,863,306	460,094	2,340,507	0
Custer	455,314	335,372	748,992	4,009,264	2,483,068	4,247,670	3,508,810	425,441	148,071	230,476
Deer Lodge	4,659,632	4,388,001	4,790,018	4,047,717	4,660,103	6,710,221	8,147,762	11,952,794	12,085,452	4,571,936
Fergus	16,519,826	19,978,846	19,059,961	19,078,016	21,104,354	9,180,229	7,364,929	13,403,177	14,185,309	16,029,988
Flathead	97,400,159	112,012,714	129,256,641	99,900,178	97,440,894	91,620,451	98,215,934	88,937,193	81,826,898	81,947,637
Gallatin	24,782,301	31,475,597	25,918,785	21,785,635	17,060,748	4,408,801	7,222,135	14,962,576	20,588,845	12,246,130
Garfield	42,661	2,316,688	1,204,073	288,325	711,424	698,197	32,811	330,332	0	262,056
Glacier	7,060	0	0	319,090	386,801	116,240	93,341	167,914	0	194,427
Golden Valley	2,542,794	1,698,619	2,326,129	866,365	1,010,181	422,045	105,758	808,425	1,160,130	350,306
Granite	16,662,207	18,760,840	14,393,488	17,765,569	15,108,583	25,647,674	32,196,541	29,688,876	28,923,901	15,091,477
Hill	4,437,127	1,610,243	332,840	311,247	1,104,511	895,123	388,961	108,937	119,479	150,270
Jefferson	2,770,502	4,010,376	1,994,231	2,041,683	3,590,413	3,656,479	5,394,341	8,525,052	3,588,017	4,485,350
Judith Basin	2,603,243	734,336	95,223	737,007	2,134,983	1,137,213	301,884	318,321	977,048	1,016,141
Lake	33,369,675	35,232,501	32,941,687	48,956,433	27,204,920	24,821,760	35,506,059	26,872,834	25,227,858	19,805,856
Lewis & Clark	12,012,940	17,191,063	13,299,636	12,562,888	20,850,857	23,832,732	26,317,951	13,238,492	15,081,062	14,819,644
Lincoln	84,053,635	93,257,818	90,365,820	87,101,283	98,650,305	93,625,522	94,300,692	80,420,462	78,317,051	79,095,722
Madison	8,517,729	8,373,097	4,864,426	2,011,013	3,073,043	5,520,398	3,912,838	2,350,857	1,281,619	5,221,886
Meagher	11,139,972	21,044,541	17,541,118	13,284,864	15,002,446	12,520,731	4,142,389	11,895,834	3,471,562	6,510,831
Mineral	9,476,764	13,212,008	14,795,862	19,537,236	16,273,859	11,903,997	19,032,748	17,448,145	13,125,656	16,562,522
Missoula	104,999,843	97,798,558	115,873,204	92,029,832	93,532,928	120,665,425	116,664,149	104,952,355	94,834,436	108,856,424
Musselshell	12,533,929	28,248,250	36,866,185	13,666,111	16,001,406	6,733,846	8,683,589	4,740,302	5,041,830	5,560,956
Park	4,479,707	7,608,021	6,227,833	9,492,886	6,114,092	3,660,377	4,119,855	4,536,012	8,572,218	19,834,558
Petroleum	1,570,847	1,180,234	1,669,856	716,444	343,998	0	0	0	0	0
Phillips	0	194,751	56,040	97,000	0	50,000	475,110	1,001,330	0	0
Powder River	9,944,813	4,567,372	4,340,384	6,338,891	9,803,081	8,208,312	2,823,764	3,519,393	3,913,849	6,132,009
Powell	36,878,840	39,360,189	32,599,158	26,490,868	39,812,328	30,197,928	41,272,025	31,267,245	38,682,465	35,236,467
Ravalli	30,049,128	31,167,740	27,337,270	20,115,120	11,945,367	10,743,229	11,004,003	11,922,066	19,811,400	6,068,190
Rosebud	3,536,396	7,114,886	8,760,237	4,956,182	5,094,789	5,607,057	2,295,905	4,099,320	2,481,928	4,956,383
Sanders	57,693,329	51,020,000	41,004,935	43,555,377	39,056,549	45,988,998	58,392,813	56,279,784	50,860,670	54,084,651
Silverbow	5,799,495	4,321,626	2,677,280	1,469,424	1,662,324	930,848	569,714	1,447,704	2,996,356	6,484,737
Stillwater	4,579,821	4,656,642	1,647,773	1,380,072	6,564,181	1,179,921	1,600,537	4,347,011	2,778,124	865,487
Sweetgrass	5,689,622	4,988,663	3,879,579	5,064,957	4,743,915	2,912,912	2,085,856	519,654	934,585	1,217,458
Teton	0	0	0	0	0	0	0	0	13,850	0
Treasure	3,789,695	5,220,944	5,479,570	5,591,195	10,446,004	3,531,130	1,383,874	513,293	631,522	0
Wheatland	774,212	207,327	708,879	583,860	895,798	2,349,921	3,554,155	343,058	1,254,857	650,177
Yellowstone	3,601,046	4,667,983	5,243,963	2,700,732	1,355,593	601,321	2,485,181	2,128,640	828,839	1,045,508
TOTALS	636,950,355	706,709,288	693,233,582	612,325,727	624,666,682	587,466,465	624,099,552	574,272,456	555,569,161	550,354,320
Percent Change From Previous Year	7.37%	10.95%	-1.91%	-11.67%	2.02%	-5.96%	6.24%	-7.98%	-3.26%	-0.94%
10 Year Average	616,564,759									

To: Bitter Root RC&D Area, Inc.
1709 N. First Street
Hamilton, MT 59840
(406) 363-1444 Ext.#5
FAX: 406-363-5011
EMAIL: bitterrootrcd@bitterrootrcd.org
c/o Tom Coston

From: Richard L. Folk, Assistant Professor
University of Idaho, College of Natural Resources
Department of Forest Products
Moscow, ID 83844-1132

Subject: **Wood Fuels Characterization**

A. Ultimate Analysis (This analysis provides the percentage by weight, dry basis, of the elements in wood such as carbon, hydrogen, nitrogen, sulfur, oxygen, other non-combustibles known as ash. Might be important from an air quality/regulatory point-of-view. The HHV or higher heat value is the total heat generated by complete combustion under controlled conditions. The available potential heat, less than the HHV, at any moisture content is called the gross heat value (GHV) and can be calculated as follows: GHV = HHV x [1 - %MC (wet basis)/100]. The recoverable or useable heat energy is even less than HHV or the GHV since it contains heat losses associated with vaporizing water, the combustion of hydrogen gas, and heat loss in the stack gases).

	C	H	N	S	O	Ash	HHV(BTU)
Douglas-fir:	52.3	6.3	0.1	0.0	40.5	0.8	9050
Wood	52.5	5.8	0.1	0.1	41.2	0.3	8730
Douglas-fir:	56.2	5.9	0.0	0.0	36.7	1.2	9570
Bark	53.0	6.0	0.0	trace	39.0	2.0	9800
Ponderosa:	51.8	6.3	0.1	0.0	41.3	0.5	9130
Pine Wood							9100
Ponderosa:	52.3	5.8	0.2	0.0	38.8	2.9	8780
Pine Bark							9030
							9100
W. Hemlock:	50.4	5.8	0.1	0.1	41.4	2.2	8620
Wood	50.1	5.9	0.1	0.1	42.2	1.6	8290
							8400
W. Hemlock:	53.7	5.7	0.0	0.03	38.9	1.7	9400
Bark							9090
White Pine:	52.6	6.1	0.0	0.0	41.3	0.1	8900
Wood							
W. Redcedar:							9700
Wood.							
W. Redcedar:	51.0	5.7	0.0	trace	38.2	5.1	8610
Bark							

Grand Fir: Wood	49.0	6.0	0.1	0.0	44.8	0.2	8200
Grand Fir: Bark	52.2	5.8	0.0	trace	40.3	1.7	8810
W. Spruce:	51.8	5.7	0.0	0.1	38.6	3.8	8740

B. Proximate Analysis (This analysis provides information about the percent of weight, dry basis, for the volatile matter, fixed carbon and ash. This might be important for energy production or "energy richness" of the wood and the amount of ash or non-combustibles which will require disposal).

	Volatile Matter	Fixed Carbon	Ash
Douglas-fir Wood:	86.2	13.7	0.1
	82.0	17.2	0.8
	82.2	17.5	0.3
Douglas-fir Bark	70.6	27.2	2.2
	72.9	25.9	1.3
Ponderosa Pine Wood	87.0	12.8	0.2
	79.4	20.1	0.5
Ponderosa Pine Bark	73.4	25.9	0.7
W. Hemlock Wood	84.8	15.0	0.2
W. Hemlock Bark	74.3	24.0	1.7
	74.2	23.6	2.2
	78.9	19.5	1.6
	72.5	25.8	1.7
Grand Fir Wood	84.4	15.1	0.5
	83.2	16.6	0.3
Grand Fir Bark	73.4	24.0	2.6
	74.3	24.0	1.7
W. Red Cedar Wood	86.7	13.1	0.2
W. Red Cedar Bark	73.0	21.9	5.1
	77.0	21.0	2.0
Lodgepole Pine Bark	73.5	26.0	0.5
W. Spruce Bark	69.6	26.6	3.8

C. Bark Ash Composition (This analysis provides information about the mineral composition of the ash which might be important from a landfill disposal, land application, slagging, and boiler corrosion point-of view).

	CaO	P2O5	Na2O	MgO	Fe2O3	SiO2	K2O	SO3	Cl
Douglas-fir	51.4	n/a	5.3	3.2	4.4	13.9	n/a	2.9	0.4
W. Redcedar	13.9	n/a	6.6	3.1	7.2	44.0	n/a	3.1	0.7
Lodgepole Pine	48.0	n/a	8.4	1.8	5.6	12.2	n/a	3.3	0.4
Grand Fir	60.8	n/a	10.4	3.0	3.2	1.7	n/a	3.0	0.4
W. Hemlock	58.2	n/a	9.1	4.4	3.6	1.5	n/a	3.7	1.4
W. Spruce	25.3	n/a	10.4	4.1	6.4	32.0	n/a	2.1	trace

D. Wood Density (This analysis provides information about the weight per unit volume (pounds per cubic foot) of wood when dry (0% MC), when green (saturated), or at some specified moisture content (10-15% MC).

	Specific gravity			Density lbs./cubic foot)		
	Dry	@ a specified MC	Green	Dry	@ a specified MC	Green
Douglas-fir (Interior West)	0.50	0.51 (13%) 0.49 (8%)	0.45 0.48	31.2	31.8 (13%) 30.8 (8%)	28.1 30.0
Ponderosa Pine	0.40	0.43 (11%) 0.44 (8%)	0.38	25.0	26.8 (11%) 27.5 (8%)	23.7
Lodgepole Pine	0.41	0.45 (8%)	0.38	25.6	28.2 (8%)	23.7
W. Hemlock	0.45	0.41 (12%) 0.46 (8%)	0.42 0.38	28.1	25.6 (12%) 28.7 (8%)	26.2 23.7
Grand Fir	0.37	0.38 (13%) 0.44 (8%)	0.35 0.36	23.1	23.7 (13%) 27.3 (8%)	21.8 22.5
W. Spruce	0.35	0.35 (12%) 0.38 (8%)	0.33 0.34	21.8	21.8 (12%) 23.2 (8%)	20.6 21.2
White Pine	0.38	0.43 (8%)	0.35	23.7	27.1 (8%)	21.8
W. Redcedar	0.32	0.33 (9%) 0.36 (8%0	0.31	20.0	20.6 (9%) 22.4 (8%)	19.3
W. Larch	0.52	0.55 (12%) 0.61 (8%)	0.48 0.51	32.4	34.3 (12%) 38.2 (8%)	30.0 31.8
Subalpine Fir	0.32	0.34 (8%)	0.31	20.0	21.3 (8%)	19.3

E. Moisture Content of Green Wood (This analysis provides information about the percent moisture content [dry basis and wet basis] of green wood [saturated] in the heartwood and sapwood regions of the tree. %MC [wet basis] = (%MC [dry basis] /(1 + %MC [dry basis])) x 100

	%Dry Basis		%Wet Basis	
	Heartwood	Sapwood	Heartwood	Sapwood
Douglas-fir	37	115	27	54
Ponderosa Pine	40	148	29	60
W. Hemlock	85	170	46	63
Lodgepole Pine	41	120	29	55
White Pine	62	148	38	60
Grand Fir	91	136	48	58
W. Spruce	51	173	34	63
W. Larch	54	110	35	52
W. Redcedar	58	249	37	71

F. Discussion & Conclusions

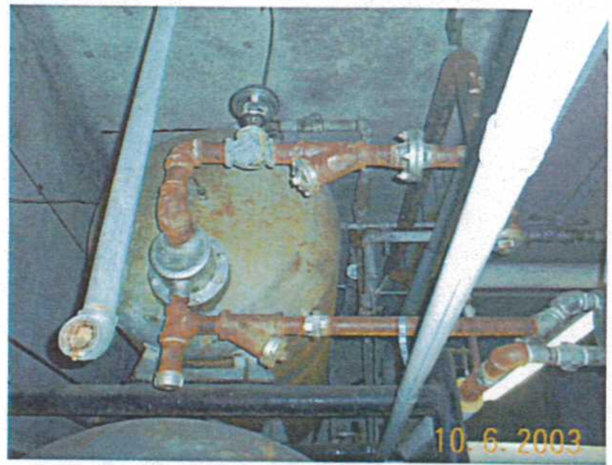
The fuel characteristics of wood will vary within species due to age of the tree (small-diameter old growth vs small-diameter young trees), geographic location (latitude and longitude), aspect (north, south, east , or west facing slopes), elevation, and inheritance. These can be very difficult to accommodate in an analysis or model so it is best to use average values. I have given multiple values for some characteristics due to different numbers being recorded by different researchers and due to the variables mentioned above. Each number is an average of all the data taken from that particular study. You may therefore want to select one of the multiple values or specify a range from the lowest to the highest of the values.

In the case of "fire-damaged pulp" trees, the bark is certain to be absent or unuseable. Moisture content of the standing tree or wood from salvage will not likely be above 30%, dry basis (23%, wet basis) so wood density values will be less than dry values but greater than green since green values represent saturation above 30%. Following is some additional information on the weight per cubic foot for selected species of logs. These values are usually important for log truckers who use cubic scale of the logs to determine legal loads.

