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Mr. Phil Giles
North Coast Resource Conservation & Development Council
2448 Guerneville Road, Suite 100
Santa Rosa, California 95403

Dear Mr. Giles:

Fort Bragg Biomass Power Facility
Feasibility Analysis

Carlson Small Power Consultants (CSPC) is pleased to transmit the attached feasibility analysis for a 15 megawatt biomass power project in Fort Bragg, California. The analysis shows that this may well be a feasible project, the financial analysis showing a 17% after tax equity return to a private developer, though the project is not without its challenges.

The project could not be completed prior to the expiration of the federal Section 45 Production Tax Credit on December 31, 2008, a credit that is crucial to the success of the project. Though Congress has previously extended the credit 5 times, it was unable to do so in 2007, and so that action remains pending. Early stage development efforts would proceed with that uncertainty hanging over the project.

The project also would contain substantial fuel risk, as the sources of fuel cannot be guaranteed over the life of the power contract. Though this fuel uncertainty is common to biomass power projects, an independent project like this not tied to a forest products company or specific mill is considered more vulnerable. It will be necessary for the project sponsors to obtain commitments from several major forest landowners/mills before project financing will be possible.

This project, if developed will have substantial economic and environmental benefits for Mendocino County and the Fort Bragg area. The project would be expected to employ 16 full time employees, while perhaps an additional 25 are employed in the fuel supply chain for the facility. With much of the fuel supplied from the residuals from forest management activities, open burning of residuals will be dramatically reduced. The project will also allow an outlet for the products of thinning around homes and communities for fire protection, lowering the cost of such activity. Some woody materials going to landfill will also be diverted as fuel for the facility.

CSPC was pleased to be a part of this important potential project. Only one new biomass power facility has been constructed in California in the last 15 years. The Fort Bragg area may represent the combination of remoteness from competitive facilities, available fuel supply and community support that is necessary to become the second new facility. CSPC stands ready to answer any questions regarding the analysis.

Sincerely,

Bill Carlson, Principal
Carlson Small Power Consultants

FORT BRAGG BIOMASS POWER FACILITY

FEASIBIITY ANALYSIS

Conducted For:

North Coast Resource Conservation & Development Council

Conducted By:

Carlson Small Power Consultants
Redding, California

January 20, 2008

FORT BRAGG BIOMASS POWER FACILITY FEASIBILITY ANALYSIS

Introduction

California, with 26 operating biomass power facilities, leads the nation in biomass power supplied to the electrical grid, but only one of those plants has been built in the last 15 years. A combination of high wood fuel costs and moderate utility avoided costs has stymied the industry and many plants have closed, including the 15 mw biomass power facility at the former Georgia Pacific sawmill in Fort Bragg.

The North Coast Resource Conservation and Development Council (RC&D) and City of Fort Bragg (Ft. Bragg) have undertaken an effort to determine if a new biomass power facility in the vicinity of Ft. Bragg is economically feasible. The study is driven by the fact that the region around Ft. Bragg has a substantial amount of unused wood waste incidental to forest management and milling activities and there is a concern for fire in overstocked timber stands adjoining communities. In addition, Ft. Bragg and the surrounding area is remote from other biomass power facilities, and so not subject to the intense fuel pressure in other areas of California.

Prior to this study the RC&D sponsored a study of biomass fuel availability (2006) in Mendocino County that was conducted by TSS Consultants. In addition, RC&D staff prepared an overview (2007) of biomass power generally and in relation to Mendocino County. This study builds on those two efforts and brings a conventional biomass power project to a specific site; investigating sizing, design, capital and operating costs, power sales revenues, available incentives and a fuel plan to determine if such a project is economically feasible. This report represents the results of that effort.

Fuel Supply

In performing this economic feasibility study, CSPC relied almost exclusively on the TSS Consultants 2006 study of fuel availability and cost in Mendocino County. This information was supplemented by discussions with major landowners and with fuel processing/delivery firms in similar situations.

The results of the above review and discussion has led CSPC to propose the following potential fuel supply for a biomass power facility in Ft. Bragg:

Fuel Type	Annual Quantity	Delivered Cost/BDT (2011)
Mill Waste	55,000 BDT	$ 27.50
Forest Residuals	45,000	52.80
Urban Woodwaste	8,000	27.50
Log Yard Cleanup	10,000	44.00
Fire Protection Thinning	10,000	44.00
TOTAL	128,000 BDT	

Mill Waste

The 5 sawmills contacted by TSS in 2006 had a total of 172,500 BDT/yr of wood residuals available consisting of shavings, bark, chips and sawdust, but excluding log yard cleanup material. Excellent markets exist for shavings and bark from Mendocino County mills as animal bedding and landscape materials, respectively. The value for these materials in those markets is substantial, and the proposed power plant should not compete for them. Likewise, paper quality chips have a home in the pulp mill in Eureka, and again this market has a lot of upside value potential. Sawdust is the lowest valued residual material, and it is assumed that the 55,000 BDT/yr of existing sawdust production is diverted to the proposed plant. The $27.50/BDT price in 2011 gives the sawmills about a $10-12/BDT value in the bin, plus freight. The proposed plant has a 60 plus mile haul advantage over existing biomass power facilities in Scotia, Oroville and Woodland, which assists in redirecting the sawdust fraction.

Forest Residuals

Forest residuals consist of tops, limbs and unmerchantable trees that result from forest management activities in the redwood and douglas fir forests of Mendocino County. TSS indicates that an average of 114 million board feet of timber is harvested annually in Mendocino County, with virtually no contribution from either state or federal lands. In looking at maps of county forests, it would appear that nearly 100 million board feet of this harvest will occur west of Highway 101 in private lands that could contribute forest residuals to a proposed power project in Ft. Bragg. The restart of modest forest management activities in Jackson State Forest under a new management plan could make a further contribution.

The 45,000 BDT/yr of forest residuals used in this analysis is the result of assuming 100 million board feet of harvesting activity annually tributary to Ft. Bragg with 0.9 BDT/1,000 board feet produced of residual materials and assuming 50% of the material is readily available at accessible landings. The 2011 cost of $53.80/BDT delivered is from the work of TSS adjusted for discussions with two contractors processing large amounts of such material. A 40 mile average haul distance is assumed. The 50% material availability assumption should build in a fair amount of conservatism.

Urban Woodwaste

Woodwaste is separated from household trash via recycling programs and at transfer stations in the county. The 8,000 BDT/yr is from the TSS Study and the $27.50/BDT delivered cost is from the high end of the TSS projection. It is typical to find that once a biomass power facility is built, the urban wood fraction is higher than anticipated due to residents having a ready disposal option and opt to deliver material to the plant as opposed to burn it in the backyard. Likewise, businesses now have a no cost disposal option for pallets, dunnage, etc. that they had previously accumulated. These increased amounts are left as upsides to the analysis.

Log Yard Cleanup

Sawmills typically accumulate substantial quantities of bark within their log yards during log scaling, storage and handling. In mills that reclaim such material via grinding, the quantities are typically 5-10% of total mill residuals.

The production of forest residuals for the proposed plant will mean that 2-3 contractors will have mobile loading and grinding equipment working in the woods during the operating season. This equipment will be idled in the winter and could be diverted to processing log yard cleanup piles, piles at transfer stations and even accumulations of agricultural residues during their off season. This is a service typically not offered unless this expensive equipment has a "regular job" working in the woods.

Fire Protection Thinning

Mendocino County is heavily forested, with forests growing up to, and often into, the small communities and outlying housing throughout the county. There is a desire in many locales to thin these forests to assist firefighters in protecting communities and rural housing from wildfire.

A lack of available funding often thwarts the desires of communities to do forest protection thinning. The existence of a biomass power facility will change the dynamic of these proposed activities as a home will now be available for all the materials removed. The $44.00/BDT delivered cost to the facility in 2010 will certainly not pay the full cost of the fire protection thinning projects, but will make a solid economic contribution. This fuel plan assumes that 1,000 acres/yr will be thinned within the west county area yielding a very conservative 10 BDT/acre of biomass material with no higher economic value.

Fuel Summary

This fuel plan has attempted to be conservative in its approach to accumulating a critical mass of annual fuel. It has utilized only ⅓ of available sawmill residual materials and ½ of available forest residuals. It has taken modest contributions of urban woodwaste, log yard cleanup and fire protection thinning. Minor contributions of material from commercial tree trimming, right-of-way clearing, and clearing for construction and agricultural activities were not counted. The plan

is designed to allow fueling of the facility even during downturns in the forest products industry such as is currently being experienced.

The amount of material is sufficient to fuel a 15 mw biomass power facility on a year round full load basis. As will be seen in other sections of this study, the structure of the likely power contract for this facility will allow plant curtailments during off peak periods as a fuel saving measure with almost no loss in margin.