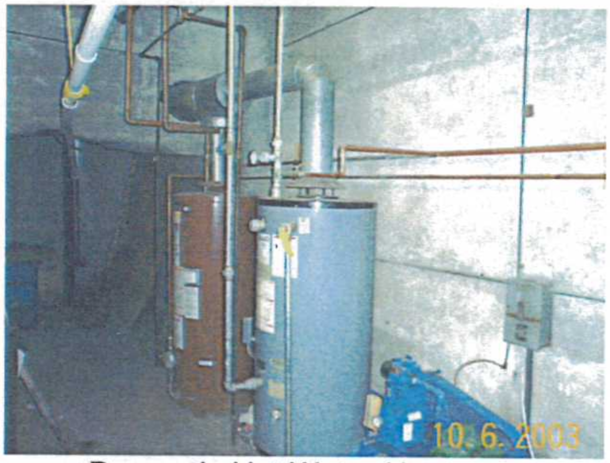
Western redcedar	27 lbs./cubic foot	
Douglas-fir (inland)	48	"
White fir/Grand fir	47	"
Western Hemlock	41	"
Western larch	48	"
Lodgepole pine	39	"
Ponderosa pine	45	"
Western white pine	35	"

SCHOOL PHOTOS

Sump Pump



Cold Water Storage Tank

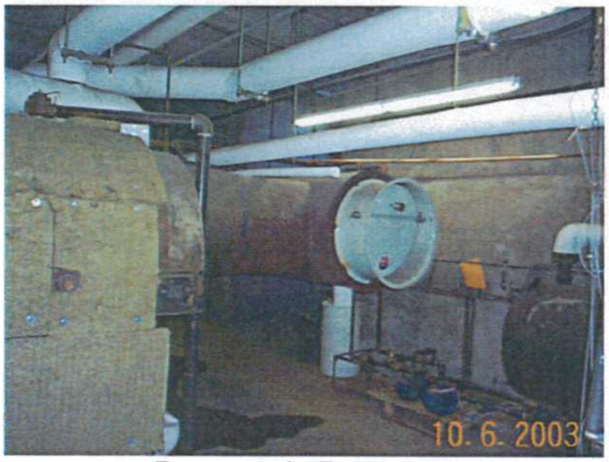


Domestic Hot Water Heaters

Boiler Stack

Inoperable Boiler

Main Steam Header



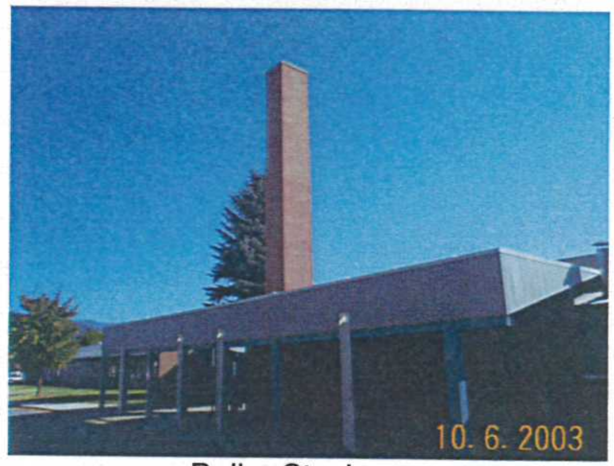
Barometric Damper

Combustion Air Grate

Coal Bin Access

Coal Bin

Gas Meter



Boiler Stack

Maintenance Building

Proposed Biomass Boiler Building Location

West Classroom Elevation

Outside Air Exhaust Fan Penthouses

Main Entrance

North Elevation

East Elevation

Typical Corridor

Fintube Radiation (Typ)

Gymnasium

Cafeteria

BIOMASS INFORMATION

A Biomass Systems Primer

The primary objectives of the Fuels for Schools Initiative are to:

- **Develop markets** for non-merchantable wood byproduct of Comprehensive Forest Treatment - *Provide a vertically integrated solution to Forest Health and Wild Fire Risk.*

- **Partner with Communities** to integrate treatment benefits into local society.

- **Develop practical, cost effective application models** for integrating biomass-heating systems into systems representative of a larger application group.

- **Identify criteria** and an evaluation technique to form an entry niche application strategy.

Benefits and Considerations for Biomass Energy

Biomass energy comes with a variety of benefits and considerations. The following are among the many benefits of biomass systems:

- Wood fuel has better cost stability than conventional fuels. Compared to petroleum based and natural gas fuels, wood based fuels have lower cost escalation and volatility.

- Although local factors vary, wood fuel typically costs less than conventional fuels. A cost comparison of wood based fuels to other common fuels is provided in the below chart and table. Note: These comparisons do not figure in recent natural gas increases.

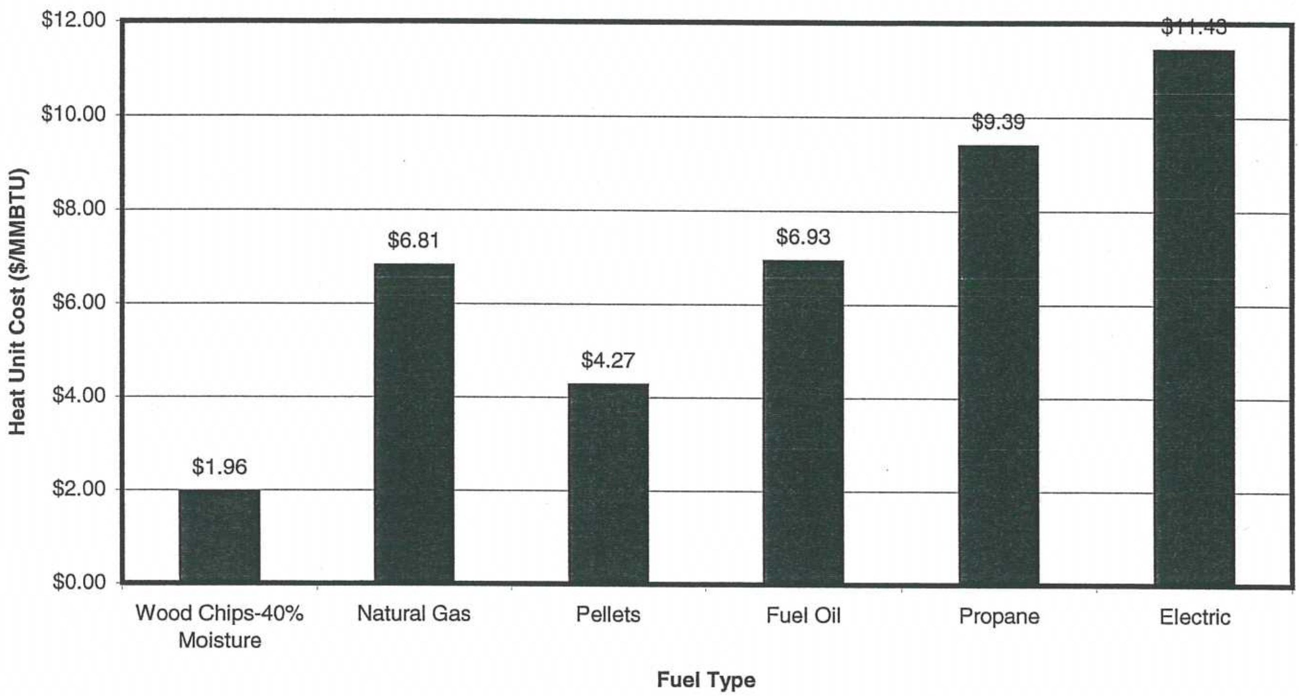
- Local fuel production adds to the economic base of our already struggling timber towns.

- Biomass energy directly integrates with efforts to improve forest health.

- When approached in a sustainable manner, biomass energy is a renewable energy source.

- Depending on the fuel production methods, the net carbon emissions to the atmosphere are near zero. The carbon released from the combustion of biomass material is already in the present carbon cycle, as opposed to coal or oil based carbon, which is reintroduced to the carbon cycle after millions of years of sequestration.

Fuels Summary



Fuel Type	Heating Value (BTU)	2003 Cost ($)	Heat Unit Cost ($/MMBTU)
Wood Chips-40% Moisture	5100 btu/pound	20/ton	$ 1.96
Natural Gas	900 btu/standard cubic foot	6.81/MMbtu	$ 6.81
Pellets	8200 btu/pound	70/ton	$ 4.27
Fuel Oil	140,000 btu/gallon	0.97/gallon	$ 6.93
Propane	90,502 btu/gallon	0.85/gallon	$ 9.39
Electric	3413 btu/kwh	0.039/kwh	$11.43

Some special considerations need to be taken into account when considering a Biomass Energy program (multiple projects in an area) or a single Biomass Project:

Some Basic Biomass Program Considerations:

- Is there a significant, sustainable need for Forest Treatment?
- Is there an existing timber industry able to process and deliver the wood fuel?
- What is the potential market within a reasonable haul range?
- Are there Commercial and Institution buildings that may benefit from biomass system energy cost savings?

- What conventional fuel sources are available, and what is their relative cost?
- What is the local enthusiasm?
- Local ability to consider new ideas.

Biomass Heating Technologies

The technologies available to produce automated heating energy from wood based biomass are varied in their approach, but largely can be separated into two types of heating plant; wood chip and pellet fueled. For this assessment only wood chips were analyzed. Particular acknowledgement should be paid to Messersmith Manufacturing and King Coal Furnace Corporation for their assistance in developing concepts, costs, and project models.

Wood Chip System Summary

Two types of wood chip boiler plants were considered for this assessment.

The first concept is developed with an on-grade chip storage method instead of the below-grade systems used in Darby, Montana and typical of systems in the New England. The system is housed in a building of slab on grade construction. Chips would be unloaded from a live floor van onto the storage floor as the van pulls slowly out from the space. A live auger would traverse the floor to dispense chips to the belt conveyance system on the opposite side of the bin wall. From the belt conveyor, the chips are transferred to a fuel metering bin and auger. The boiler room would be set two feet in elevation below the chip storage to allow for the conveyance equipment.

The second concept utilizes a prefabricated fuel storage bin and chip conveyance equipment and, up to 5MMBTUH capacity, a prefabricated boiler room. The chips are unloaded directly into the storage bin by backing the chip van into the bin and unloading the chips as the truck slowly pulls out. Chips are conveyed from the bin to a fuel-metering conveyor (twin screw auger) by hydraulic floor wedges, which gradually move the fuel supply into the auger and eventually the furnace. From the fuel-metering conveyor, the fuel moves through an air lock to the furnace stoker auger where it is delivered to the furnace for combustion. After the products of combustion leave the boiler, they pass through a multicone separator to remove suspended particulate. Schematics of this system type are available in the Biomass Information Appendix.

Independent of system type, wood chip systems have distinct advantages and disadvantages:

<u>Advantages of the green chip system:</u>

1. Readily available fuel sources, such as hazardous fuel reduction residue, could be integrated on site with the involvement of only a local treatment and chip supply contractor.

2. The technology would be more of a known quantity than others would after the Darby, Montana job is complete.

3. The installation is fully indoors, minimizing the aesthetic effect on the school and surroundings.

Disadvantages of the green chip system:

1. In some sizes the initial capital cost of these systems is high compared to pellet systems.

2. The quality, moisture content, heating value, and consistency of chip fuel can be highly variable.

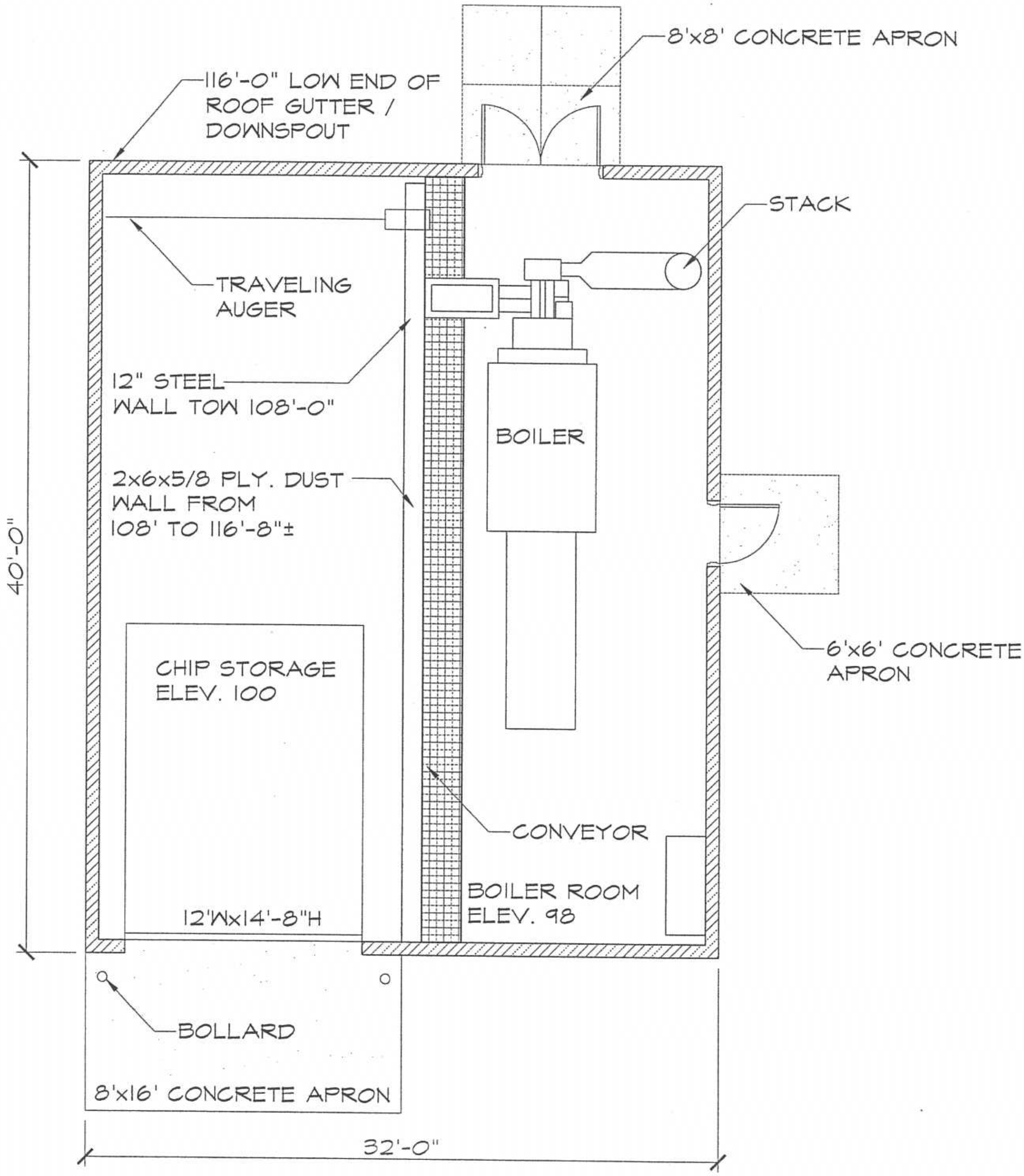
3. Depending on this fuel quality, the material conveyance portion of this system is susceptible to disruptions.

The sizes of the green chip storage, material handling, and boiler are large. This requires additional building be built, further increasing an already high capital cost.

Air Quality Permitting

In the State of Idaho the biomass boiler plants will likely require an air quality permit from the Department of Environmental Quality (DEQ). DEQ is primarily concerned with emissions of carbon monoxide (CO), sulfur oxides (SOx), nitrogen oxides (NOx), volatile organic compounds (VOC's), and particulate matter (PM). This permit is called a "Permit To Construct" (PTC) and it has an application fee. If the project is approved, the project will also have annual fees. The annual fee is dependent on the amount of emissions the plant can theoretically produce in one year.

In wood fired combustion, CO and PM are by far the pollutants produced in greatest amount relative to the other pollutants listed above. Preliminary calculations were performed and it is estimated that the annual fees for this project will be $2500. The permitting process is a public process, so there will be public review and public comment periods. The application process takes a minimum of 30 days and can take as long as 120 days. Once in operation, source testing will also be required at the initial start-up and then at periodic intervals (every one to five years).



1
A100

PROTOTYPE BOILER PLANT BUILDING

1/8" = 1'-0"

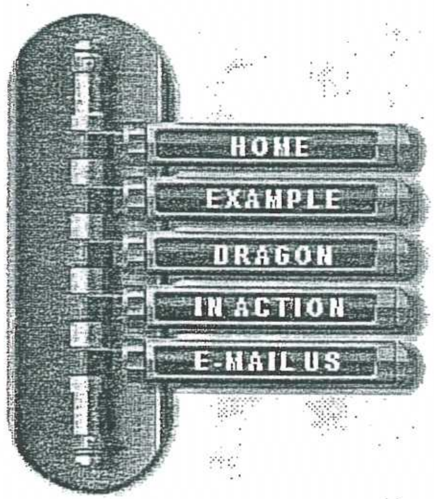
Drawn By________ Checked By_______ Date__________ CTA # ________ Cadd File: ______	CTA ARCHITECTS ENGINEERS BILLINGS • MISSOULA BOISE • GREAT FALLS HELENA • KALISPELL SPOKANE architects engineers 1500 Poly Drive, Box 1439 Billings, Mt 59103-1439 (406)248-7455 Fax(406)248-3779	ADDENDUM # SHEET #

MESSERSMITH MANUFACTURING INFORMATION

Messersmith

Industrial Conversion Combustion Systems

Messersmith Manufacturing, Inc.
2612 F Road
Bark River, MI. 49807
906-466-9010
Fax 906-466-2843
sales@burnchips.com



The Messersmith system takes you one step beyond the traditional woodburning stove.

An automatic BIOMASS fuel system custom designed for the unique needs of your location.

THE COST SAVING MESSERSMITH COMBUSTION SYSTEM

The Messersmith Institutional and Industrial Combustion System

- **Hopper sized according to your needs and limitations.**
- **Factory installed on your site.**
- **Firing wood chips, sawdust, or other particle biomass fuels.**
- **Burn clean and efficient.**
- **Heating outputs from 1,000,000 to 20,000,000 B.T.U.H.**
- **Converts many boilers and furnaces.**

Is designed to minimize overall operating costs. Wood fueled heating systems are expensive, and this expense must be balanced by the savings that these systems can produce in the long term. Our system is designed to lower operating costs in the following ways:

- Relatively Low First Cost
- Simplicity of Maintenance and Repair
- High Fuel Efficiency and Versatility in the Fuel Choice
- Low Electrical Energy Consumption

Please allow us to explain briefly how our system achieves these results

these results.

Relatively Low First Cost

Messersmith Systems are usually priced below those offered by competing manufacturers. This is because our systems are as simple as possible, without sacrificing reliability, performance, or safety. Unique features of the Messersmith system that contribute to its low first cost are the traveling auger bin unloader and direct combustion burner. The traveling auger eliminates the need for costly hydraulic system, required with wedge floor unloading systems, and reduces bin construction cost. The direct combustion burner operates to atmospheric pressure, avoiding the cost of rotary air locks and induced draft fans used in gasifier-based systems.

Simplicity of Maintenance and Repair

The Messersmith System is designed and built to be reliable and easy to maintain and repair. Most of the mechanical and electrical components of our system are obtainable directly from W.W. Grainger, which has nation-wide distribution, usually on a next day basis. The Messersmith System is simple; therefore, maintenance and repairs can be easily and quickly carried out. Often maintenance personnel become so familiar with our systems during the warranty period that there is practically no need for subsequent professional servicing.

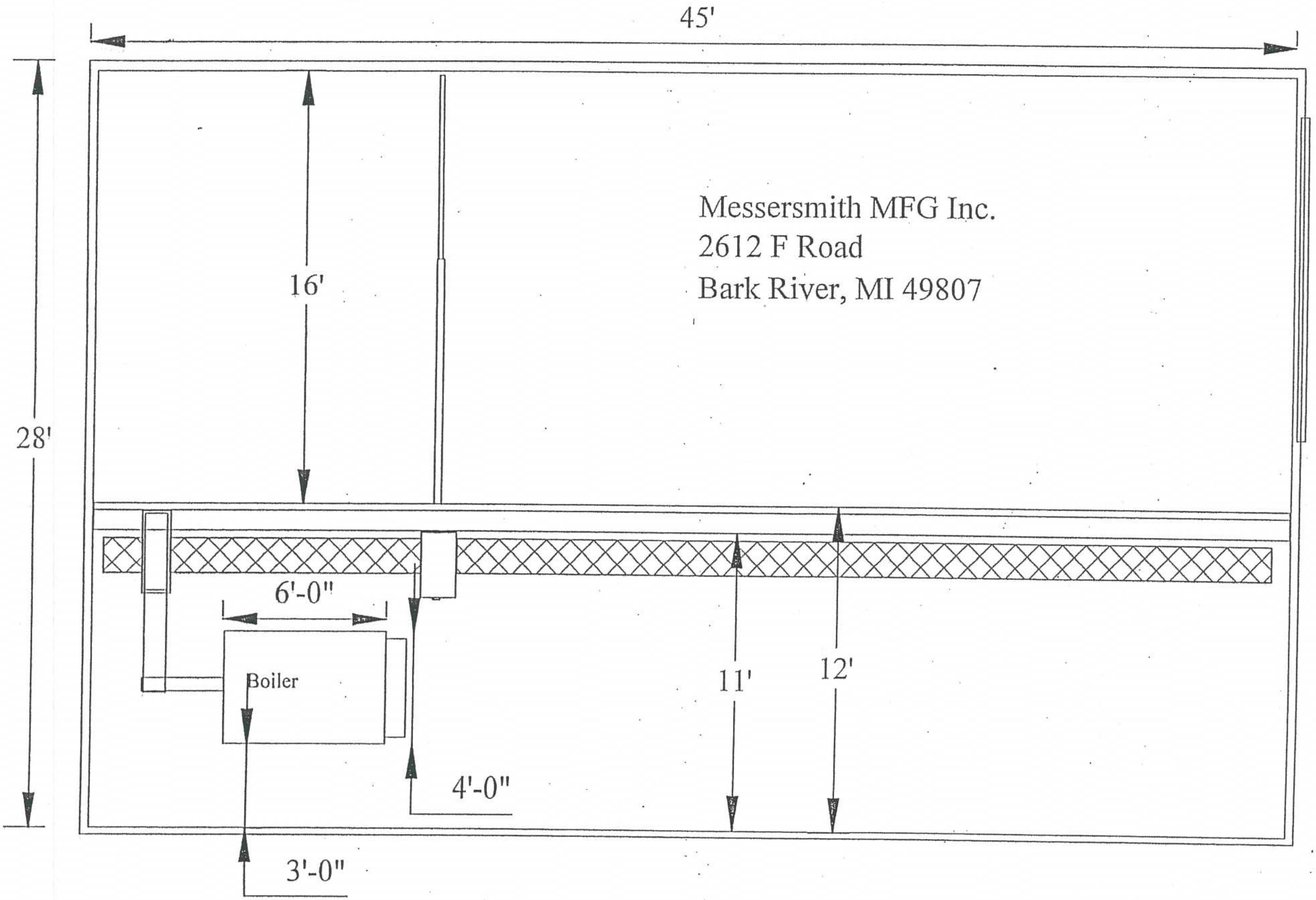
High Fuel Efficiency and Versatility in Fuel Choice

The Messersmith System is very efficient and clean burning. Larger Messersmith Systems provide modulated fuel and air supply to the combustor, providing the correct ration and placement of fuel and air for efficient, smoke free combustion over the full range of heat output. Automatic flue cleaning systems are a standard feature of our systems, maintaining maximum transfer of heat to the boiler with no operator attention. While the use of natural draft from a properly sized (larger) chimney enables our system to minimize its electrical consumption, we can also supply a cyclone ash separator to minimize ash emissions from the stack.

Messersmith Systems perform more reliably than many other wood chip systems when burning whole tree chips. Its reliability is directly attributable to the simplicity of the fuel flow path to the boiler, including the absence of rotary air locks. Its reliability has recently been further improved by the use of conveyor belts instead of augers to move fuel from the chip storage bin to the metering bin. Conveyor belts are not susceptible to jamming from oversized chips, use less electric power, and are quieter than augers. The ability to burn whole tree chips is an advantage of the Messersmith System that is apt to get more important with time as the demand for high quality mill residue chips will eventually exceed the supply.

Low Electrical Energy Consumption

The Messersmith System is remarkably efficient in its use of electricity. When operated under natural draft, the electricity use of a 1 to 5 million BTU Messersmith System averages from one to two kilowatts. Its high electrical efficiency is due to the small number and size of electric motors employed. The largest motor on a natural draft system is the hopper auger motor, which is only 1.5 hp on the 1.5 million BTU system, and operates less than one hour per day under average winter conditions. A natural draft Messersmith System can be expected to consume less than one fourth of the electricity of a typical gasifier based system with induced draft fan. While an induced draft Messersmith with cyclone ash removal will consume about half of the electrical energy of a gasifier-based wedge floor system.


45'
28'
16'
Messersmith MFG Inc.
2612 F Road
Bark River, MI 49807
6'-0"
Boiler
11'
12'
4'-0"
3'-0"

KING COAL INFORMATION

King Coal Packaged Boiler Rooms With Fuel Storage

King Coal Furnace Corporation
PO Box 2161
Bismarck, ND 58502
Phone: 701-255-6406
Fax: 701-255-6916
E-Mail: kingcoal@btinet.net

KING COAL FURNACE CORPORATION

P.O. Box 2161
Bismarck, ND 58502
Phone: 701-255-6406 Fax: 701-255-6916 E-Mail: kingcoal@btinet.net

The King Coal prefab boiler room and fuel storage is the result of 23 years of knowledge gained by us in the wood and coal industry. King Coal has been building package boiler plants for schools, sawmills and kiln drying plants for years.

We have stoker fired boilers in Alaska, Canada, and North and South America.

The King Coal Advantage Is:

- Above ground operations- no ground water problems.
- The plant comes completely assembled, wired, plumbed, etc. Very minimal on site labor for assembly of fuel augers, ash removal, etc.
- No expensive construction required. Just a slab for boiler room and fuel storage, or only footings where permitted.
- Our stoker system will burn chips, sawdust and bark (50% moisture to dry) or wood pellets. All these fuels use the same equipment and fuel storage.
- We provide P.L.C./ V.F.D electronic control panels as standard equipment to provide maximum efficiency of combustion and proper turn down.
- Our prefab boiler plants are available from 50-250 HP, or to 500 HP with on site construction.
- Our stoker is a close coupled gasifier that sets under the boiler to take best advantage of radiant heat.

Wood fuel is augured up through a retort into a pile. The wood is pyrolyzed and the gas is combusted with secondary air. Its flame then enters the firebox of the boiler which is refractory lined, and includes an ignition arch for proper flame travel and retention time.

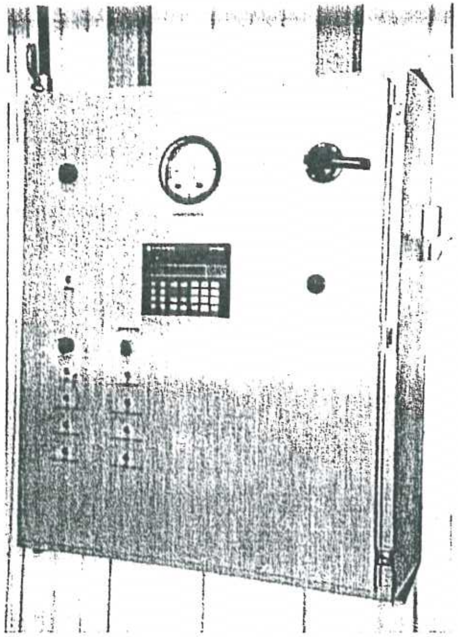
Primary and secondary combustion air is preheated for efficient and smokeless combustion.

- Construction time to delivery for our package plants can be as short as 90 days from receipt of order. This may vary depending on the time of season and work backlog.

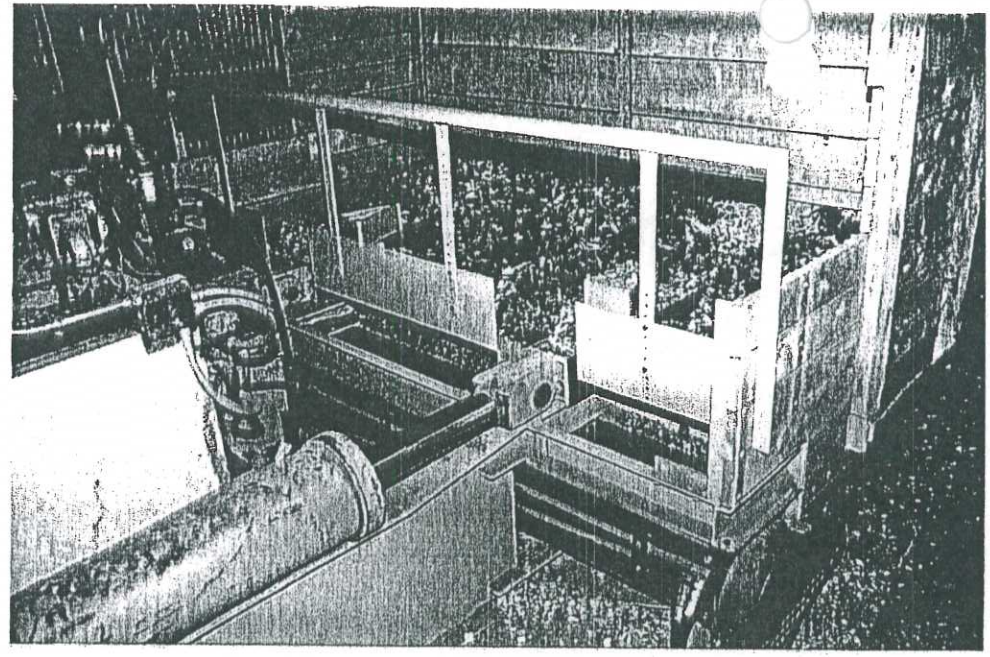
- All systems come with multi-cone dust collection. Our stoker is designed to burn the gas produced by the wood fuel. No suspension burning occurs, so very little particulate and char escapes the boiler. Fly ash that does escape is collected and sent to ash storage.
- All stokers are equipped with automatic ash removal, which consists of an in-base cross auger with integral incline drag chain conveyor.
- All boilers come equipped with soot blowers, eliminating the need for manual brushing of the tubes. The benefits are maximum heat absorption in the convective tube section of the boiler and no shut downs for manual cleaning.
- Our package boiler and fuel storage plants are your best value. No one can block and brick build a boiler room, wire, plumb, install controls on-site, plus the other work required to complete a project and come close to our price.
- King Coal offers one source responsibility, no excuses or reasons why it's some one else's problem.
- All plants come with a prefab, insulated chimney.
- Start-up procedures and operator training are included.
- We can also provide current low interest financing to qualified buyers.

Thank you for your time in reviewing this information. If you have a project that you feel could utilize our equipment, please notify us and we can discuss the details of your particular facility.