Plant Size

The plant was sized in order to take advantage of the available fuel supply in the area without taxing that fuel supply. With the fuel analysis showing 128,000 BDT/yr reasonably available for the facility, a 150,000 lb/hr boiler was chosen. This boiler is expected to consume, in an 8,200 hour operating year, 125,800 BDT of fuel at continuous full load. This steam, when converted to electricity, will produce an average gross output of 16,460 kw with the plant utilizing 9.5% of this power internally, and selling 14,900 kw to the grid. The complete plant operating assumptions and calculations are shown below:

Plant Assumptions and Calculations

Boiler

Item	Units	Quantity
Boiler Size	lb/hr	150,000
Steam Temperature	º F	900
Steam Pressure	psig	900
Main Steam Enthalpy	btu/lb	1451.3
Feedwater Enthalpy	btu/lb	198.2
Fuel Average Moisture	%	52
Boiler Efficiency	%	70
Fuel Heating Value	btu/BDT	17.5 million
Boiler Hours of Operation	hr/yr	8,200
Boiler Fuel Consumption	BDT/yr	125,800

Turbine-Generator

Turbine Size	mw	17
Condensing Pressure	in-Hg	2
Turbine Extraction Pressure	psig	50
Turbine Inlet Flow	lb/hr	150,000
Deaerator Flow	lb/hr	16,000
Turbine Exhaust Flow	lb/hr	134,000
Turbine Conversion Efficiency	%	73

Generator Gross Output	kw	16,460
Plant Auxiliary Power	kw	1,560
Plant Net Sales	kw	14,900
Turbine Hours of Operation	hrs/yr	8,200

Plant Design

A merchant biomass power facility at Ft. Bragg should utilize a standard boiler design such as a spreader stoker fed moveable grate (traveling, shaker, rotating) or a fluidized bed (bubbling or circulating). Though gasification technologies hold efficiency advantages if they eventually can be direct coupled to a combustion turbine, they are typically confined to smaller facilities and today utilize standard steam generation/steam turbine technology.

In this study, a spreader stoker fed moveable grate is proposed. The design is proven and is familiar to many operators in California. Because the fuel is expected to be fairly uniform in origin (redwood and douglas fir wood and bark), and Ft. Bragg is in attainment for air quality criteria pollutants, the higher capital cost and auxiliary power requirements of a fluidized bed could not be justified for this study.

The steam conditions chosen were 900 psig and 900º F. These steam conditions are very common among biomass facilities in California and offer the tradeoff of being very reliable while offering reasonable efficiency. The boiler is equipped with an electrostatic precipitator for particulate control, multiple levels of overfire air for low carbon monoxide and nitrogen oxides. Discussions with Mendocino Air Quality officials indicate an add on nitrogen oxide control system may not be required.

The steam turbine-generator is a conventional 3,600 rpm direct coupled unit with a single automatic extraction at 50 psig for deaerator heating and to potentially supply future steam to adjacent sawmill dry kilns. Generator voltage will be either 13.8 kv or 12.47 kv. The plant will be interconnected to PG&E through a main 13.8kv/60kv step up transformer and approximately ½ mile of transmission line.

Plant circulating water will be cooled in a 2 cell mechanical draft cooling tower. Makeup water (approx. 240 gpm) is expected to be supplied by on site or Park District wells and boiler and cooling tower blowdown water (50 gpm) is of a quality that it could be routed to the future golf course for irrigation.

Because of the seasonality of forest operations on the north coast, the plant will feature a large fuel storage area capable of holding up to 40,000 BDT of fuel. The fuel pile will, at maximum, require approximately 4 acres for fuel storage.

Plant Site

The proposed plant site at the Georgia Pacific bark dump southwest of Ft. Bragg was visited and is considered to be an excellent site. The characteristics that make the site acceptable are the following:

1. The site is remote enough that it should not have neighbor issues with respect to noise or traffic.

2. The site has an industrial use background (redwood bark disposal) so that major use changes are not required.

3. Parts of the site are located within ¼ mile of PG&E's main transmission line serving the Ft. Bragg area (cost to interconnect included in capital cost). This 60KV line has sufficient capacity to accept the proposed project.

4. The site can be served by a ¼ mile extension of Summers Lane from Highway 20. Cost to extend/improve included in capital cost.

5. The site contains a substantial quantity of buried redwood bark which may be able to supplement existing fuel sources. Trials will need to establish if this recovery is economically and environmentally feasible.

6. The site is large enough to accommodate the substantial fuel storage required due to the seasonality of a large fraction of the total fuel supply.

7. The site is adjacent to the proposed regional park and golf course (to the south) that has undergone extensive aquifer testing and groundwater modeling to determine groundwater availability for the proposed development. The results were positive. The cost of additional wells is included in the project capital cost.

8. The adjacent park and golf course has a need for 250 – 300 gpm of water for irrigation purposes, water that will be stored in two on site lakes. Approximately 50 gpm of high quality blowdown water could be supplied by the power plant to the lakes, water that is acceptable for irrigation purposes. The cost for a pipeline to deliver this blowdown water is included in the project capital cost.

9. Ash remaining after wood combustion can be used to replace the redwood bark reclaimed from pits on the project site, representing an economic disposal option as well as a net positive environmental benefit to the site.

For all of the above reasons, the Georgia Pacific bark dump site is considered a very acceptable site and will be used in the economic analysis of the project.

Capital & Operating Cost

CSPC obtained a detailed quotation from Wellons, Inc. (attached) for the turnkey installation of a 150,000 lb/hr boiler and used reconditioned 17mw turbine-generator of $34,100,000. This quote is from a major supplier of wood-fired boilers and is for a complete plant, except for the following additional equipment required:

Capital Item	Cost
Wellons Quotation	$ 34,100,000
Transmission Line/Interconnect	1,250,000
Site Preparation	400,000
Water Supply	300,000
Wastewater disposal (golf course)	200,000
Entrance Road and Site Roads	1,000,000
Fuel Yard Facilities	900,000
Site Purchase	200,000
Permitting	300,000
SUBTOTAL	$ 38,650,000
Inflation on non Wellons Items to 2011	364,000
TOTAL CAPITAL	$ 39,014,000

The detailed operation and maintenance (O&M) cost is shown on the attached financial analysis. The project is expected to operate with a total of 16 personnel. Total O&M cost, including ash disposal is expected to be $3.47 million in 2011, the first year of operation. All O&M costs are projected to increase annually by 2.6%, which is the average inflation rate for the last 10 years. Largest O&M cost items are labor and benefits (34% of total), maintenance (27%) and property taxes (15%).

Power Sales Revenue

Renewable electric power generation, such as this biomass power facility, has a ready market within California's public and investor owned electric utilities due to California's Renewable Portfolio Standard (RPS) law. The RPS mandates that utilities obtain 20% of power sales from renewable sources by 2010, and has a goal of 33% by 2020. This mandate is jointly administered by the California Public Utility Commission (PUC) and the California Energy Commission (CEC). In addition to the RPS, customers of California's investor owned utilities pay a Public Benefits Charge (PBC) that is administered by the CEC, much of which can go to fund the over market costs of renewable power. As it lies within Pacific Gas & Electric's service territory, this project may qualify for PBC funding providing it sells energy to PG&E.

Both public and investor owned electric utilities add renewable power to their portfolios via annual solicitations for projects. In order to determine the reasonableness of offerings, the PUC annually publishes a Market Price Referent (MPR), which is the projected cost of an equivalent new fossil fired unit. These MPR calculations have been rising in value quickly with natural gas shortages and the new necessity to account for carbon emissions. Any offer to sell renewable power at or below the MPR is judged "per se reasonable" by the PUC. An offer above the MPR may be eligible to receive Supplemental Energy Payments (SEP's) from the PBC funds administered by the CEC. A recent change allows the SEP's to be added directly to the utility contract to aid in project financing. The latest MPR's for investor owned utilities were published by the PUC on October 4, 2007. In that filing a 2011 project seeking a 20 year contract could be paid up to a fixed MPR price of 9.969 cents/kwh before needing to seek SEP's.

In conjunction with this study, two public power agencies, a power marketing firm and PG&E were contacted regarding a reasonable value for power from a Ft. Bragg biomass facility. The consensus was that the current MPR is a good value to use. Further discussions with PG&E indicate that the firmness and end of line voltage support benefits of the project will allow the project to be scored highly in an RPS solicitation. PG&E has recently had contracts approved by the PUC that were above the MPR. This study assumes a power sales price of 9.6 cents/kwh, slightly below the 20 year MPR value for a 2011 project, but with a small annual escalator.

Another feature of the MPR process is that the MPR price is also subject to a time of use (TOU) pricing that varies the hourly price by season, time of day and day of the week. For PG&E, the price will vary from a high of 1.663 times the MPR on a summer weekday afternoon to a low of 0.59 times the MPR on a winter weekend night, aggregating to an annual average of 1.0 times the MPR value. For biomass plants that purchase outside fuel, this variable pricing is very valuable. When fuel is very tight or very expensive, the project can be throttled back during low price periods with almost no loss of margin. That will clearly be the case for the Ft. Bragg project
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Deal Structure

The deal structure utilized in this analysis is that of a private developer undertaking the project. Should a public entity undertake the project, the tax incentives, in terms of the federal production tax credit and accelerated depreciation would have no value to a non taxpaying entity. These are the very incentives that turn a project with little or no
pretax cash flow into a project with an acceptable after tax return.

It is anticipated that an experienced private developer would bring the required development capital and equity investment to the project, borrowing the remainder of the capital funding on the strength of the long term power contract, fuel arrangements and a turnkey capital price for the facility. The process could be enhanced, however, by the participation of local public entities in terms of provision of utilities, zoning, site access and permitting.

Available Incentives

The power output of the proposed facility will clearly qualify as renewable under California's RPS regulations. Consequently, the proposed project can bid its output into renewable requests for offers posted by various public and investor owned utilities in California.

The project, if completed prior to January 1, 2009 would qualify for a federal Section 45 Production Tax Credit of 1.0 cents/kwh sold. This credit is available for the first 10 years of project operation and escalates with the Consumer Price Index over that period. This project obviously cannot be completed by January 1, 2009, so current law would exclude the use of the tax credit. However, the credit has been extended by Congress five times since 1992, and Congress came within one vote of extending it further just prior to adjourning for 2007. The further extension is expected in this Congress and this is considered a threshold issue for the project. In other words, without the availability of the tax credit, the project would not move forward. The availability of the current tax credit is assumed in the financial analysis of the project.

The project also qualifies for accelerated depreciation under current Internal Revenue Service regulations. The majority of the total investment will qualify as 7 year property under IRS rules.

Project Schedule

Two features of this project force a longer than normal development schedule for a biomass power facility:

1. The handoff of the project from its current local agency focus to a private developer who can utilize available tax advantages and meet community objectives.

2. The necessity of bidding the project output into a utility solicitation(s) and the subsequent contract negotiation and Public Utility Commission approval.

The early stage project development is also done with the backdrop of the U.S. Congress debating the extension of a federal production tax credit that is crucial to the successful development of the project, and California agencies crafting a greenhouse gas compliance strategy that may hold substantial upside potential for the project. Even with these uncertainties, it is possible for local governmental and private sponsors to advance the project to the point its development can be handed off to an appropriate private developer.

A very preliminary project schedule would appear as follows:

Tentative Schedule

Month	Year	Activity
Jan	2008	Feasibility analysis delivered
Feb/Mar	2008	Internal discussion of feasibility analysis
April	2008	Formation of local govt./private group to advance project
May/June	2008	Group assembles support among site owner, timberland owners/mills, park district, local PG&E, govt. agencies
July/Sept	2008	Group defines project, works with site owner, identifies potential developers
Oct	2008	Meet with and select project developer
Nov/Mar	2008/2009	Developer due diligence/agreements and utility bid preparation
April	2009	Bid to PG&E/others
July	2009	Project selected for contract negotiation
Nov	2009	Contract negotiation completed
Feb	2010	Engineer/Procure/Construct (EPC) contract let for project
May/Apr	2010/2011	On site construction activity
Mar	2011	First fuel delivered to site
May	2011	Project delivers first power to grid
July	2011	Project declared commercial

A project rarely maintains the linear schedule shown above due to challenges, permit issues, financing hurdles, etc. This schedule is designed to take advantage of the optimum construction weather on the California coast and come on line for California's peak electrical usage in the summer of 2011. The schedule also gives time for Congress to resolve the extension of the Production Tax Credit and for state agencies to complete work on a greenhouse gas compliance strategy. However, the above schedule should be viewed as only a rough project guide.

Financial Results and Summary

The financial analysis develops an after tax equity return for a private developer who is able to utilize the federal tax credits and accelerated depreciation within this or other taxable ventures. The complete model is attached.

This project is assumed to be developed with 30% developer equity and 70% long term (20 yr) debt at 7.75% interest. Project revenue derives from a 20 year PG&E power contract with a 2011 price of 9.6 cents/kwh, escalating at 1.5% annually over the life of the contract.

With the above assumptions and the capital, O&M and fuel costs developed earlier, the project delivers to the developer a net present value after tax rate of return of 17% on his equity over the 20 year life of the power contract. While an after tax equity return of 17% is acceptable to many developers, this potential project has substantial risk. For instance, none of the fuel supply is guaranteed, either in price or quantity, except on a short term basis. Mills deliver what they have to the project, but make no quantity guarantee. Forest residual quantities depend on the level of activity in the woods and continued access to materials.

Technology risk is fortunately low with the proven equipment selected. The power contract will likely have a low fixed escalator, while project O&M and fuel costs will inflate at an unknown, likely higher, rate. All of these things add up to an increased risk for the developer.

Since CSPC has attempted to be somewhat conservative in the assumptions used in this analysis, there is a fair to good chance that a biomass power facility could be developed successfully in the Fort Bragg area. The area is remote from other biomass users, an excellent site is available, local government is in support, forest landowners are in support, there are synergies (water, wastewater) with a proposed publicly developed golf course adjacent, and a strong power contract is likely available.

Discussion

There are developments in California that could further enhance project economics. A compliance strategy is being developed for the AB32 Greenhouse Gas legislation. If a cap and trade system for carbon emissions is part of the compliance strategy, this may mean another revenue stream for the project. Biomass power facilities convert potential methane emissions from forest or landfill wood disposal into carbon dioxide at a savings of a substantial quantity of greenhouse gases. This difference could be certified and sold.

The proposed project site contains over 100,000 BDT of buried redwood bark that could potentially be reclaimed, screened and air dried for a cost substantially below the highest cost projected fuel, forest residuals. The existence of this fuel on the site strengthens the overall fuel

plan and protects against temporary shortages. Local officials are urged to remove enough materials as part of the development effort to test for quality and contamination and determine if the material can be successfully air dried. Another benefit of utilizing this material is that the pits can be refilled with ash, and the available volume will last the project well beyond its projected life; saving a substantial amount in disposal costs each year. The trade of buried fuel for ash is also a net environmental benefit to the community.

The synergies with the proposed adjacent part and golf course should be developed and defined as part of the early development effort. The well field and ponds serving the golf course could also serve the makeup water needs of the power plant. Blowdown water from the power plant could be routed back to a golf course pond to be used as irrigation water. Because of the proximity of the two developments, the joint infrastructure development can aid both developments financially and remove two elements of risk for a project developer.

There is hope that a small log sawmill can be attracted to the same location to begin processing the large volume of small redwood and douglas fir logs available off private lands in the immediate Fort Bragg area. The development of this sawmill adjacent to the power facility will have substantial economic benefit to both the sawmill and power plant. The sawmill will have a lower capital cost due to no need for a boiler to serve the mill dry kilns and will have a cheaper source of dry kiln steam than if it produced the steam itself.

The power facility will benefit by having a low/no cost source for a portion of its fuel on site, and a customer for low pressure extraction steam. CSPC has analyzed many such combined heat and power applications involving sawmills, and has looked at the economic advantage to the proposed power facility. CSPC analyzed a 50 million board foot per year lumber scale sawmill locating adjacent to the power facility. The mill would supply 20,000 bdt of fuel to the plant annually and take 13,000 lb/hr of steam on average from the power facility. The synergies of the operation raise the power facility after tax equity return from 17% to 25%. The sawmill would be a substantial positive development for the proposed power facility.

The development of a 15 mw biomass power facility by private developers on the Georgia Pacific bark dump site, selling its output to PG&E, appears feasible. The project would have a substantial economic and environmental benefit to the local community as a dramatic decrease in burning of forest residuals would occur, and thinning of forests around communities would become more economic. If a sawmill could be attracted to the same or an adjacent site, the project becomes more of a sure thing. The synergies with the proposed park and golf course should be developed by local officials as a risk mitigation factor, as well as a way to improve project economics. Likewise, risk to the project developer can be mitigated by formalizing commitments from private forest landowners to make available to the project at forest landings tops, limbs and unmerchantable trees.

DESCRIPTIVE SPECIFICATIONS

AND

BUDGETARY ESTIMATE

PREPARED FOR

CITY OF FT. BRAGG

FT. BRAGG, CALIFORNIA

COVERING A

WELLONS 150,000PPH WOOD-FIRED STEAM GENERATION SYSTEM

AND

NOMINALLY RATED

17,000 KW ELECTRICAL POWER PLANT

Budgetary Estimate No. 8089

January 18, 2008

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INTRODUCTORY STATEMENT

Wellons Incorporated has been a leader in providing wood-fired energy systems and lumber dry kilns for the Forest Products Industry for over 35 years. We are firmly established, providing our customers complete services in engineering, manufacturing, and installation of our products and systems. Wellons offers a full range of products of our own design and manufacture, including lumber dry kilns, wood-fired boiler systems, wood-fuel storage bins, electrostatic precipitators, and cogeneration systems. In fact, Wellons has the unique capability of being able to offer an integrated package of a wood-fired boiler system and lumber dry kilns of our own design and manufacture.

Our company headquarters is located in Vancouver, Washington, with our main manufacturing facilities in Vancouver, Washington and Sherwood, Oregon near Portland, with additional manufacturing facilities in Surrey, British Columbia. We have sales and service offices in Idaho, Georgia, Pennsylvania, Massachusetts, Montana, and South Carolina. We have equipment installations in 40 states, Canada, Chile, Mexico, and Russia.

Our various divisions and affiliated companies bring a broad range of expertise to a wood-fired energy system project. These include:

- Wellons Water Technology provides boiler water treatment equipment and service expertise along with the ability to provide treatment chemicals, and routine boiler water treatment program monitoring.
- Our Rogue Pro Division provides refractory expertise during initial installation and to support future maintenance needs.