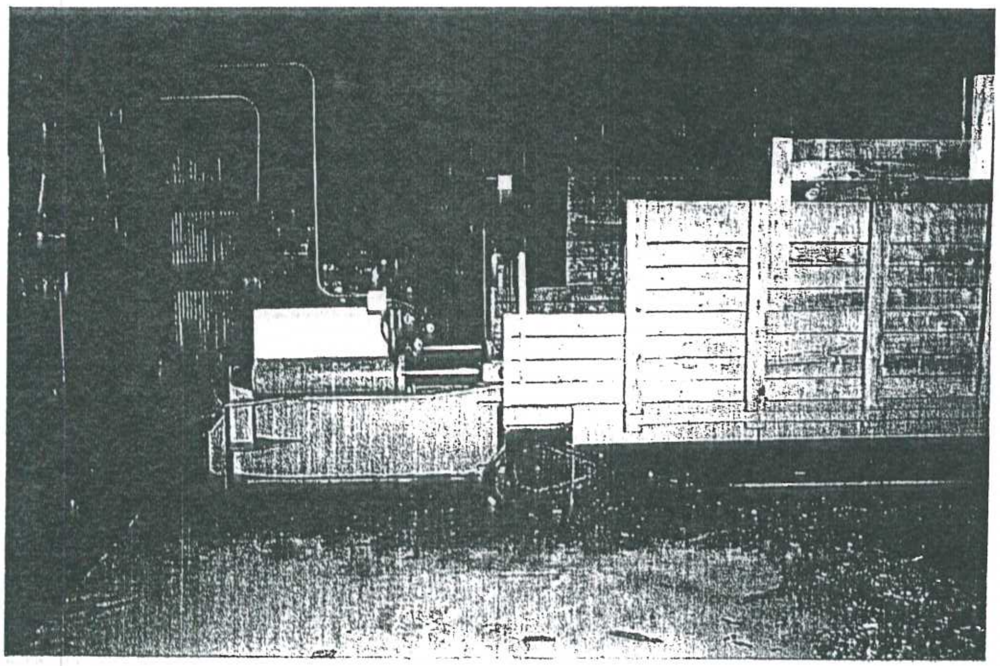
MICHAEL F. ROBB
President
King Coal Furnace Corporation