This proposal defines the activities associated with the supply and installation of a 150,000PPH wood-fired steam generation system, and a nominally rated 17,000 KW electrical generating facility utilizing a used and reconditioned condensing-extraction steam turbine-generator unit. Wellons' proposed scope includes equipment supply, foundation design, permitting support, mechanical installation services, commissioning and start-up services, operator training, and other support services necessary to result in a complete and operating system. Certain project responsibilities would remain with City of Ft. Bragg, with Wellons providing support.

Wellons is uniquely qualified to offer this proposal of equipment and services. Here are a few of the reasons why:

- Our business is focused on wood-fired energy systems and lumber dry kilns and the support equipment needed to operate these systems. These systems are not a part of our business, they are our business.

- Wellons has over 200 wood-fired boiler systems in operation, over 800 lumber dry kilns in operation, and has been involved in over 20 electrical power generating systems. Our recent experience includes several boilers of this size and steam conditions. This will help shorten the boiler system engineering and design cycle in order to meet project schedule needs. We have demonstrated environmental permit compliance with these recent, similar boilers which should assist in your permitting efforts. When it comes to experience in this business, we've got it.
- Working with reconditioned steam turbine-generator equipment is not new to Wellons. Our experience list includes a number of wood-fired power plants which incorporated used and reconditioned power generation equipment, including several of similar size within Oregon.
- We have our own design and engineering staff. Wellons is committed to quality and cost effective design and engineering of individual components as well as complete systems. We are fully capable of identifying what components or systems are needed for any application, then seeing the project through to completion from initial design to installation.
- We use our own installation personnel and maintain contractor's licenses in over 15 states. Wellons Rogue Pro Division provides the specialized refractory installation services for projects of this type.
- We have established relationships with key sub-suppliers for the specialty services needed when used turbine-generator equipment is part of our project.
- We are an authorized ASME facility. ASME standards are recognized throughout the world, and we are proud of the fact that we have the capability to meet these standards in our own facilities.
- Wellons is a financially sound company, fully capable of taking on this project and seeing it through to completion.

After reading this proposal, we hope that you will select Wellons, Inc., for this project.

I. GENERAL DESCRIPTION

A. OVERVIEW

The scope contained in this proposal is for a nominally rated 17,000 KW wood-fired cogeneration facility, based upon a Wellons wood-fired steam generation system, rated at 150,000PPH, and a used and reconditioned condensing steam turbine generator unit. The proposal is based upon a Wellons Model 2DS4C8.0 field erected boiler and a used turbine-generator unit which is described more fully in Section VI.

Wellons' scope also includes supply of two (2) 150 unit fuel storage bins and fuel conveying to the boiler furnace, boiler water treatment system, and other auxiliary equipment and systems.

Project Services, including engineering and design, mechanical installation, foundations design, start-up and checkout services, operator training, and permitting assistance are also included.

Specific details are provided in various sections of the proposal.

B. BOILER SYSTEM

The scope of this proposal describes a Wellons 150,000PPH boiler system, burning wood-waste, operating at 900-psig and 900 degrees F. It consists of systems engineering and design, manufacturing of the combustion equipment, boiler system, fuel storage and delivery system, electrostatic precipitator, and procurement of the associated balance of plant equipment.

The proposal scope covers the complete boiler system, starting with the fuel storage bins through the precipitator exhaust stack. The main boiler section will be housed in a building enclosure of Wellons' design and manufacture.

The proven Wellons four (4) cell furnace system will be utilized. This combustion system allows for high-efficiency wood burning as demonstrated by low fan horsepower requirements and low exhaust stack temperatures.

C. STEAM TURBINE-GENERATOR SYSTEM

A used and reconditioned condensing steam turbine-generator unit and associated auxiliary equipment would receive steam from the boiler for electrical power production. A specific used unit has not been final selected for this project. Several potential units are being evaluated in order to select the unit best suited for this application. The unit will be an automatic extraction-condensing type with a nominal rating of approximately 17 MW.

The unit selected would be inspected, modified as required to meet project requirements, and reconditioned as necessary for satisfactory operation.

Auxiliary system components are also provided as required to result in a fully operating system. Electrical switchgear, relaying and control system equipment is provided to permit electrical power delivery to the utility power network.

D. OTHER

Wellons' scope encompasses the start-up and training services to provide a high quality wood-fired electrical generation facility. Further details are provided in the various sections of this proposal.

As described more completely in this proposal, City of Ft. Bragg will be responsible for certain work scope and component supply activities. These include permitting, site preparation, fuel supply to the storage bins, fire protection, outside area lighting, utilities connections, raw water supply, electric utility company interconnection equipment and other site finishing activities.

E. BASIC LIST OF EQUIPMENT & SERVICES

Wellons Inc. will provide Project Management, Engineering and Design Services, Construction Services, and Support Services to City of Ft. Bragg as required to result in an operational facility. The following is a brief summary of the components and services which are associated with the supply of the boiler and electrical generation system. Items marked "X" are included in Wellons' proposed scope of supply. Items marked "P" are by others.

Item	
Watertube Boiler System	
Boiler Pressure Vessel	**X**
Boiler Casing and Insulation	**X**
Boiler Accessories	**X**
Sootblowers	**X**
Feedwater Control System	**X**
Supporting Structure	**X**
Furnace System	
Cell Furnace System	**X**
Metering Surge Bin	**X**

Item	
Furnace Fuel Feed Screw	**X**
Self-Cleaning Rotary Grates	**X**
Combustion Air Handling System	
Forced Draft Fan	**X**
Ducting and Insulation	**X**
Exhaust Gas Handling System	
Combustion Air Preheater	**X**
Economizer	**X**
Multiple Cone Collector	**X**
Ducting and Insulation	**X**
Induced Draft Fan	**X**
Computerized Boiler Control System	
Computer Equipment and Peripherals	**X**
Proprietary Software	**X**
Additional Boiler Equipment	
Electric Motors	**X**
Boiler System Piping	**X**
Blowdown Separator	**X**
Supplemental Equipment	
Water Treatment Equipment	**X**
Feedwater and Deaeration System	**X**
Boiler Feedwater Pumps	**X**
Boiler Gratewater Pump	**X**
Ash Handling	**X**
Emissions Monitoring Equipment	**X**
Boiler Walkways, Stairs, and Decks	**X**
Boiler Building	**X**
Facility Motor Control Centers	**X**
Steam Main & Condensate Lines to/from any process	**n/a**
Electrostatic Precipitator	
General Structure	**X**

Item	
Precipitator Internal Components	**X**
Electrical Equipment and Control	**X**
Safety Key Interlock System	**X**
Ash Handling System	**X**
Electrical Generation System	
Steam Turbine (reconditioned)	**X**
Generator (reconditioned)	**X**
Condenser (reconditioned)	**X**
Cooling Tower	**X**
Switchgear	**X**
DC Power System	**X**
Motors and Starters	**X**
Control Panels	**X**
Main Power Step-Up Transformer (reconditioned)	**X**
Switchyard Equipment	**X**
Protective Relaying and Metering (generator side)	**X**
Utility Interface	**P**
Fuel Storage and Handling System	
Two (2) Fuel Storage Bins	**X**
Fuel Delivery Conveyors to Boiler	**X**
Fuel Receiving & Handling System to Storage Bins	**P**
Project Services	
Procure & Recondition Used TG Equipment	**X**
System Design and Engineering	**X**
Site Preparation & Site Finishing	**P**
Foundation Design	**X**
Foundation Construction & Grounding Grid	**X**
Mechanical Installation-Boiler & T-G System	**X**
Electrical Installation-Boiler & T-G System	**X**
Permitting & Emissions Testing	**P**
Freight to Site-Boiler & T-G System	**X**

Item	
Finish Painting-Boiler & T-G System	**X**

F. UTILITY CONNECTIONS

Water supply-boiler system	300 gpm nominal surge make-up, 80–100 psig
Water supply-T-G system	250 gpm, 80-100 psig
Electrical	480 VAC, 3-Phase, 60 Hz
Drains	As required

II. FUEL STORAGE AND HANDLING SYSTEM

Two (2) Wellons Model A-30-40 fuel storage bins are provided with a net active and usable capacity of approximately 150 units per bin, 300 total units of storage. One unit equals 200-cubic feet in volume. Each freestanding bin system consists of a storage silo, a cone section below the silo, a powered agitator and material removal section at the bottom.

A. SILO STORAGE SECTION

The silo section of each A-30-40 bin is 30-feet in diameter at its base and approximately 40-feet high (silo section only). The silo is made up of panel sections, each approximately 6-feet wide and 10-feet high, of heavy gauge steel with pre-punched holes for bolting together. Vertical, ribbed reinforcing is provided on panel sections to give balanced structural integrity from the bottom to the top of the silo. Heavy rolled steel channel supports and ties the silo structure to the steel columns. The interior of the silo is smooth with no corrugations or flanges, with the top of a smaller diameter than the bottom, giving a negative slope to the walls to ease flow of stored material. An additional steel rolled channel is provided to bolt to the top ring of the panels and to support roof frame members.

B. ROOF STRUCTURE

A galvanized sheet steel roof is provided with a slight slope for weather run-off. Heavy main cross members, located to suit the cyclone or conveyor feed system, become part of the roof main frame. Minor joists bridge from the reinforced top silo rolled channel to the main cross members and support sheet steel roofing. Venting areas are provided between main cross members to balance internal pressures.

C. CATWALKS AND LADDERS

A catwalk grating with railing is provided at the top of the cone (base of silo) for easy access to the agitator drive wheel raceway. A guarded ladder extends from the ground to the catwalk and from the catwalk to the roof of the silo. The ladder is placed adjacent to access doors at the bottom and near the top of the silo for ease in reaching material level limit switch sensors. A handrail is provided for the perimeter of the silo roof, however any additional walkways, railings and other personnel access/safety related assemblies on top of the roof structure are not furnished by Wellons and are to be provided by others as part of the material conveying equipment to the silo.

D. CONE SECTION

The cone section ties to common support columns with the silo through a heavy rolled steel angle at the upper edge. This member also serves as a track and raceway for the upper wheel on the agitator. The cone section is made up of heavy steel rolled sections welded together when installed. The lower part of the cone section is prefabricated into a rolled ring and cone section, and ties to upper segments and the lower feed-out enclosure.

E. POWERED AGITATOR

A powered agitator is provided rotating on its' own axis and around the periphery of the cone section. This provides a positive means of bringing wood particle material from the cone and silo to the fuel removal section. The upper end of the agitator is guided and held to the track by attachment to the chain through a slot in the chain race.

When power is applied through the universal joint at its base, the agitator provides a sawing action on the fuel. The universal joint and vertical section of the agitator drive components are isolated from the fuel by a special bushed and sliding shield assembly, providing long life and easy maintenance of the universal joint and related items. The power unit for this rotating action is located at the base of the bin system for easy access.

Hinged covers are provided around the raceway at catwalk level for ease of observing and checking the upper agitator bearing, attachment to chain, adjusting chain take-up support wheels and air cylinder mechanisms. The rotating drive is protected by a current limiting sensor and relay.

A ratchet-type drive provides power for the agitator assembly to sweep around the periphery of the cone in a smooth and positive manner. Pressure applied to force the rotating agitator into the fuel is easily adjustable. The ratchet assembly consists of the following:

- Heavy-duty mill chain running on high density polypropylene chain race liners, two (2) air cylinders with 4-inch bore and 8-inch stroke, with reversing limit switch and valving, complete with mounting plate, rod ends and catches and guide bars to match chain pitch, filter, regulator and oiler set, flow control valves, air supply valve, bushed bearing and bushed idler wheels.
- Gear unit - cone gear reducer with vertical output shaft and 40:1 reduction.
- Motor - 15 hp, 1,800-rpm, TEFC, 460/230-volt, 60 cycle, 3-phase.

F. MATERIAL REMOVAL SECTION

The material removal section is located beneath the cone section. It is prefabricated in one unit consisting of twin outfeed screws with motors and drives, gear reduction units, bearings, shafting and a universal joint for the agitator. A constant speed drive is provided for fuel flow from this section at the desired rate.

- Gear unit - cone gear reducer with horizontal output shaft and 50:1 reduction.
- Motor – 7.5 hp, 900-rpm, TEFC, 480-volts, 60 hertz, 3-phase.

G. CONTROLS AND ELECTRICAL

All controls are for 120-volt circuitry and are provided for all applicable devices. Electrical motors and switches are of a proven type for this application. A material level switch is provided for high level sensing. An access door is included located adjacent to a switch positioned for easy access. The switch operates an indicating light depicting high material levels. Additional contacts are provided to operate alarm devices, which are provided by others.

H. BIN ENCLOSURE

A metal enclosure is provided to cover and protect the lower cone portion of the storage silo in order to help maintain reliability of the bin feed-out in all weather conditions. Metal siding is provided with a choice of standard colors.

I. MAIN FUEL CONVEYOR

Fuel from the material removal section of storage bin #1 is discharged into a surge area equipped with a bin level switch to prevent fuel overflow from the bin. A bottom feed drag chain conveyor forms the floor of the surge area and from there carries the fuel to the boiler house to the metering bin supply auger. Operation of the conveyor is automatically controlled via an interlock with the supply auger. The conveyor comes complete with heavy-duty chain, trough, support and reduction drive including motor. The trough is manufactured in 10-foot sections for ease of installation and is equipped with a UHMW liner for extended life and reduced drag. Outside portions of this conveyor shall be enclosed with inspection covers provided.

J. MIXING CONVEYOR

Fuel from bin #2 is metered and blended with fuel from bin #1 to obtain an optimum mix for the furnace. The mixing conveyor is complete with variable speed A.C. drive.

K. FUEL DISTRIBUTION BIN WITH METERING BIN SUPPLY AUGERS

An elevated fuel distribution bin receives fuel from the main fuel conveyor. Two (2) cross-transfer fuel augers form the bottom of the distribution bin and deliver fuel to two (2) metering surge bin supply augers (one (1) on each side of the boiler furnace). The metering surge bin supply augers each deliver fuel to the inlets of two (2) metering surge bins. Operation of the cross-transfer augers and metering surge bin supply augers is automatically controlled by level switches located in the metering surge bins.

III. BOILER AND ACCESSORIES

Specific design data is provided in various portions of this section, with specific values referenced, based upon past systems built by Wellons. During the project design, these specific values will be reviewed and adjusted as required to meet the system performance criteria.

A. GENERAL DESCRIPTION

One (1) Wellons open bottom watertube steam generator, 900-psig, 900 degrees F. operating conditions, having a capacity of 150,000 lbs/hr of steam when supplied with feedwater at 230°F and firing hogged wood-waste. The unit will be complete including equipment and accessories as described herein.

B. DESIGN STANDARDS, TESTS & REPORTS

The design, material and workmanship of all pressure parts shall be in strict conformity with the rules and regulations in effect at the date of contract as required by:

1. The ASME BOILER AND PRESSURE VESSEL CODE.
2. The laws of the state in which the equipment is to be installed.

A hydrostatic test at one and one-half times the design pressure shall be applied to the pressure part in accordance with the ASME Code.

Wellons, Inc. shall furnish Purchaser two (2) copies of the Manufacturer's Data Report. The boiler shall be registered with the National Board of Boiler & Pressure Vessel Inspectors and with the State Boiler Inspection Department in the state in which the boiler is installed.

C. DESIGN AND ESTIMATED OPERATING CONDITIONS

Steam capacity	150,000	PPH
Design pressure	1,050	Psig
Operating pressure	900	Psig
Steam temperature	900	°F
Feedwater supply temperature	230	°F

Estimated fuel flow at 50% MC WB	64,900	Lb/hr
Estimated combustion air flow	316,100	Lb/hr
Estimated exhaust gas flow	380,350	Lb/hr

D. DRUM DATA (ESTIMATED)

	Steam Drum	Mud Drum
Inside diameter	54”	48”
Length (seam to seam)	15’ - 6”	16’
Shell thickness	Per ASME	Per ASME
Head thickness	Per ASME	Per ASME

Material is SA-515-70 or SA-516-70.

Boiler drums shall be fusion welded in accordance with the latest ASME Boiler and Pressure Vessel Code, Section I covering power boilers, including x-raying and stress relieving as required.

Each drum shall be provided with a 12-inch by 16-inch man-way with cover in each head.

The steam drum will be provided with steam purifiers discharging into a pressure tight steam chamber.

E. TUBE DATA

Boiler bank: 2 - 1/2 inch O.D., 0.135 inch thick, SA-178 Grade “A” material.

Furnace water walls: 2 - 1/2 inch O.D., 0.135 inch thick, SA-178 Grade “A” material.

Furnace screen tubes: 2 - 1/2 inch O.D., 0.150 inch thick, SA- 178 Grade “A” material

Superheater tubes: 2 - 1/2 inch O.D. 0.165 inch thick, SA – 213 Grade T11

F. WATER WALL HEADER DATA

Front wall: one (1) 10” pipe, (Schedule 120) 0.843” thick, SA-106B material.

Side wall: four (4), 10” pipe, (Schedule 120) 0.843” thick, SA-106B material.

Headers are provided with handhole openings and gasketed covers for cleanout and tube maintenance.

G. SUPERHEATER

The boiler will include a pendant type superheater system designed to superheat 150,000 lbs. of steam per hour to a final temperature of 900°F at 900-psig at the superheater discharge.

Headers are 10" pipe, (schedule 120) 0.843" thick, SA 335P11 material.

H. SUPERHEAT TEMPERATURE CONTROL

A superheat temperature control system will be included with the boiler system to provide control of superheat temperature at the desired temperature over the expected range of operation. Control will be accomplished using a lower drum attemperation coil through which a portion of the superheated steam would be automatically diverted to maintain preset temperature.