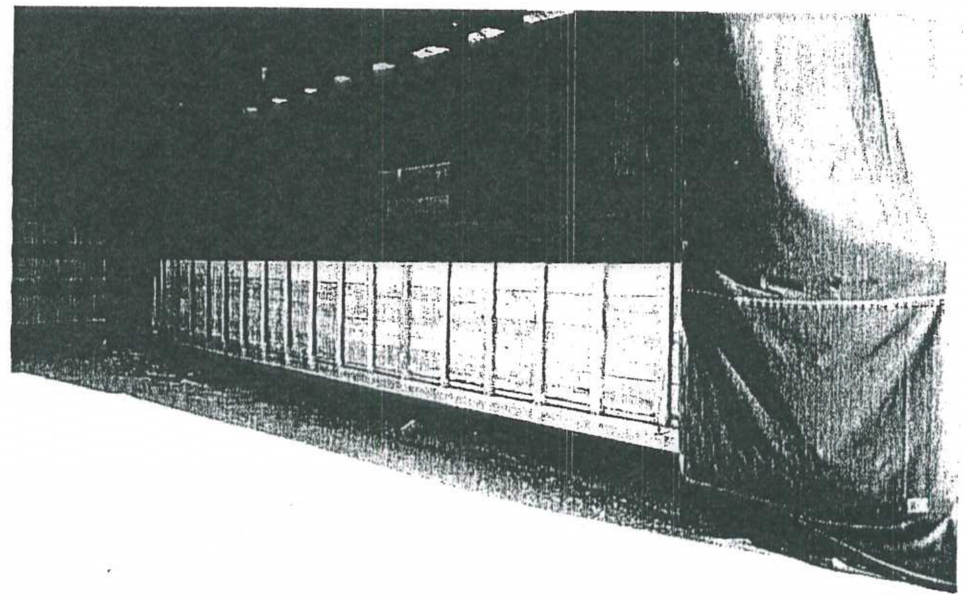
P.L.C. & VFD CONTROL PANEL

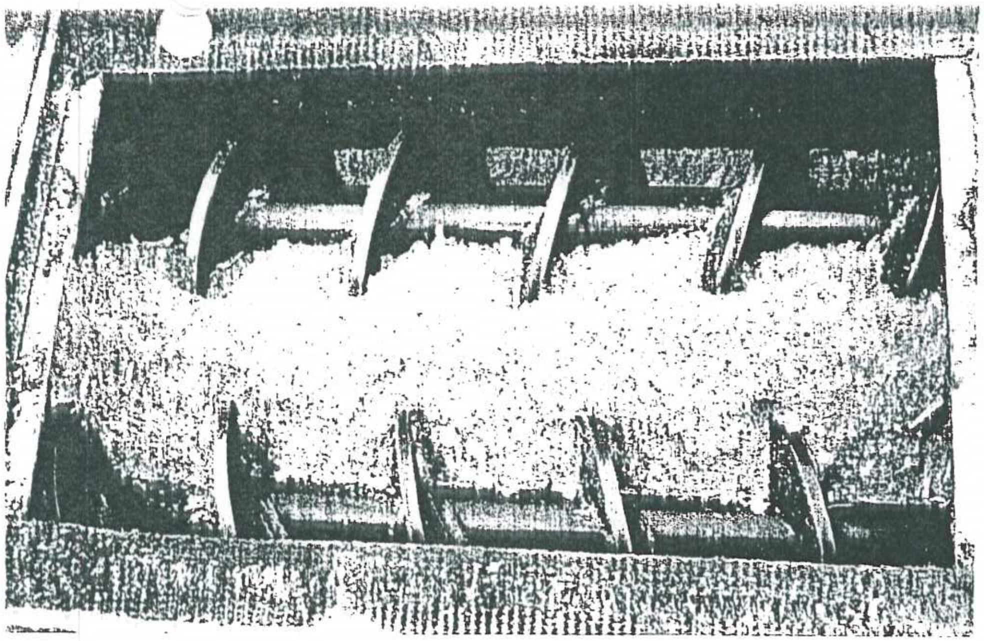


PORTABLE FLOOR SCRAPE FUEL STORAGE

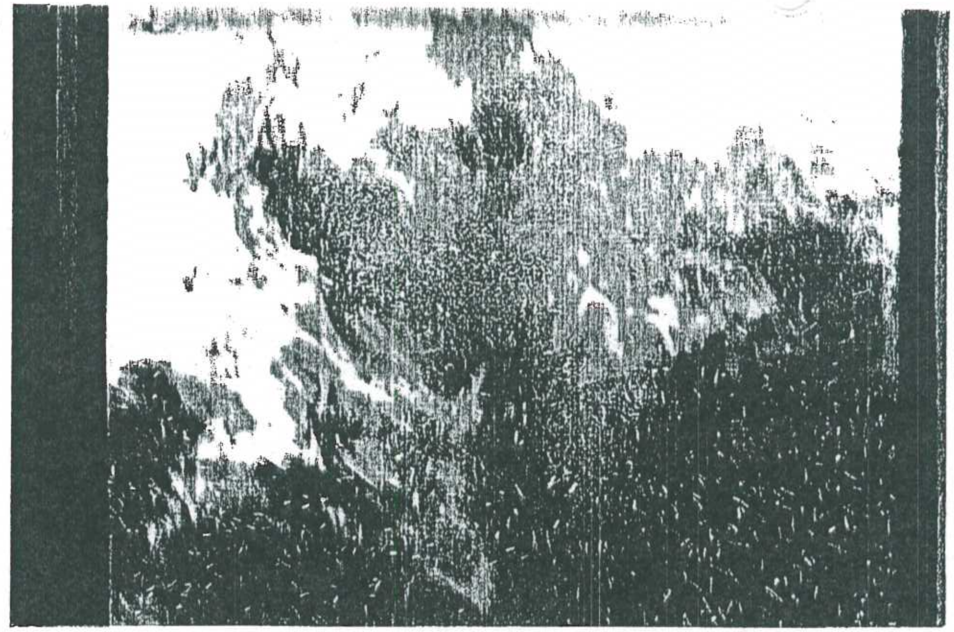


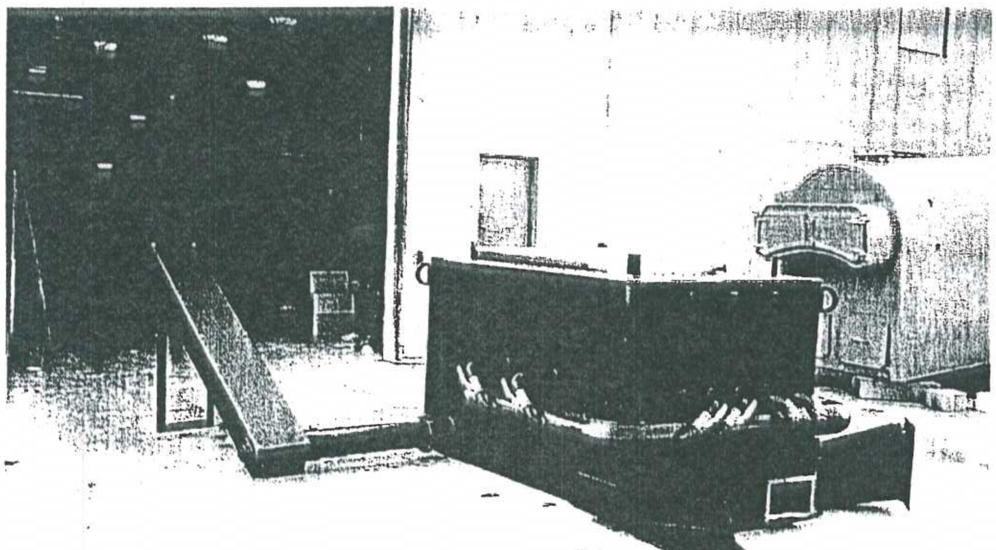
FUEL IS PULLED INTO CROSS AUGER
THEN FED TO BOILER

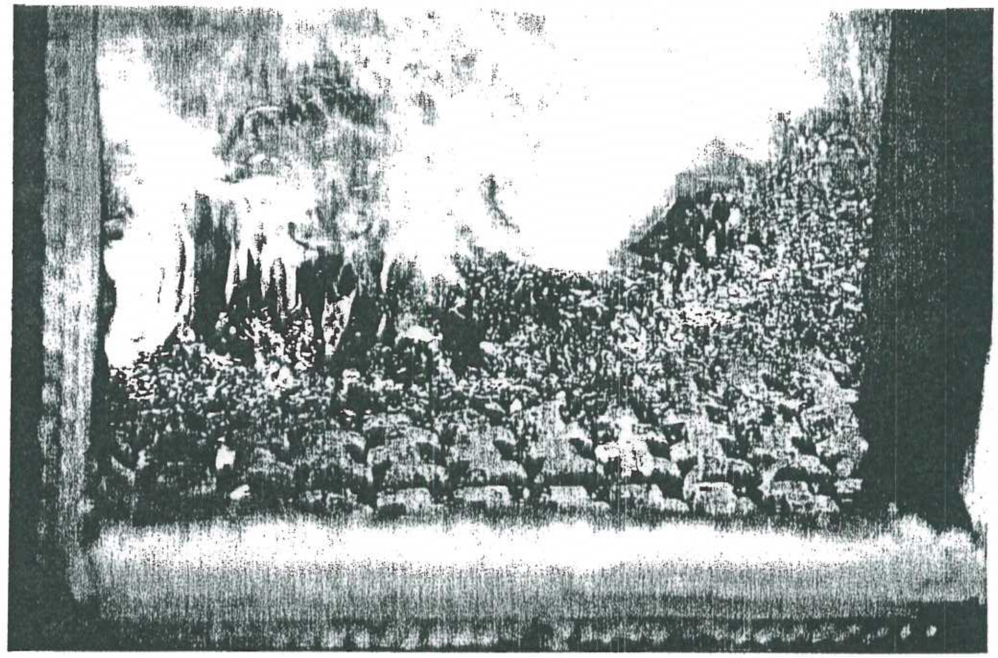




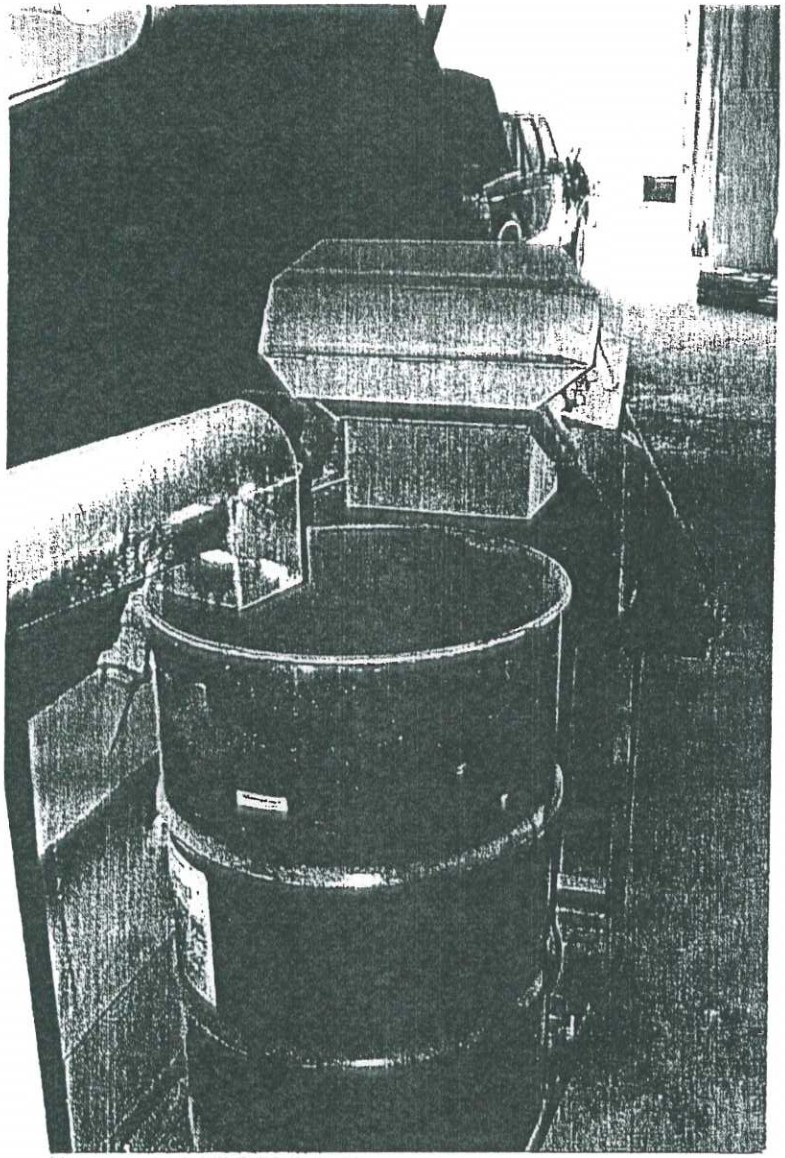
HYDRAULIC DRIVEN TWIN SCREW FUEL FEEDER



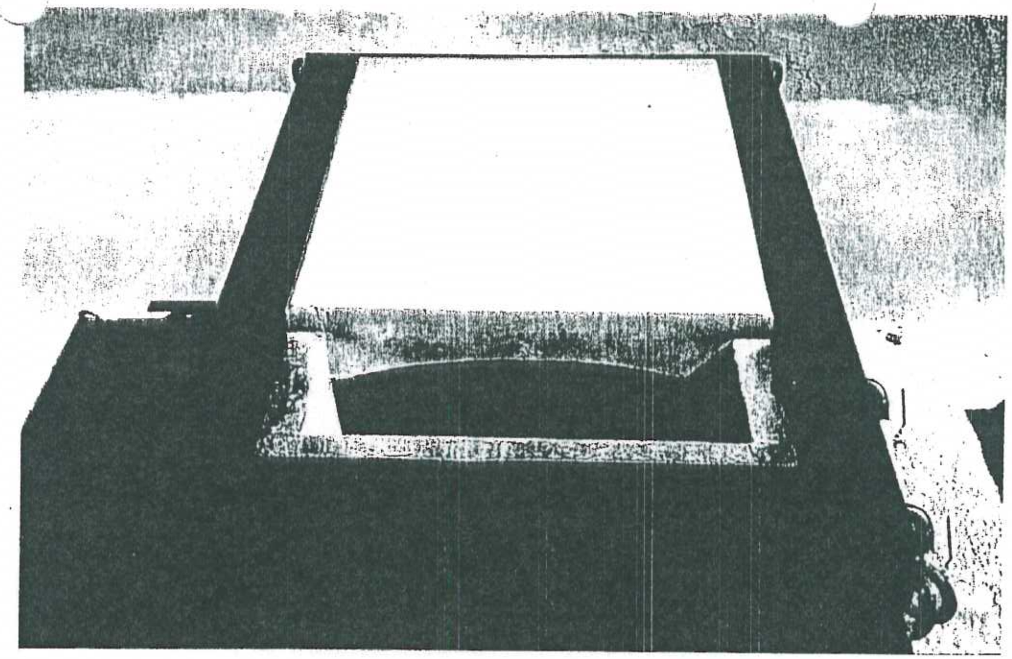




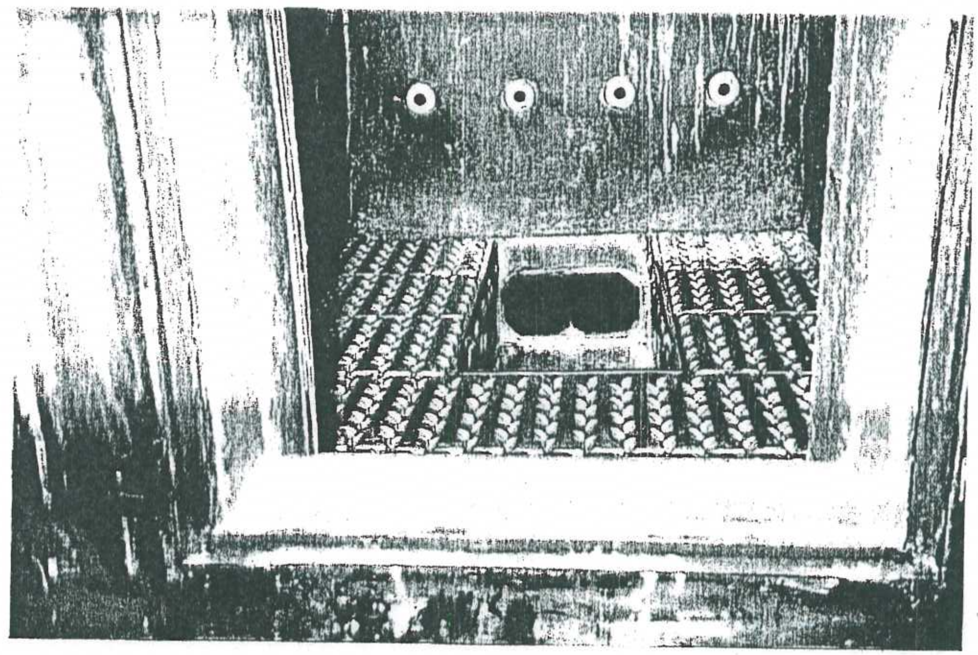
TYPICAL BURNER WITH OVER AND UNDER FIRE AIR
CROSS AUGER AND DRAG CHAIN ASH REMOVAL



TYPICAL ASH REMOVAL FROM STOKER & FROM MULTICONE COLLECTION ON BOILER SMOKE BOX OR WE CAN SUPPLY AN OPTIONAL ASHWAGON

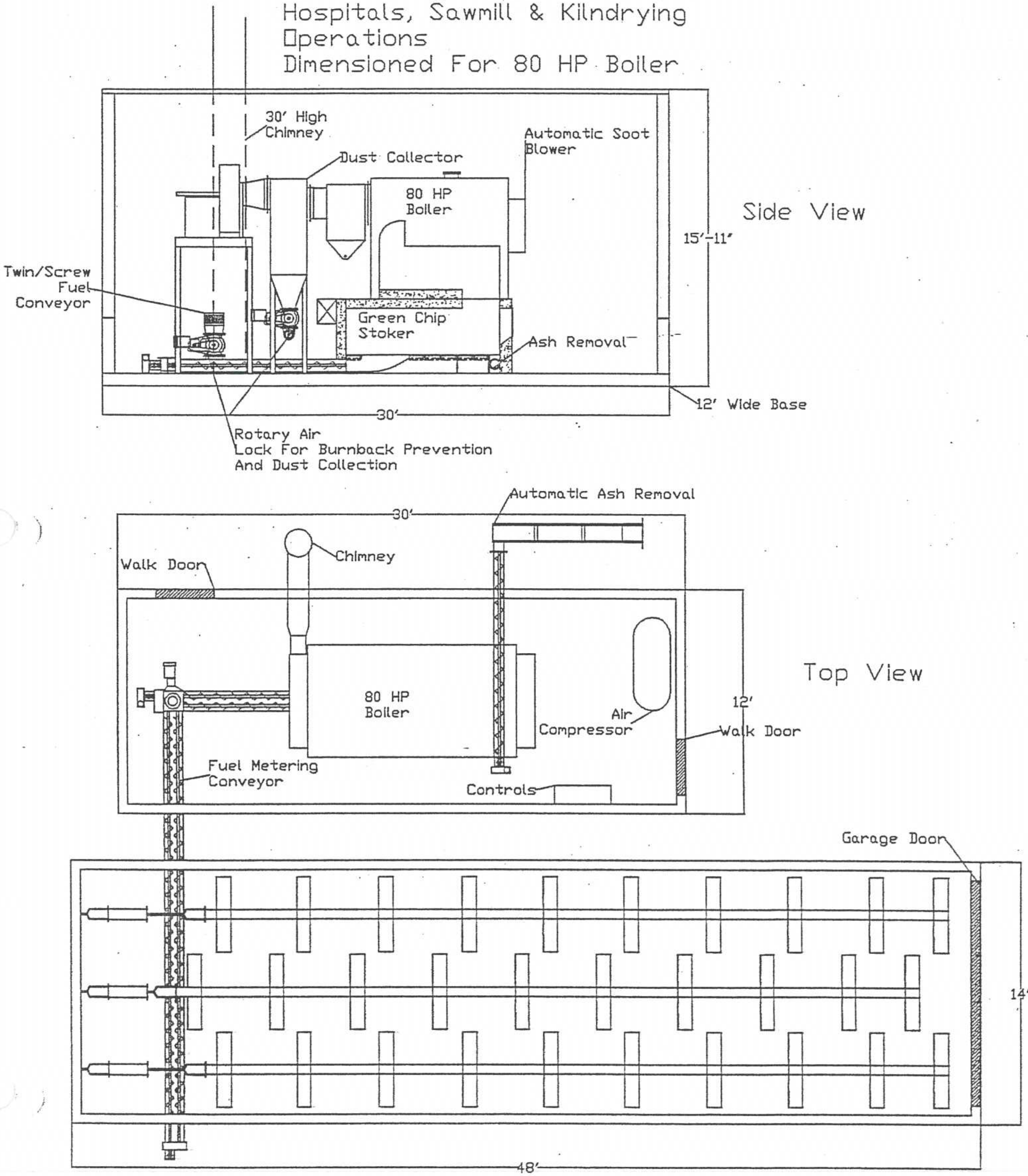


OUR COMBUSTION CHAMBER WITH TOP COMBUSTION ARCH

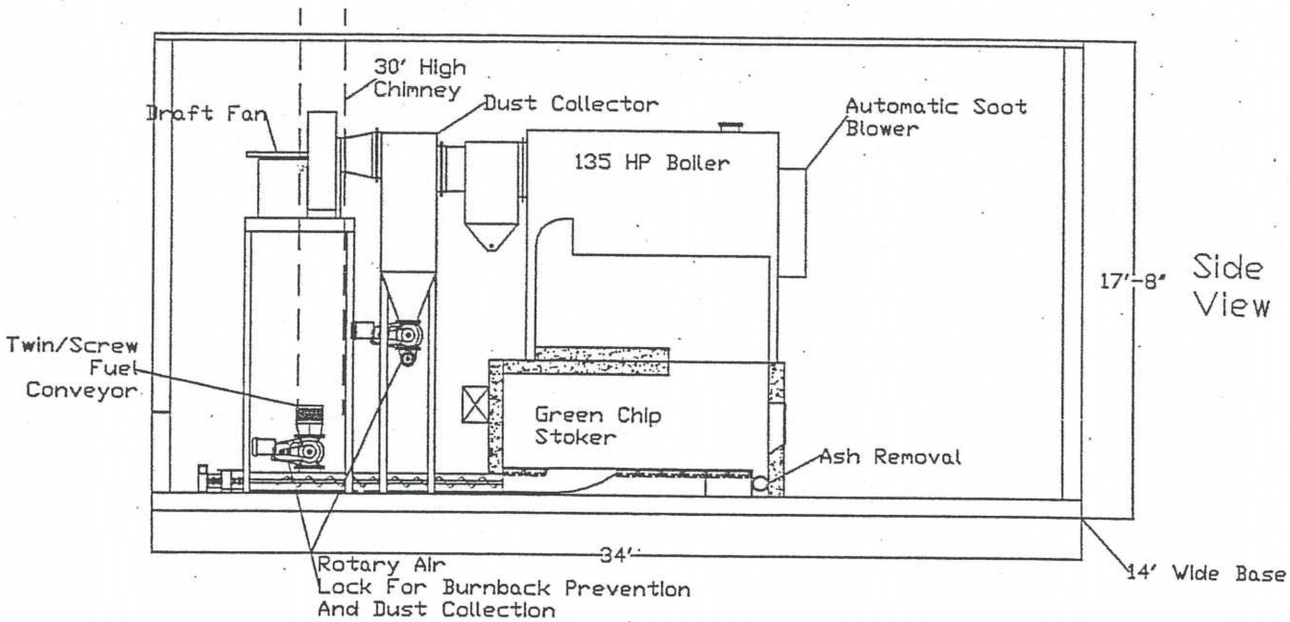


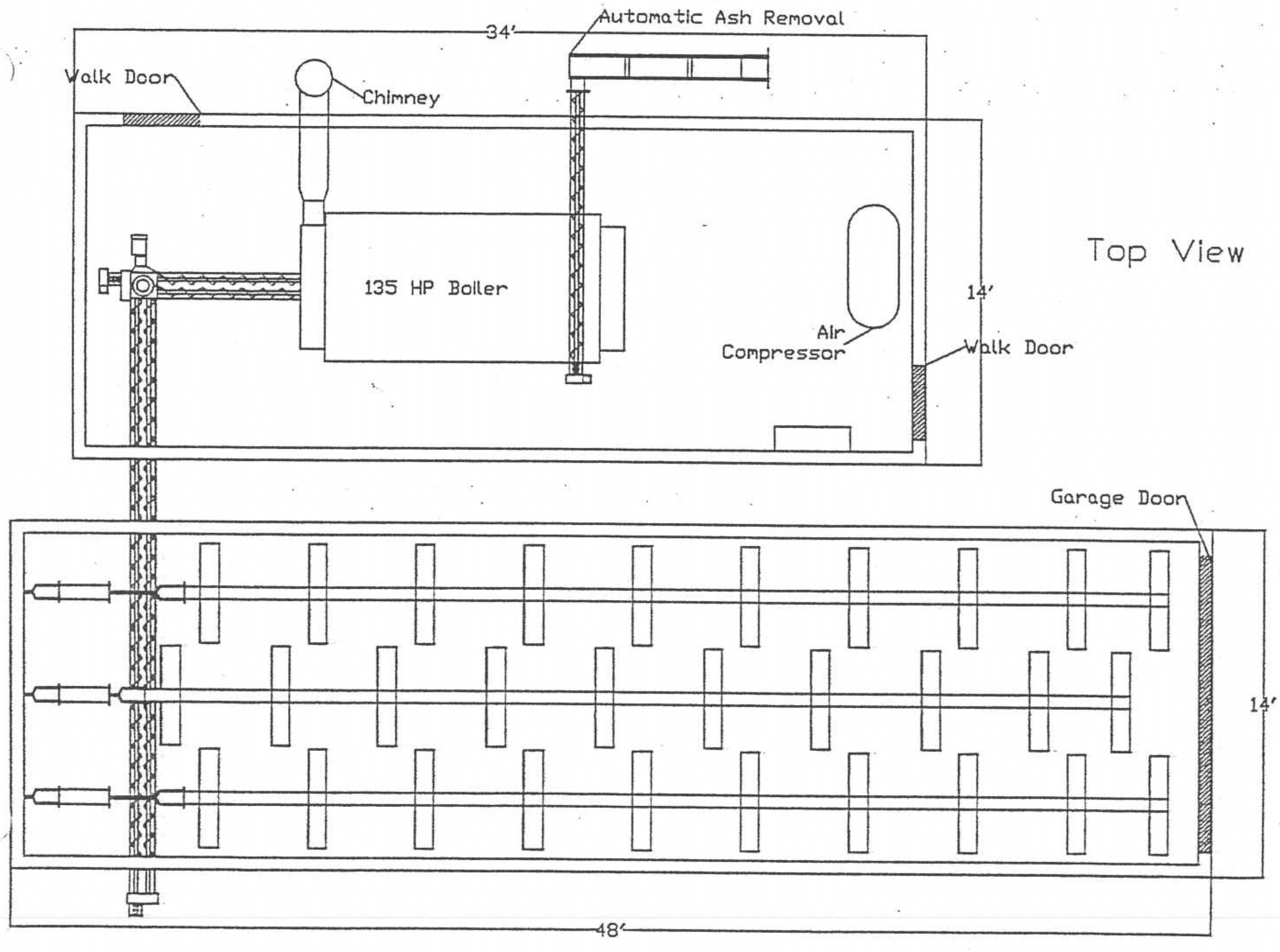
STOKER TUYERES, RETORT & OVER FIRE AIR JETS

King Coal Package Boiler Room With Fuel Storage- For Schools, Hospitals, Sawmill & Kilndrying Operations Dimensioned For 80 HP Boiler

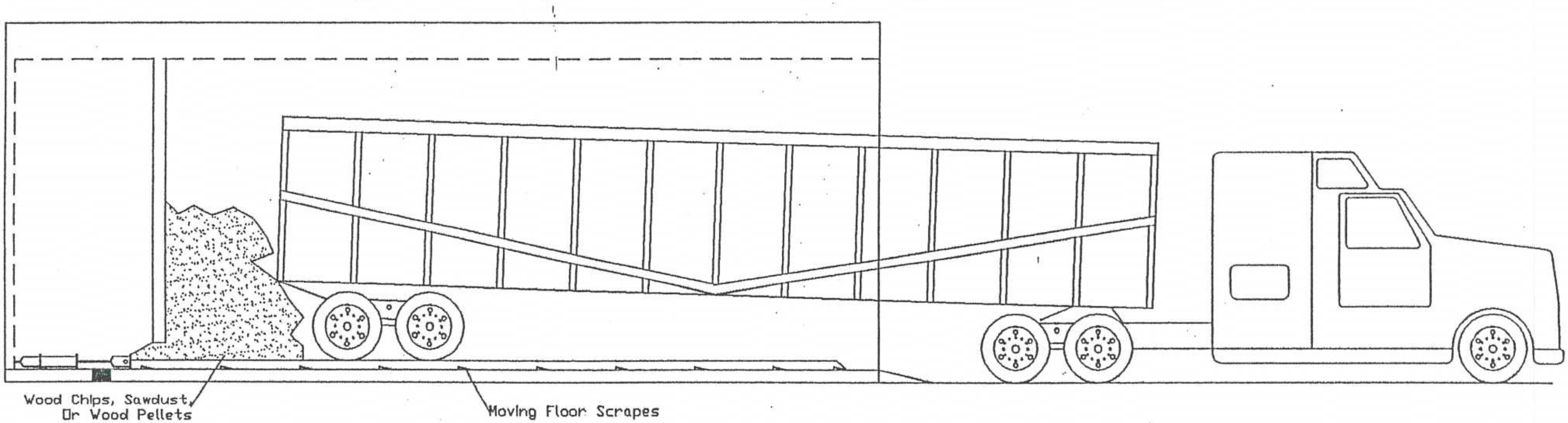


King Coal Package Boiler Room With Fuel Storage- For Schools, Hospitals, Sawmill & Kilndrying Operations
Dimensioned For 135 HP Boiler

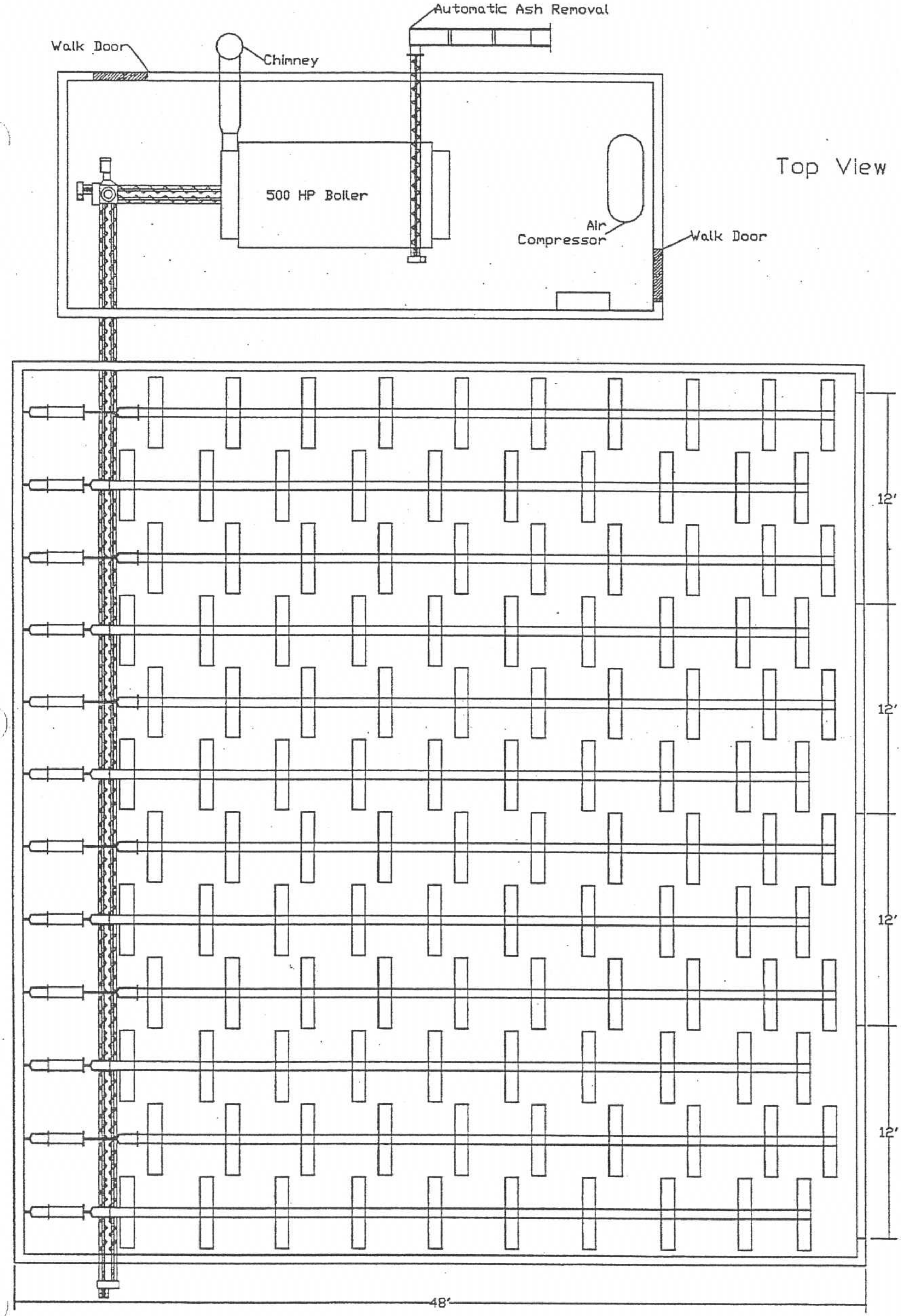




King Coal Floor Scrape Fuel Storage Prefab Building. These Storage Buildings Can Be Built 8'-10'-12'-14' Wide & 48' Long Or Can Be Ganged Together Side By Side For Greater Capacity.



The King Coal Advantage Is: You Can Back Your Fuel Delivery Truck On To The Floor Scrapes & Unload In The Building



4 Of Our Modular 12' By 48' Floor Scrape's
Combined To Make a 48' By 48' Building

May 29, 2003

Mr. Dan Stevenson
CTA Inc.
1500 Poly Drive
P. O. Box 1439
Billings, MT 59103
Phone: 406-896-6171 Fax: 406-248-3779
Cell: 406-670-8222 E-mail: dans@ctagroup.com

BUDGET QUOTATIONS: Eureka Public Schools
Prefabricated Boiler Plants and Fuel Storage Facilities
(Fuel – Green Wood Chips)

SPECIFICATIONS:

Elementary and Middle Schools

Prefabricated skid mounted boiler room (12' wide, 30' long, 16' high - nominal size)
Contents include the following equipment and accessories:

- 80-HP steel fire tube boiler with factory installed trim and controls. Accessories include, manually operated soot blower, air compressor, refractory lined base with built-in stoker assembly, ash removal, dust collector, draft inducing fan, chimney, and PLC control system.

Prefabricated fuel storage facility (14' wide, 48' long, 17' high - nominal size)
Contents include the following equipment and accessories:

- Hydraulic floor scrape unloading system with twin-screw fuel metering conveyor that transports fuel to the adjoining stoker system. The interior walls shall be lined with wood planks. A hot water piping system shall be incorporated into the wall liner to provide heat to the storage facility. This heating system shall be connected to the stoker fired boiler. The storage facility shall be equipped with an overhead door to allow the fuel supply truck to back into the storage area to unload.

The above equipment is fabricated under strict quality control at KING COAL's manufacturing plant. Both the boiler room and fuel storage facility are modular structures that are designed for portability. This eliminates delays and field fabrication problems associated with on-site construction.

Budget cost **Elementary** and **Middle Schools** is **$530,000.00** ($265,000.00 each) +15,000 each for backup burner
plus shipping and any applicable taxes

BUDGET ESTIMATE

KC COST PER ABOVE -	$265,000
ADD FOR SHIPPING	$15,000
ADD FOR BACKUP BURNER	$15,000
	$295,000

High School

Prefabricated skid mounted boiler room (14' wide, 34' long, 18' high - nominal size) Contents include the following equipment and accessories:

- 135-HP steel fire tube boiler with factory installed trim and controls. Accessories include, manually operated soot blower, air compressor, refractory lined base with built-in stoker assembly, ash removal, dust collector, draft inducing fan, chimney, and PLC control system.

165 BHP Kewanee "Mint Condition"

Prefabricated fuel storage facility (14' wide, 48' long, 17' high - nominal size) Contents include the following equipment and accessories:

- Hydraulic floor scrape unloading system with twin-screw fuel metering conveyor that transports fuel to the adjoining stoker system. The interior walls shall be lined with wood planks. A hot water piping system shall be incorporated into the wall liner to provide heat to the storage facility. This heating system shall be connected to the stoker fired boiler. The storage facility shall be equipped with an overhead door to allow the fuel supply truck to back into the storage area to unload.

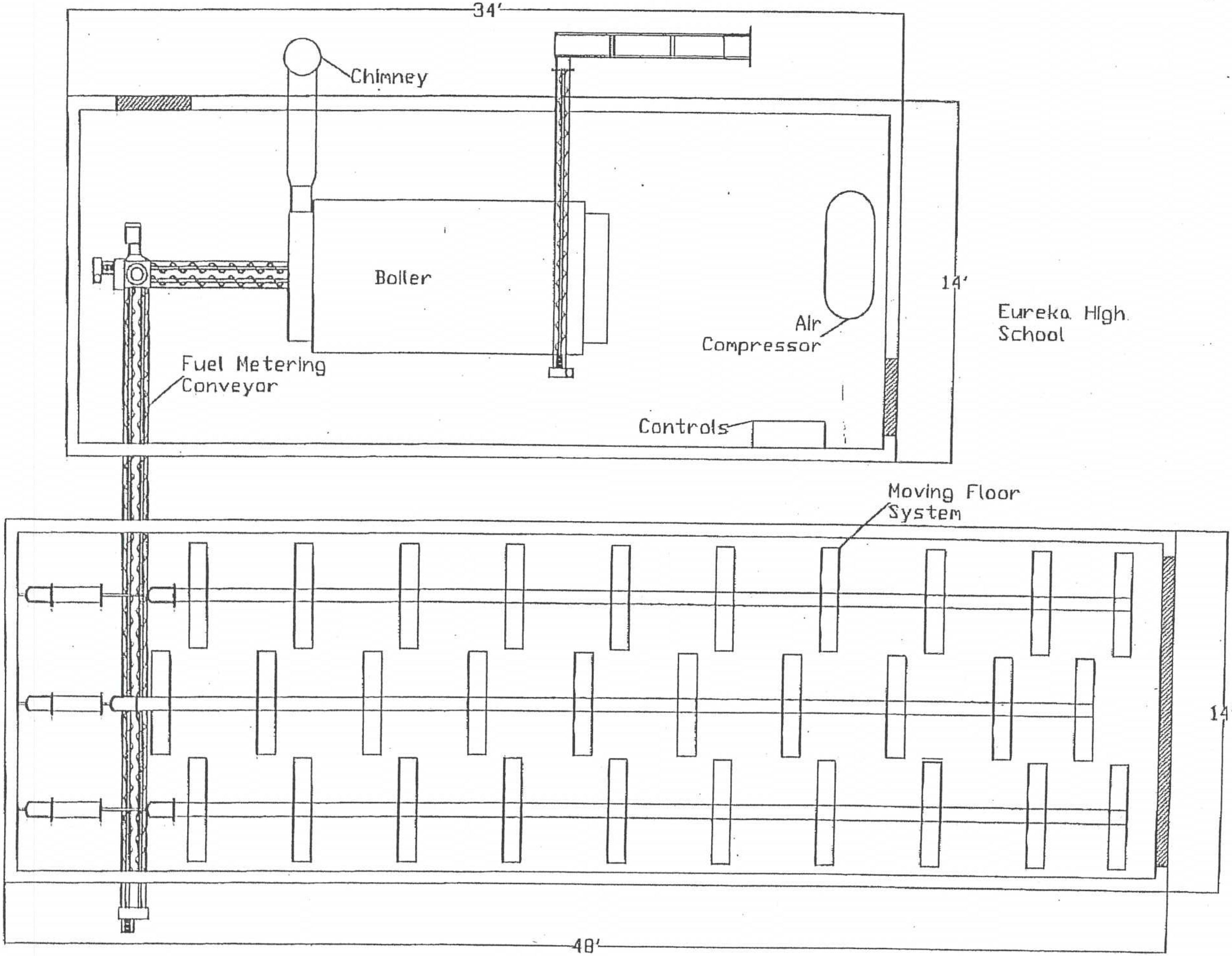
The above equipment is fabricated under strict quality control at KING COAL's manufacturing plant. Both the boiler room and fuel storage facility are modular structures that are designed for portability. This eliminates delays and field fabrication problems associated with on-site construction.

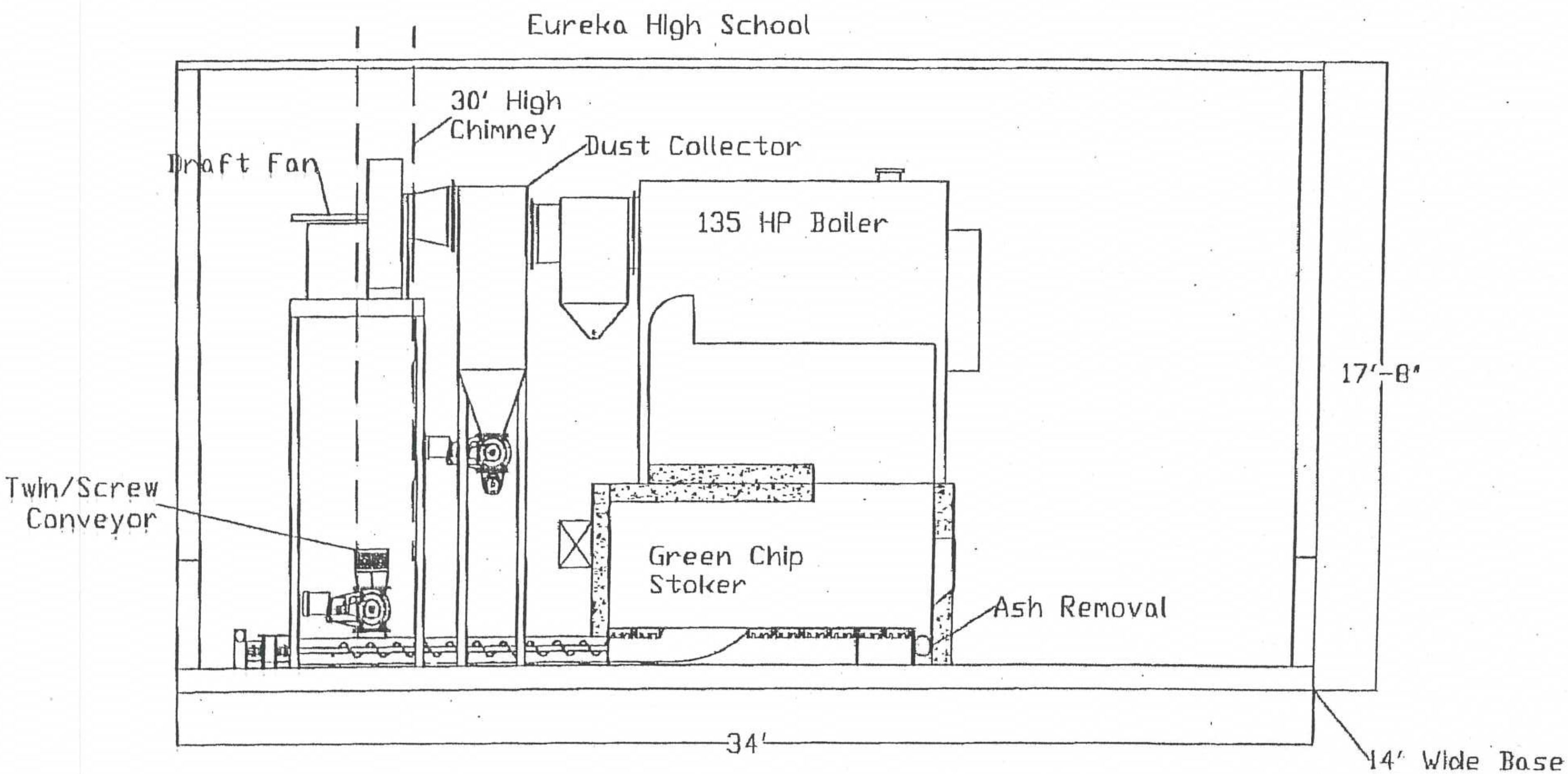
Budget cost for the **High School** equipment package is **$315,000.00.** +15,000 (Backup Burner)
plus shipping and any applicable taxes