I. STEAM TRIM

The steam generator shall have the following trim, complete with all integral piping:

Quantity	
Per ASME	Safety valves
2	Water column and gauge
1 set	Drain valve, water column and gauge
1	Drum vent valve
1	Steam gauge w/ siphon
1	Steam gauge shutoff valve
1	Steam sampling valve
1	Chemical feed valve
1 set	Tandem drum blowoff valves
3 sets	Tandem header blowoff valves
1	Continuous blowdown valve
1	Sootblower supply valve
1	Sootblower shutoff valve
1	Sootblower drain valve
1	Superheater drain valve

Quantity	
1	Superheater vent valve
1	Superheater thermometer
1	Stop valve
1	Drain valve

J. BOILER CASING

The setting above the front and side wall headers, rear side walls and rear wall shall be #10 gauge steel casing with 2-inch first quality ship lap tiles, high temperature cement, 2-inch 1,800° F block insulation, and three 3-inch blanket insulation.

K. MOTORIZED SOOTBLOWERS

Ten (10) rotary steam sootblowers complete with heads; 2-inch diameter element, bearings and wall box are included. These sootblowers are located in the convection bank section of the boiler and will be motorized for ease of operation.

L. RETRACTABLE SOOTBLOWERS

Two (2) retractable steam sootblowers are installed in the superheater section of the boiler. These sootblowers are piston operated, with adjustable pressure control, and come complete with motor, mounted to an enclosed drive carriage assembly.

One (1) retractable steam sootblower is also installed near the furnace floor above the furnace cells to help prevent ash accumulation within the furnace.

M. FEEDWATER AND DEAERATION SYSTEM

A horizontal spray-tray type deaerating feedwater heater is provided, capable of deaeration for 150,000PPH, 10-minute storage with fifty percent (50%) cold-water make-up capability. It shall have a 30-psig design, ASME coded and stamped, operating at 5-psig pressure.

Stainless steel spray nozzles operate under full pressure under all load conditions for maximum spray efficiency. The non-condensable gases are released to the atmosphere through an unrestricted vent condenser. The unit consists of the following:

- Horizontal tank for 10-minute storage.
- Overflow trap.
- Pneumatic level controller with diaphragm regulating valve for cold water make-up.
- Steam pressure relief valve.
- Pressure gauges and thermometers.
- Pump bypass line to tank.

N. BOILER FEED PUMPS AND GRATEWATER PUMPS

Two (2) boiler feed pumps are provided. One (1) pump shall be motor-driven and will operate as the primary pump. The second pump shall be for emergency use, and will be turbine-driven using a mechanical drive steam turbine. Exhaust from the turbine shall be vented to the deaerator or to atmosphere.

A recirculation valve will be incorporated into the pumping assembly piping.

Two (2) motor-driven grate water cooling pumps are provided for cooling cell grates.

O. BOILER SYSTEM PIPING

All materials are provided to complete piping of the following:

- Deaerator to feedwater pumps to boiler inlet.
- Boiler blowdown piping to blowdown separator.
- Treated makeup water piping from water treatment system to deaerator.
- Steam and air pressure taps to control panel.
- Gratewater piping to and from deaerator.
- Steam piping to and from feedwater pump turbine.
- Steam piping to main steam turbine inlet connection..
- Steam piping from steam turbine extraction port to deaerator.

- PRV and desuperheating stations, and associated piping for bypassing the turbine for steam supply to deaerator.
- Sootblower system steam and drain piping.

P. BLOWDOWN HEAT EXCHANGER AND SEPARATOR

An ASME coded blowdown shell and tube receiver shall be provided to separate the flash steam, exchanging heat to the condensate, venting to the deaerator heater. The heat exchanger and flash tank will be mounted in the support steel for the deaerator tank. The discharged blowdown water is piped to the building waste drain system.

A pressure rated blowdown receiver separates the flash steam from the intermittent blowdown and discharges blowdown water to a wastewater connection provided by others. The unit is located at the boiler house wall.

Manual valves are provided for header blowdown and a manual continuous blowdown is included for steam drum.

Q. FEEDWATER CONTROL SYSTEM

One (1) three-element feedwater control system shall be provided and piped to the boiler, with the sensing elements attached with isolating valves and drain valves.

R. WATER TREATMENT EQUIPMENT

A reverse-osmosis based demineralizing system will be furnished to remove dissolved minerals from the water received from the plant water supply. The basic components of the system include:

- Reverse Osmosis Machine with membrane housings and membranes, prefilter housings and filters, feed pump, and Allen-Bradley PLC-based control system. System is factory pre-assembled and mounted on a structural steel frame.
- Conductivity monitor and flow sensors.
- Membrane clean-in-place system with cleaning solution tank, cleaning pump and valving for in-place membrane cleaning. System is factory pre-assembled and mounted on a structural steel skid.
- Anti-Scalent Injection system for membrane scale prevention, with chemical solution tank with mixer and injection pump.

A 10,000-gallon water-treated storage tank is included, with associated piping, two (2) pumps and level controls.

A water treatment test station for testing boiler water is included, with sink, countertop and sample cooler assembly.

IV. FURNACE SYSTEM

A. METERING SURGE BINS

Each furnace cell has a Wellons metering surge bin to control fuel flow into the cell. A fuel level is constantly maintained in the surge bin by controlling the storage removal and conveyor chain of the distribution bin through a safety switch. Fuel is then accurately metered to the cell infeed screw at an automatically controlled rate so as to maintain boiler pressure. The bin is shipped with shafts, screws and bearings installed. An A.C. variable frequency speed drive is furnished for accurate and wide range of control. A hinged inspection cover is supplied above the furnace feed screw area for ease of cleaning and safety precautions.

B. FURNACE FUEL FEED

A constant speed, continuously running, feed screw conveys the metered fuel to the cell, where it flows down a refractory chute to the fuel pile, and isolates the metering bin from possible hot gas feedback. The feed system is complete with motor and drive ready for installation.

C. CELL-TYPE FURNACE

Four (4) Wellons cells are provided, each 8-feet in diameter, set in a side-by-side arrangement to fire independently or in unison. Each consists of heavy rolled steel outside casing with high temperature insulation and an air space between the steel shell and refractory for secondary combustion air. Sight glass openings are provided to view firing characteristics, and clean-out doors are located above and below the hearth. The refractory is field installed, consisting of minimum 9-inch thick low cement castable mullite-based shotcrete. Multiple tuyere holes are formed tangentially in the cell refractory, creating a cyclonic action. Each cell hearth is equipped with the Wellons automatic ash discharge rotary grate system.

D. ROTARY GRATE SYSTEM

The Wellons water-cooled rotary grate system is provided, which is comprised of pairs of rotating tubular tangential rolls, which index in a ratcheting manner creating a grinding effect on the ash. The tubular rolls have knobs firmly attached to their periphery and are spaced at intervals allowing for the knobbed surfaces to pass by each other and to also provide space for passage of undergrate combustion air.

The rolls are assembled in pairs, tied together to rotate in opposite directions. At timed intervals, each pair of rolls rotate, crushing the ash between them, and dropping it to a conveyor below.

These crushing tubular rolls are hydraulically powered by an indexing, ratcheting mechanism with built-in load limits to prevent overload. Should an overload condition occur, the pair of tubes suffering the overload may be reversed.

E. COMBUSTION CHAMBER

The combustion chamber is the zone where gas velocity is reduced, radiant energy is transferred to boiler waterwalls, and volatile organic compounds are reduced through complete combustion. As combustion gases enter the convection passage, heavier particulates fall into the drop-out hoppers for easy removal. Construction of hoppers is of heavy steel plate casing with 3-inch refractory and insulated lining. Particles dropping out in this area will pass into screw augers connected below. The material is then conveyed by an en masse conveyor to be discharged into Purchaser's tote bin or truck. Doors are provided for access to the combustion chamber between each cell position. Sight glass ports are provided at several locations for viewing the combustion process within the chamber.

F. SUPPORTING STRUCTURE

Heavy structural members are provided for supporting the boiler and casings. These same structural members are utilized for integral ties with walkways, catwalks, etc., in order to obtain effective utilization of material.

G. F. D. FAN SYSTEM

Warm air is drawn from the upper level of the boiler house building, through ducting, to a forced draft fan with backwardly inclined air foil wheel driven with an 1,800-rpm motor and variable frequency drive.

Air from the combustion F.D. fan is ducted through the combustion air preheater and is then routed to a set of linear controlled dampers providing pre-determined amounts of primary, secondary, and tertiary air to each cell furnace.

The air dampers are operated with an electric activated positioner, responding to signals from the computer controller, which senses changes in steam pressure. Continuous monitoring of undergrate and over-fire combustion air pressures gives assurance of the proper firing balance at all times.

Air ducting is manufactured with heavy gauge steel and insulated from the heat exchanger outlet to the cell casing with three inches (3") of 700°F mineral wool and weather protected with a 0.032" thick aluminum cover.

H. I. D. FAN SYSTEM

A single width, single inlet induced draft fan with radial tip wheel, direct coupled with an 1,150-rpm motor, with variable speed drive, maintains a constant negative pressure in the furnace, drawing the combustion gases through the economizer for feedwater heating, multiple cone collector for removal of particulate, and through the heat exchanger for pre-heating of the combustion air. The fan discharges into the electrostatic precipitator for secondary particulate removal and then to the discharge stack.

Draft control is automatically maintained with an electric actuator, operating a damper immediately ahead of the I.D. fan. The I.D. fan bearings shall be air-cooled.