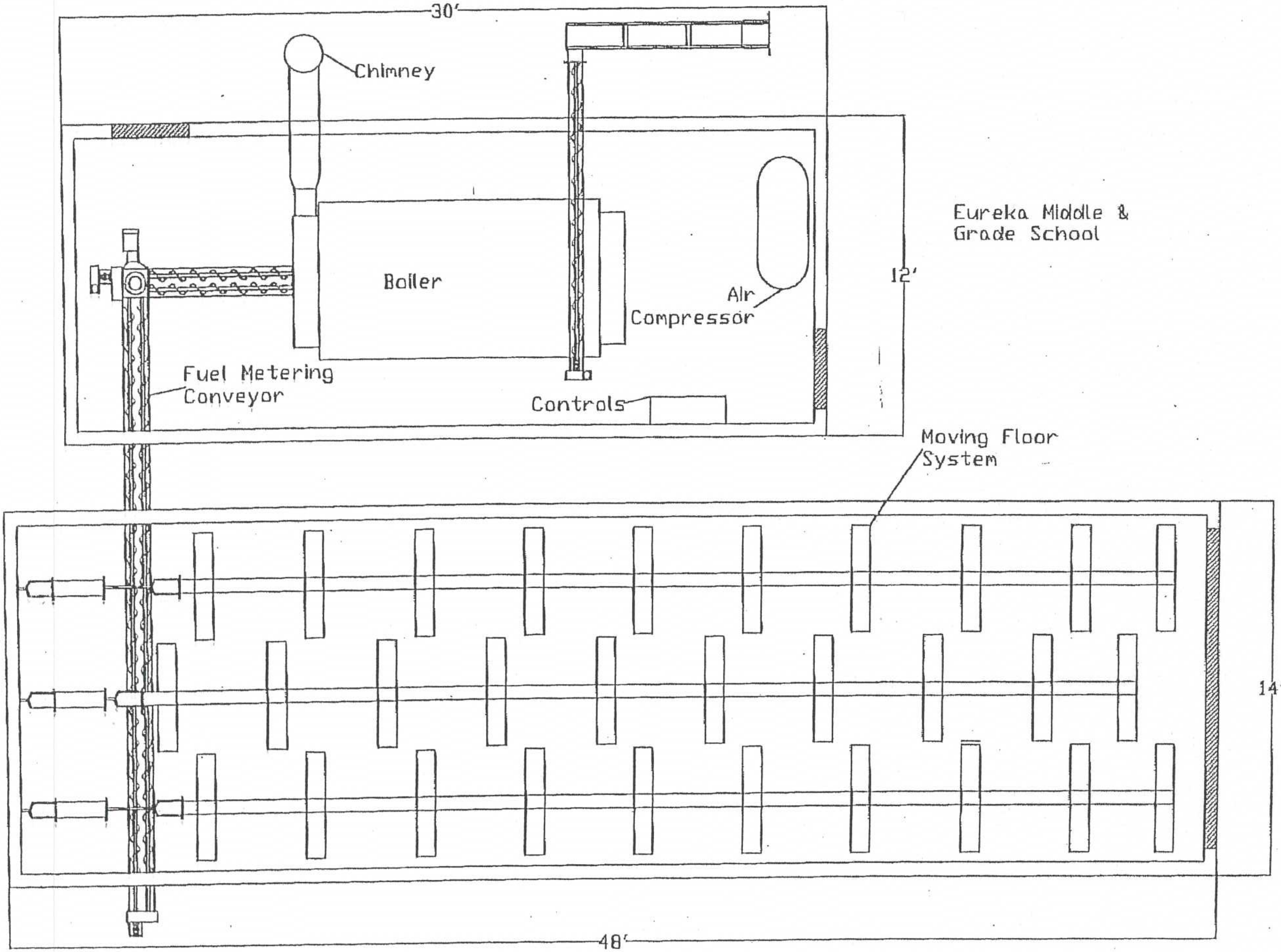
10 mmBTU 500-600

Following are several drawings that depict the equipment packages for the above project. Please feel free to contact Mike Robb or myself if you have any questions.

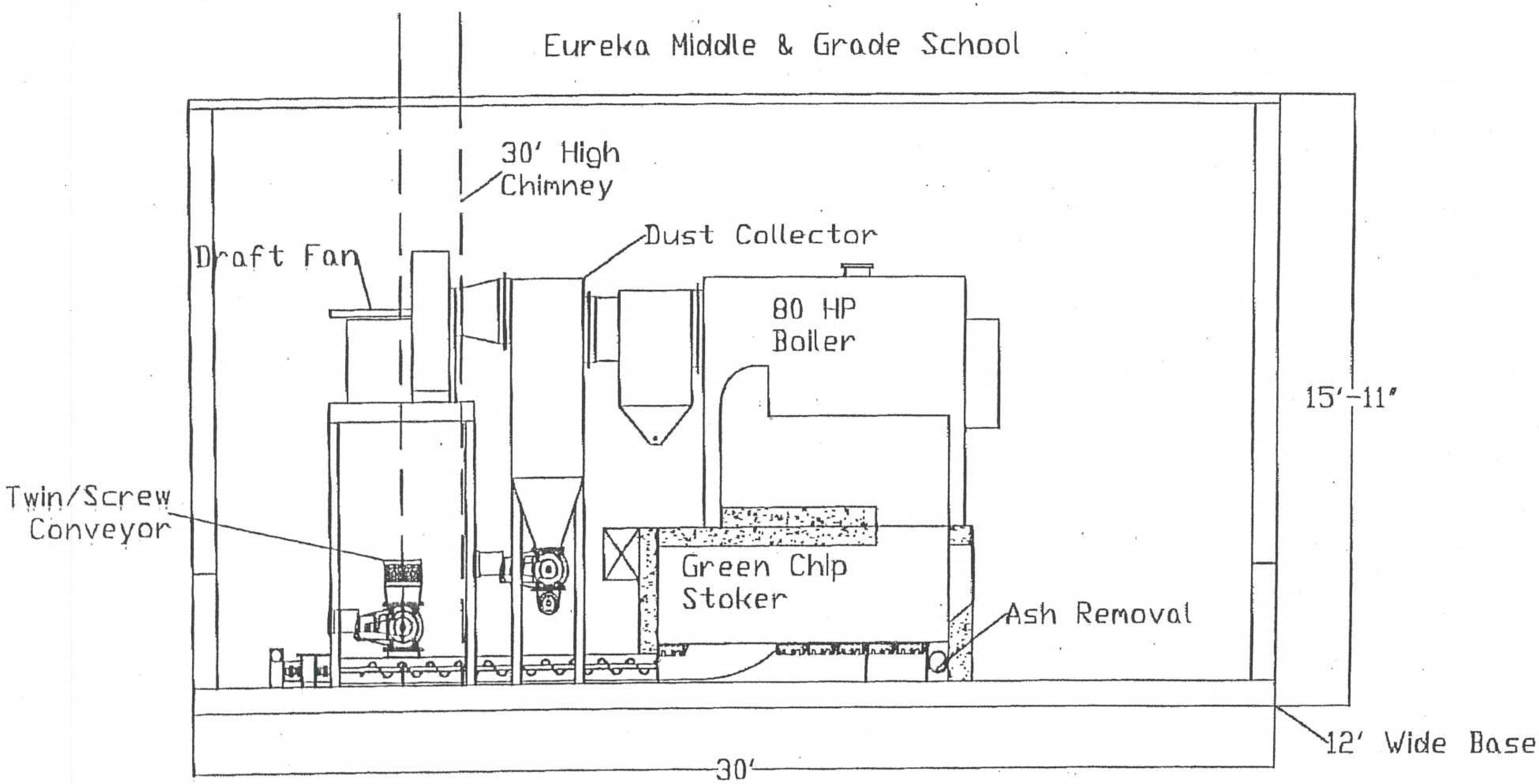
BUDGET ESTIMATE	
KC COST PER ABOVE -	$315,000
ADD FOR SHIPPING -	$10,000
ADD FOR BACK UP BURNER -	$15,000
ADD FOR BFW SPACE.	$10,000
BUDGET - 135 HP	$350,000


34'
Chimney
Boiler
Fuel Metering
Conveyor
Air
Compressor
Controls
14'
Eureka High
School
Moving Floor
System
14'
48'


Eureka High School
30' High Chimney
Draft Fan
Dust Collector
135 HP Boiler
Twin/Screw Conveyor
Green Chip Stoker
Ash Removal
17'-8"
34'
14' Wide Base



Eureka Middle & Grade School
30'
Chimney
Boiler
Air Compressor
12'
Fuel Metering Conveyor
Controls
Moving Floor System
14'
48'


Eureka Middle & Grade School
30' High
Chimney
Draft Fan
Dust Collector
80 HP
Boiler
15'-11"
Twin/Screw
Conveyor
Green Chip
Stoker
Ash Removal
12' Wide Base
30'

ENERGY DATA AND LOAD PROJECTION APPENDIX

Location	**Pinehurst, ID**	
Building owner		
Program user	**BRE**	
Company	**CTA**	
Comments		
By	**CTA Architects Engineers**	
Dataset name	**C:\calcs\Calcs\pinehurst\Pinehurst.TRC**	
Calculation time	**03:07 PM on 10/31/2003**	
TRACE® 700 version	**4.1**	
Location	**Polson, Montana**	
Latitude	**48.3**	**deg**
Longitude	**114.3**	**deg**
Time Zone	**7**	
Elevation	**2,490**	**ft**
Barometric pressure	**27.3**	**in. Hg**
Air density	**0.0693**	**lb/cu ft**
Air specific heat	**0.2444**	**Btu/lb·°F**
Density-specific heat product	**1.0162**	**Btu/h·cfm·°F**
Latent heat factor	**4,473.3**	**Btu·min/h·cu ft**
Enthalpy factor	**4.1574**	**lb·min/hr·cu ft**
Summer design dry bulb	**96**	**°F**
Summer design wet bulb	**63**	**°F**
Winter design dry bulb	**-18**	**°F**
Summer clearness number	**1.00**	
Winter clearness number	**1.00**	
Summer ground reflectance	**0.20**	
Winter ground reflectance	**0.20**	
Design simulation period	**January - December**	
Cooling load methodology	**TETD-TA1**	
Heating load methodology	**UATD**	

SYSTEM SUMMARY

DESIGN AIRFLOW QUANTITIES

By CTA Architects Engineers

		MAIN SYSTEM						
System Description	System Type	Outside Airflow cfm	Cooling Airflow cfm	Heating Airflow cfm	Return Airflow cfm	Exhaust Airflow cfm	Auxiliary System Supply Airflow cfm	Room Exhaust Airflow cfm
System - 001	Ventilation and Heating	0	0	36,580	0	8,019	0	0
System - 002	Ventilation and Heating	0	0	6,160	0	1,564	0	0
Totals		0	0	42,740	0	9,584	0	0

Note: Airflows on this report are not additive because they are each taken at the time of their respective peaks. To view the balanced system design airflows, see the appropriate Checksums report (Airflows section).

SYSTEM SUMMARY

DESIGN CAPACITY QUANTITIES

By CTA Architects Engineers

		COOLING				HEATING						
System Description	System Type	Main System Capacity ton	Auxiliary System Capacity ton	Optional Vent Capacity ton	Cooling Totals ton	Main System Capacity Btu/h	Auxiliary System Capacity Btu/h	Preheat Capacity Btu/h	Reheat Capacity Btu/h	Humidification Capacity Btu/h	Optional Vent Capacity Btu/h	Heating Totals Btu/h
System - 001	Ventilation and Heating	0	0	0	0	-2,542,471	0	0	0	0	0	-2,542,471
System - 002	Ventilation and Heating	0	0	0	0	-432,673	0	0	0	0	0	-432,673
Totals		0	0	0	0	-2,975,144	0	0	0	0	0	-2,975,144

*** The building peaked at hour 1 month 1 with a capacity of 0 tons.**

ENGINEERING CHECKS

By CTA Architects Engineers

Description	Type	COOLING					HEATING			Floor Area
		% OA	cfm/ft²	cfm/ton	ft²/ton	Btu/hr·ft²	% OA	cfm/ft²	Btu/hr·ft²	ft²
Unit 1 Classrooms	Room	0.00	0.00	0.0	0.0	0.00	0.00	0.89	-62.20	13,200
Unit 2 Admin	Room	0.00	0.00	0.0	0.0	0.00	0.00	0.65	-45.11	12,816
Unit 3 Classrooms	Room	0.00	0.00	0.0	0.0	0.00	0.00	0.87	-60.73	11,050
Unit 5 Maint	Room	0.00	0.00	0.0	0.0	0.00	0.00	0.61	-42.73	11,050
Zone - 001	Zone	0.00	0.00	0.0	0.0	0.00	0.00	0.76	-52.84	48,116
System - 001	System - Ventilation and Heating	0.00	0.00	0.0	0.0	0.00	0.00	0.76	-52.84	48,116
Unit 4 Stage, Gym, and Shop	Room	0.00	0.00	0.0	0.0	0.00	0.00	0.66	-46.10	9,386
Zone - 002	Zone	0.00	0.00	0.0	0.0	0.00	0.00	0.66	-46.10	9,386
System - 002	System - Ventilation and Heating	0.00	0.00	0.0	0.0	0.00	0.00	0.66	-46.10	9,386

System Checksums

By CTA Architects Engineers

System - 001 | **Ventilation and Heating**

COOLING COIL PEAK / CLG SPACE PEAK

Cooling Coil Peak — Peaked at Time: Mo/Hr: 0 / 0; Outside Air: OADB/WB/HR: 0 / 0 / 0