Heavy gauge steel exhaust gas ducting is provided between the boiler, economizer, heat exchanger, multiple cone collector, induced draft fan and the discharge stack. All ductwork is manufactured with matching flanges, pilot drilled for assembly and seal-welded during installation. The ducting is insulated from the boiler outlet through the heat exchanger with three inches (3") of 700°F mineral wool and weather protected with a 0.032" thick aluminum cover.

I. ECONOMIZER

A factory-assembled economizer is furnished to recover excess heat in boiler exhaust gases for increasing temperature of feedwater prior to entry into the boiler steam drum.

The economizer is furnished with two (2) motor-operated rotary sootblowers, an access man-way, thermometers and safety relief valve. Unit is insulated and jacketed for weather protection and gas inlets and outlets are flanged for connection to transition duct sections. The economizer is furnished with manual drain valves to permit draining during shutdown periods.

J. MULTIPLE CONE COLLECTOR

A Wellons multiple cone collector with 9-inch diameter cast tubes is located downstream from the heat exchanger. Entrained particulate from exhaust gases is efficiently removed and deposited in the lower hopper section of the collector. These non-combustible particulates are then passed through a continually running rotary air lock valve with 1/2 hp electric motor drive, and

into a large drop-out container for convenient removal and disposal. A 3-inch pipe poke hole is provided in the hopper section just above the rotary valve and a latched 14-inch by 20-inch access door is located at a higher elevation on the hopper for inspection and maintenance. The collector is partially shop assembled and comes complete with structural supports, ladders and a service platform at the discharge level.

K. COMBUSTION AIR PRE-HEATER

A Wellons heat exchanger is installed on the boiler exhaust for cooling stack temperatures and raising combustion air temperatures. The heat exchanger allows the system to gain up to ten percent (10%) overall efficiency and permits the firing of green or wet hogged fuel (up fifty percent (50%) moisture content), as received. It consists of 3-inch vertical tubes with 0.083" wall thickness and baffles for directing forced draft air around the outside of the tube surface. Boiler gases pass through the inside of these tubes and discharge at low temperatures. Access is provided at top and bottom of the heat exchanger for ease of cleaning tubes and drop-out. Outside surfaces are fully insulated with three inches (3") of 700°F mineral wool and weather protected with a 0.032" aluminum cover. Manual heat exchanger bypass is included for stack temperature control during extended periods of low firing rates and start-up.

L. COMPUTER CONTROLS

The control system for the boiler system is based on a Programmable Logic Controller (PLC) for discrete logic control and Wellons Combustion & Process Controller for analog loop control.

The operator interface to the system is via an industrial based personal computer configured through INTOUCH Wonderware HMI software. Two (2) monitors are provided for viewing operating controls and trending information simultaneously.

1. SYSTEM COMPONENTS

- One (1) HP Compaq Business Desktop dc7600-C/P4 530 computer with 3.0 GHz, 40 GB hard drive, 106 keyboard & mouse, 48x CD-ROM, Windows XP Professional, 3 serial ports, 1 parallel port, 8 USB ports, integrated Intel PRO/100 Ethernet 10/100.
- Two (2) 17" flat-screen LCD color monitors.
- One (1) external ZIP drive.
- A Hewlett-Packard color printer.

- A Zoom V.92/V.44 external fax modem.
- Wellons Control System software package.
- Interface cables and adapters.
- I/O Interface Boiler Panel (housing analog and discrete controls).
- Supplemental Software: pcAnywhere and Modem Support Software.
- One (1) 1,000VA Uninterruptible Power Supply System (UPS) with Surge Protection and integral 12-volt battery.

2. CONTROL FUNCTIONS

- Combustion and Process Controls:
  - Fuel delivery rate.
  - F.D. fan and damper operation.
  - I.D. fan and damper control.
  - Master Control Function, which automatically controls fuel supply and F.D. fan control under several extenuating conditions.
  - Feedwater pumps.
  - Gratewater pump.
  - Tuning screens for all process controls.

- Trending and Recording
  - Steam flow.
  - Steam pressure.
  - Daily totalized steam production.
  - Boiler drum level.

3. SAFETY FEATURES

Automatic combustion control safety devices conform to applicable codes and standards and include:

- Automatic plant shutdown on low water alarm.
- Automatic plant shutdown on failure of I.D. fan by power interruption or other.
- Audible and visual alarms including:

- Boiler water level low.
- I.D. pressure low.
- Feedwater tank level low.
- Fuel System trouble.
- Steam pressure low.
- Motor operation fault.

- Individual manual over-ride controls are supplied with a master relay to shut down the entire plant.

M. ELECTRICAL MOTORS AND CONTROL PANELS

A load center provides for distribution of 480 VAC power to the various panels supplied with the system, including the boiler motor control center and the electrostatic precipitator distribution panel.

An Allen-Bradley motor control center pre-wired to NEMA Class B specifications is supplied, including main disconnects, copper busing, separate branch disconnects and necessary starters for each motor, 15 KVA lighting transformer and a branch circuit breaker panel, all in a freestanding NEMA 12 enclosure with engraved nameplates for compartment labeling.

A separate pre-wired control cabinet is also furnished and contains relays and related controls for automatic operations, along with an over-ride relay and stop button to shut down the entire plant.

Motors are Toshiba-brand, 460 volt, 3-phase, 60 hertz, high efficiency, TEFC, with a 1.15 service factor.

N. ASH HANDLING

The heavy ash deposits on cell water-cooled grates are automatically discharged into ash conveyors below the cell furnaces. This cell ash is then transferred to a primary ash conveyor which discharges into a Purchaser furnished ash receiving bin. The fly-ash collected at the boiler dropout and multiple cone collector is also conveyed to a Purchaser provided receiver. Ash from the electrostatic precipitator hoppers is dropped into a separate Purchaser provided ash bin.

O. O2 COMBUSTION CONTROL

The system is provided with O_2 combustion control by means of a power positioner actuated damper in the bypass ducting between the I.D. discharge and F.D. inlet. The sensing signal is provided to the power positioner from the computer controls.

P. CONTINUOUS EMISSIONS MONITORING SYSTEM

Opacity, CO and NOx monitoring systems (CEMS) meeting EPA Performance Specifications in 40 CFR Part 60 Appendix B shall be provided to monitor and record opacity, CO and NOx emissions levels in the boiler system exhaust stack.

The system uses the chemiluminescence method for NOx detection. The NOx level signal is also used to control the rate of urea injection. The system is complete with sensing probe mounted in the exhaust stack and heated sensing line from the probe to the gas analyzer.

The CEMS system will be capable of data storage and reporting of hourly average ppm, lbs/hr and lbs/day of any or all of the three (3) monitored pollutants, depending upon permit requirements.

The system will also provide fuel use data calculated from steam production as recorded by the boiler control system.

Stack gas flow will be derived by calculation based on steam production data.

V. ELECTROSTATIC PRECIPITATOR

A. GENERAL DESCRIPTION

1. GENERAL

A Wellons designed and fabricated three (3) field modular electrostatic precipitator (ESP), Model #3W-101-2730 Size 13, is provided for secondary particulate emission control. The unit includes all collecting plates, discharge electrodes, roof section, insulator compartments, access doors, all internal components and power supplies to make a complete assembly.

2. GENERAL STRUCTURE

The precipitator structure is a welded, totally gas tight, enclosure. The unit is fabricated from ASTM A-36 steel shapes and plate with stiffeners as required to support the precipitator equipment per the plant specific design criteria.

A structural steel support is provided under the precipitator to allow ample clearance for hoppers and ash conveying equipment installation and maintenance.

The precipitator roof contains much of the electrical equipment including: transformer/rectifier sets, high voltage bus, rappers, rapper control panel, purge air system, and the power distribution panel.

A stairway is provided from the grade line to the roof. Handrails with kickguards are provided around the perimeter of the roof and the stack-testing platform. Handrails and vertical posts are 1 - 1/2" square tubing. All access structures comply with applicable OSHA standards.

3. PERFORATED PLATES

The precipitator inlet transition has one (1) gas flow diffuser (perforated) plate and the outlet transition has one (1) diffuser plate to ensure uniform gas flow distribution. The inlet plate is equipped with a rapper to remove accumulation of dust during normal operation.

4. COLLECTOR PLATES AND ELECTRODES

The collector plates are fabricated panels of sheet steel with formed edges for stiffening. The plates are held in vertical alignment parallel to each other by hangers and an alignment assembly at the bottom. Additional support is provided by alignment bars used to maintain the spacing of the collecting surfaces located at the top and bottom edges of the collecting surfaces.

The high voltage electrodes are of a tube type mast design with spikes or studs at equal spacing. The electrodes are suspended from a framework and are supported such to prevent horizontal movement. The tubular mast is held in proper vertical alignment by a framework at the bottom of the assembly.

The collector plates are at earth ground potential, while the electrodes are at a high negative DC (direct current) voltage. Thus, the electrodes must be supported with electrical insulators to prevent the grounded plates from shorting out the high voltage electrodes.

5. EXHAUST STACK

The precipitator outlet transition and stack is equipped with test ports at the EPA test platform. All external surfaces of the transition and stack are painted with high temperature primer and finish paints. Stack discharge height is approximately 90-feet above grade.