CLG Space Peak — Mo/Hr: 0 / 0; OADB: 0

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads						
Skylite Solar	0	0	0	0.00	0	0.00
Skylite Cond	0	0	0	0.00	0	0.00
Roof Cond	0	0	0	0.00	0	0.00
Glass Solar	0	0	0	0.00	0	0.00
Glass Cond	0	0	0	0.00	0	0.00
Wall Cond	0	0	0	0.00	0	0.00
Partition	0		0	0.00	0	0.00
Exposed Floor	0		0	0.00	0	0.00
Infiltration	0		0	0.00	0	0.00
Sub Total ==>	0	0	0	0.00	0	0.00
Internal Loads						
Lights	0	0	0	0.00	0	0.00
People	0		0	0.00	0	0.00
Misc	0	0	0	0.00	0	0.00
Sub Total ==>	0	0	0	0.00	0	0.00
Ceiling Load	0	0	0	0.00	0	0.00
Ventilation Load	0	0	0	0.00	0	0.00
Ov/Undr Sizing	0		0	0.00	0	0.00
Exhaust Heat		0	0	0.00		
Sup. Fan Heat			0	0.00		
Ret. Fan Heat		0	0	0.00		
Duct Heat Pkup		0	0	0.00		
Reheat at Design			0	0.00		
Grand Total ==>	0	0	0	100.00	0	100.00

HEATING COIL PEAK

Mo/Hr: 13 / 1; OADB: -18

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-611,167	24.04
Glass Solar	0	0	0.00
Glass Cond	-1,126,918	-1,126,918	44.32
Wall Cond	-111,451	-188,823	7.43
Partition	0	0	0.00
Exposed Floor	-6,609	-6,609	0.26
Infiltration	-698,439	-698,439	27.47
Sub Total ==>	-1,943,417	-2,631,955	103.52
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-169,200	0	0.00
Ventilation Load	0	0	0.00
Ov/Undr Sizing	-960	-960	0.04
Exhaust Heat		90,443	-3.56
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
Grand Total ==>	-2,113,576	-2,542,471	100.00

TEMPERATURES

	Cooling	Heating
SADB	0.0	125.0
Plenum	0.0	56.6
Return	0.0	56.6
Ret/OA	0.0	56.6
Fn MtrTD	0.0	0.1
Fn BldTD	0.0	0.1
Fn Frict	0.0	0.2

AIRFLOWS

	Cooling	Heating
Vent	0	0
Infil	0	8,019
Supply	0	36,580
MinStop/Rh	0	0
Return	0	44,599
Exhaust	0	8,019
Rm Exh	0	0
Auxiliary	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	0.00	0.76
cfm/ton	0.00	
ft²/ton	0.00	
Btu/hr·ft²	0.00	-52.84
No. People	268	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	48,116		
Part	0		
ExFlr	1,544		
Roof	48,116	0	0
Wall	18,528	11,597	63

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-2,542.5	36,580	56.6	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-2,542.5			

System Checksums
By CTA Architects Engineers

System - 002

Ventilation and Heating

COOLING COIL PEAK / CLG SPACE PEAK

Cooling Coil Peak — Peaked at Time: Mo/Hr: 0 / 0; Outside Air: OADB/WB/HR: 0 / 0 / 0

CLG Space Peak — Mo/Hr: 0 / 0; OADB: 0

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads						
Skylite Solar	0	0	0	0.00	0	0.00
Skylite Cond	0	0	0	0.00	0	0.00
Roof Cond	0	0	0	0.00	0	0.00
Glass Solar	0	0	0	0.00	0	0.00
Glass Cond	0	0	0	0.00	0	0.00
Wall Cond	0	0	0	0.00	0	0.00
Partition	0		0	0.00	0	0.00
Exposed Floor	0		0	0.00	0	0.00
Infiltration	0		0	0.00	0	0.00
Sub Total ==>	0	0	0	0.00	0	0.00
Internal Loads						
Lights	0	0	0	0.00	0	0.00
People	0		0	0.00	0	0.00
Misc	0	0	0	0.00	0	0.00
Sub Total ==>	0	0	0	0.00	0	0.00
Ceiling Load	0	0	0	0.00	0	0.00
Ventilation Load	0	0	0	0.00	0	0.00
Ov/Undr Sizing	0		0	0.00	0	0.00
Exhaust Heat		0	0	0.00		
Sup. Fan Heat			0	0.00		
Ret. Fan Heat		0	0	0.00		
Duct Heat Pkup		0	0	0.00		
Reheat at Design			0	0.00		
Grand Total ==>	0	0	0	100.00	0	100.00

HEATING COIL PEAK

Mo/Hr: 13 / 1; OADB: -18

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-118,065	27.29
Glass Solar	0	0	0.00
Glass Cond	-84,155	-84,155	19.45
Wall Cond	-182,053	-216,791	50.10
Partition	0	0	0.00
Exposed Floor	-1,232	-1,232	0.28
Infiltration	-139,895	-139,895	32.33
Sub Total ==>	-407,335	-560,138	129.46
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-41,986	0	0.00
Ventilation Load	0	0	0.00
Ov/Undr Sizing	105,022	105,022	-24.27
Exhaust Heat		22,443	-5.19
OA Preheat Diff.		0	0.00
RA Preheat Diff.		0	0.00
Additional Reheat		0	0.00
Grand Total ==>	-344,298	-432,673	100.00

TEMPERATURES

	Cooling	Heating
SADB	0.0	125.0
Plenum	0.0	55.9
Return	0.0	55.9
Ret/OA	0.0	55.9
Fn MtrTD	0.0	0.1
Fn BldTD	0.0	0.1
Fn Frict	0.0	0.2

AIRFLOWS

	Cooling	Heating
Vent	0	0
Infil	0	1,564
Supply	0	6,160
MinStop/Rh	0	0
Return	0	7,724
Exhaust	0	1,564
Rm Exh	0	0
Auxiliary	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	0.0	0.0
cfm/ft²	0.00	0.66
cfm/ton	0.00	
ft²/ton	0.00	
Btu/hr·ft²	0.00	-46.10
No. People	30	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0.0	0.0								

AREAS

	Gross Total	Glass ft²	Glass (%)
Floor	9,386		
Part	0		
ExFlr	280		
Roof	9,386	0	0
Wall	8,400	840	10

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-432.7	6,160	55.9	125.0
Aux Htg	0.0	0	0.0	0.0
Preheat	0.0	0	0.0	0.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-432.7			

MONTHLY ENERGY CONSUMPTION

By CTA Architects Engineers

Alternative: 1 Base Building

------- Monthly Energy Consumption -------

Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Electric													
On-Pk Cons. (kWh)	30,885	27,065	31,089	27,720	14,871	12,531	7,188	7,464	24,364	28,052	28,659	29,398	269,285
On-Pk Demand (kW)	87	86	88	89	88	86	86	86	86	90	85	86	90
Gas													
On-Pk Cons. (therms)	7,623	5,679	4,823	3,655	1,569	243	2	19	5	425	3,685	5,836	33,563
On-Pk Demand (therms/hr)	23	22	21	22	16	6	0	0	6	8	11	14	23
Water													
Cons. (1000gal)	8	6	5	5	4	0	0	0	0	1	5	7	41

Building Energy Consumption = 74,352 Btu/(ft2-year)
Source Energy Consumption = 109,395 Btu/(ft2-year)
Floor Area = 57,502 ft2

EQUIPMENT ENERGY CONSUMPTION
By CTA Architects Engineers

Alternative: 1 Base Building

Equipment - Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Lights													
Electric (kWh)	24,517.5	22,174.3	26,343.2	23,432.1	10,091.6	6,124.0	6,210.2	6,339.6	23,432.1	25,430.3	24,345.0	23,604.6	222,044.3
Peak (kW)	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9	71.9
MISC LD													
Electric (kWh)	978.1	885.0	1,071.3	931.5	1,024.7	1,075.3	977.5	1,124.2	931.5	1,024.7	978.1	931.5	11,933.4
Peak (kW)	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Bsu 1: Domestic Hot Water (gas)													
Gas (therms)	215.6	194.9	227.9	206.7	221.7	218.9	2.3	18.8	4.7	21.8	211.2	204.6	1,749.1
Peak (therms/Hr)	1.2	1.2	1.2	1.2	1.2	1.2	0.1	0.1	0.1	0.3	1.2	1.2	1.2
Cpl 1: Cooling plant - 001													
Hpl 1: Heating plant - 002													
Boiler - 001 (Heating Equipment)													
Gas (therms)	7,407.7	5,484.4	4,594.7	3,447.9	1,347.0	24.4	0.0	0.0	0.0	403.3	3,473.6	5,631.3	31,814.2
Peak (therms/Hr)	22.9	21.8	21.3	21.8	15.8	6.1	0.0	0.0	6.3	8.0	11.4	14.4	22.9
Eq5020 - Heating water circ pump (Misc Accessory Equipment)													
Electric (kWh)	2,053.4	1,515.2	1,415.9	1,324.8	1,048.8	11.0	0.0	0.0	0.0	218.0	1,333.1	1,943.0	10,863.4
Peak (kW)	2.8	2.8	2.8	2.8	2.8	2.8	0.0	0.0	2.8	2.8	2.8	2.8	2.8
Eq5240 - Boiler forced draft fan (Misc Accessory Equipment)													
Electric (kWh)	1,488.0	1,098.0	1,026.0	960.0	760.0	8.0	0.0	0.0	0.0	158.0	966.0	1,408.0	7,872.0
Peak (kW)	2.0	2.0	2.0	2.0	2.0	2.0	0.0	0.0	2.0	2.0	2.0	2.0	2.0
Eq5307 - Boiler cntl panel & inter (Misc Accessory Equipment)													
Electric (kWh)	372.0	274.5	256.5	240.0	190.0	2.0	0.0	0.0	0.0	39.5	241.5	352.0	1,968.0
Peak (kW)	0.5	0.5	0.5	0.5	0.5	0.5	0.0	0.0	0.5	0.5	0.5	0.5	0.5
Eq5061 - Condensate return pump (Misc Accessory Equipment)													
Electric (kWh)	69.9	51.6	48.2	45.1	35.7	0.4	0.0	0.0	0.0	7.4	45.4	66.2	370.0
Peak (kW)	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1

EQUIPMENT ENERGY CONSUMPTION
By CTA Architects Engineers

Alternative: 1 Base Building

Equipment - Utility	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
					------- Monthly Consumption -------								
Hpl 1: Heating plant - 002													
Eq5406 - Make-up water (Misc Accessory Equipment)													
Make Up Water (1000gal)	7.7	5.7	5.3	5.0	3.9	0.0	0.0	0.0	0.0	0.8	5.0	7.3	40.8
Peak (1000gal/Hr)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
System - 001													
Eq4003 - FC Centrifugal const vol (Main Htg Fan)													
Electric (kWh)	1,039.7	764.2	619.5	496.9	1,680.6	4,956.9	0.0	0.0	0.0	796.2	507.6	805.5	11,666.9
Peak (kW)	3.7	3.1	5.3	5.3	6.9	6.9	6.9	6.9	6.9	6.9	4.1	2.1	6.9
Eq4003 - FC Centrifugal const vol (System Exhaust Fan)													
Electric (kWh)	129.7	117.1	129.7	125.5	0.0	0.0	0.0	0.0	0.0	151.1	124.2	107.4	884.7
Peak (kW)	0.7	0.7	0.7	0.7	0.0	0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.7
System - 002													
Eq4003 - FC Centrifugal const vol (Main Htg Fan)													
Electric (kWh)	211.1	162.5	153.5	139.8	39.3	353.6	0.0	0.0	0.0	197.7	93.8	158.5	1,509.8
Peak (kW)	0.6	0.6	0.6	0.6	0.4	1.2	1.2	1.2	1.2	1.2	0.3	0.4	1.2
Eq4003 - FC Centrifugal const vol (System Exhaust Fan)													
Electric (kWh)	25.3	22.9	25.3	24.5	0.0	0.0	0.0	0.0	0.0	29.5	24.2	20.9	172.6
Peak (kW)	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1

ENERGY CONSUMPTION SUMMARY

By CTA Architects Engineers

	Elect Cons. (kWh)	Gas Cons. (kBtu)	Water Cons. (1000 gals)	Percent of Total Energy	Total Source Energy* (kBtu/yr)
Primary heating					
Primary heating	10,210.0	3,181,416.8	40.8	75.2 %	3,453,410.3
Primary cooling					
Cooling Compressor				0.0 %	0.0
Tower/Cond Fans				0.0 %	0.0
Condenser Pump				0.0 %	0.0
Other CLG Accessories				0.0 %	0.0
Cooling Subtotal....				0.0 %	0.0
Auxiliary					
Supply Fans	14,233.9			1.1 %	145,755.0
Circ Pumps	10,863.4			0.9 %	111,241.2
Base Utilities		174,912.4		4.1 %	184,118.3
Aux Subtotal....	25,097.2	174,912.4		6.1 %	441,114.4
Lighting					
Lighting	222,044.3			17.7 %	2,273,739.3
Receptacle					
Receptacles	11,933.4			1.0 %	122,198.2
Heating plant load					
Base Utilities				0.0 %	0.0
Cogeneration					
Cogeneration				0.0 %	0.0
Totals					
Totals**	269,284.9	3,356,329.0	40.8	100.0 %	6,290,462.0

* Note: Resource Utilization factors are included in the Total Source Energy value.
** Note: This report can display a maximum of 6 utilities. If additional utilities are used, they will be included in the total.

KELLOGG - PINEHURST 4/4

PINEHURST				
ending date	Kwh use	Kwh cost	Therm use	Therm cost
7/11/2000	5580	$226.99	925	$443.58
8/9/2000	3960	$158.58	0	$98.48
9/12/2000	8280	$319.94	744	$395.33
10/9/2000	10800	$417.31	2752	$1,548.94
11/7/2000	13500	$521.64	4444	$2,442.55
12/8/2000	14760	$570.33	7644	$4,132.60
1/15/2001	16200	$625.94	9949	$5,349.96
2/15/2001	16020	$636.30	6661	$3,654.31
3/14/2001	13140	$537.03	4080	$3,026.41
4/12/2001	12240	$500.25	3991	$2,962.47
5/10/2001	12240	$500.25	2683	$2,022.86
6/11/2001	11880	$485.54	1487	$1,163.70
7/11/2001	4140	$396.21	340	$278.87
8/8/2001	3600	$374.98	30	$107.51
9/1/2001	5580	$477.76	198	$170.62
10/1/2001	10867	$728.00	1205	$1,065.00
11/1/2001	13320	$915.48	3765	$3,125.56
12/1/2001	14400	$994.88	4950	$4,079.16
1/1/2002	11700	$753.00	7278	$5,952.00
2/1/2002	13140	$931.64	6598	$5,405.44
3/1/2002	21060	$1,406.38	5821	$4,780.12
4/1/2002	35100	$2,074.75	5847	$4,801.05
5/1/2002	34380	$2,074.75	4389	$3,627.68
6/1/2002	32400	$1,973.13	2049	$1,744.49
7/9/2002	29160	$1,464.42	187	$177.13
8/6/2002	21240	$1,066.00	52	$119.00
9/5/2002	27360	$1,374.02	256	$232.91
10/7/2002	36720	$1,844.08	1477	$1,284.16
11/6/2002	35820	$1,798.88	3641	$2,923.52
12/9/2002	39960	$2,006.79	4928	$3,370.01
1/8/2003	34200	$1,717.52	4728	$3,237.11
2/7/2003	38520	$1,934.47	4844	$3,314.19
3/10/2003	38340	$1,925.43	5460	$3,723.51
4/9/2003	35280	$1,771.76	3833	$2,642.41
5/9/2003	37080	$1,862.16	3372	$2,336.09
6/6/2003	32940	$1,654.25	1668	$1,203.84
7/8/2003	31140	$1,563.85	441	$336.98
8/5/2003	12420	$623.73	512	$390.71

35,399 therms