6. HIGH VOLTAGE BUS AND INSULATORS

The high voltage bus is a rigid power conductor that supplies power from the transformer/rectifier (T/R) sets to the electrode racks. The bus is constructed of 3/4-inch pipe and is protected by a sheet metal duct.

The bus and electrodes operate at or near 60,000-volts DC (60 KV DC), which requires that they be supported and isolated from the structural steel and collector plates by insulators.

The bus is supported by the T/R set bushings and porcelain insulators. The electrode racks are supported at the top of the precipitator by alumina insulators and are stabilized at the bottom by alumina insulators. The rappers that rap the electrode rack are isolated by porcelain insulators.

7. TRANSFORMER/RECTIFIER AND CURRENT LIMITING REACTOR (CLR)

   The current limiting reactor (CLR) limits the current available to pass through the transformer/rectifier, thus providing a protective function.

   The combination of the T/R and the CLR convert 480-volts AC, single phase, to approximately 60,000-volts DC (60 KV), which is applied to the electrodes.

   The T/R set also houses a safety-grounding switch to be used during maintenance.

   A total of three (3) T/R sets are provided, with one (1) set serving each mechanical field.

8. RAPPERS

   The rappers are used to strike the collector plates, electrodes, and diffuser plates to knock loose particulate. They are basically an electro-mechanical sledgehammer.

   Energizing the rapper lifts a cylindrical metal slug. Once the rapper is de-energized, the slug falls due to gravity striking the equipment.

9. HOPPER EQUIPMENT

   Each precipitator field has a hopper, which funnels the particulate that falls from the collector plates into the precipitator ash auger for final removal.

   Each hopper is equipped with a vibrator-mounting pad on one side drilled to accommodate the future mounting of an electrical vibrator if required.

10. PURGE AIR SYSTEM

    The purge air system applies a slight positive pressure to the high voltage electrode support insulator compartments on top of the precipitator. The purge system is designed to keep the insulators clean and dry. The system includes a forced air blower with thermostatically controlled heaters and an air filter.

11. ACCESS HATCHES

Access hatches are provided for maintenance activities. All access openings into the precipitator interior, high voltage compartments, and hoppers are 24” x 30”. Each hatch is equipped with a hinged steel door, quick release hold-downs, and gas tight seals. Each door is provided with a safety key interlock and a "DANGER - HIGH VOLTAGE" warning sign. The hopper access hatches are accessible from the grade level while the rest are easily accessible from the ESP access platform.

B. PRECIPITATOR CONTROLS

The control for each type of equipment is summarized in the following sections.

1. HIGH VOLTAGE CONTROL

Each high voltage field is controlled independently by a separated microprocessor based programmable controller. This state-of-the-art controller automatically controls the voltage applied to the electrodes.

Maximum precipitator efficiency is obtained when the voltage on the electrodes is as high as possible without continuous spark-over to the collector plates; thus, the controller is continuously verifying the spark-over voltage and making the necessary adjustments.

The high voltage controller has two (2) modes of operation, "AUTO" and "MANUAL":

- AUTO - automatic control continuously adjusts the voltage to the maximum level permissible based on the present precipitator loading and conditions.
- MANUAL - manual control allows the operator to limit the maximum voltage to a lower setpoint than would normally be obtainable when in automatic. The controller will continue to automatically limit the spark-over rate by adjusting the voltage should the manual control be set too high for the present precipitator conditions.

The controller adjusts the voltage by firing a silicon control rectifier (SCR) stack, which controls the voltage to the T/R.

The controller also provides several protective functions for the T/R set and associated equipment. It also provides monitoring and alarm functions.

2. RAPPER CONTROL

The rappers are controlled by a dedicated programmable control system. The time between raps and the intensity (lift) are programmable via an external communication interface.

3. PURGE BLOWER & HEATER CONTROL

The blower fan runs continuously and is powered from the 120 VAC distribution panel on the roof. An alarm contact will alert the operator should the fan be turned off or trip during unit operation.

C. SAFETY KEY INTERLOCK SYSTEM

The safety key interlock system is a series of mechanical locks that can only be opened and closed in a particular sequence. This system is engineered to ensure that the precipitator high voltage is properly de-energized and secured before access to the precipitator internals is attainable.

D. INSULATION AND SIDING

1. Insulation: included is factory insulation of the electrostatic precipitator (including module, hopper, inlet and outlet transitions). The insulation consists of three inches (3") of 4# density mineral wool. The precipitator roof is insulated with six inches (6") of 8# density mineral wool and covered with 1/4-inch checkered plate.
2. Siding: the insulation on the module side's inlet transition and outlet transition is covered with 26-gauge, ribbed siding. The siding runs vertical and is overlapped at all seams. All openings are filled with synthetic rubber closure strips to match the siding contour.

The siding material is attached with #14 by 1" TEK screws with neoprene washers. All sheet-to-sheet connections are #14 by 7/8" stitching screws with neoprene washers. All siding seams subject to moisture infiltration are sealed with clear silicone sealant prior to assembly.

E. PRECIPITATOR ASH AUGER

Each precipitator ash hopper discharges into the precipitator ash screw auger complete with insulated formed trough, inlet and outlet and hinged and bolted inspection hatch at discharge end.

The auger drive is a Falk (or equal) shaft mounted reducer (25:1 ratio) with a 3 hp, 1,800-rpm NEMA B TEFC 460 V motor.

F. TECHNICAL SUMMARY

Design Conditions

Design Gas Volume:	160,000	ACFM
Flue Gas Temperature:	350	ºF
Flue Gas Moisture:	20	% Volume
Design Inlet Dust Load:	0.10	Gr/DSCF
Design Outlet Emission:	0.025	Lb/MM Btu input

ESP DESIGN

Gas Passages (12” Wide):	27	
Field Height:	30	ft.
No. Fields in Series:	3	
Field Length:	10.07	ft.
Collecting Area:	48,955	sq. ft.
Gas Velocity:	3.19	ft./sec.
Treatment Time:	9.49	sec.
T/R Rating:	1250	mA & 60KV
Stack Diameter:	9.0	ft.
ESP Height (Grade to Roof)	52.5	ft.
Stack Height Above Grade:	90	ft.
ESP Length Excluding Nozzles:	34	ft.
ESP Length Including Nozzles	53	ft.
ESP Overall Width	29.5	ft.

VI. ELECTRICAL GENERATION SYSTEM

The electrical generation system will consist of a used and reconditioned extraction-condensing steam turbine, generator, condenser, cooling tower and system auxiliary equipment. Control panels for electrical and mechanical control functions will be provided. Switchgear, consisting of a main power transformer and circuit breaker with relaying is provided to permit parallel operation with the local utility network.

This proposal is based on utilizing a used and reconditioned steam turbine generator unit, condenser and certain auxiliary equipment. The specific unit has not yet been selected, but is expected to have the general characteristics and features described herein.

A. TURBINE MECHANICAL SYSTEMS

Mechanical components required to provide a complete power generation system are included in this section. These consist primarily of a turbine, condenser, cooling tower, condenser condensate pumps, circulating water pumps, air ejector, piping, valves, tanks and heat exchangers to make the system operable.

1. STEAM TURBINE

The unit shall have the following general characteristics:

- Rating: nominal 17,000 KW
- Inlet steam flow minimum capacity: 150,000KW
- Exhaust pressure: 2” HgA
- Speed (preferred): 3600-RPM
- Automatic extraction pressure: approx 100 psig
- Extraction flow capacity: 15,000 to 70,000PPH

The unit will be thoroughly inspected, and reconditioned for operation as required. Turbine inlet steam conditions shall be 900-psig and 900 degrees F. Turbine exhaust conditions shall be 2” HgA.

Inspection, reconditioning, steam path design review and any required modifications shall be performed by specialty contractor, TurboCare, Inc. of Houston, Texas.

The unit will be procured with lube oil system, primary and secondary lube oil circulation pumps, trip and throttle valve, turning gear, over-speed protection, and other associated auxiliary

The unit will be provided with modern, Woodward Governor 505 type turbine-generator controls. Any control system modernization and upgrading required will be performed by specialty contractor, TurboCare, Inc.

2. USED T-G-CONDENSER EQUIPMENT PURCHASE SCOPE

The used steam turbine-generator equipment to be procured for the project shall include auxiliary and accessory equipment, and available manuals, drawings and maintenance records, consisting of:

- Steam turbine-generator set
- Associated generator and exciter
- Equipment sole plates
- Inlet throttle valve
- Extraction non-return valves
- Surface condenser and air ejectors
- Lube oil system
- Turbine-generator governor and controls
- Generator terminal boxes
- Associated piping and valves
- Turbine drains system
- Control oil system
- Any available spare parts and special tools
- O&M manuals
- Drawings of equipment and existing foundations and installation details
- Any other equipment reasonably connected to the turbine-generator-condenser

3. CONDENSER

The reconditioned condenser, procured with the turbine, is a horizontal, tube and shell, surface condenser mounted under the turbine exhaust flange. Flanged water boxes are provided for tube and tube sheet inspection and maintenance. The shell is fitted with flanged connections for removal of condensate from the hotwell, and removal of non-condensable gases. Operating pressure of the condenser is estimated to be 2" HgA.

4. AIR EJECTOR

A reconditioned, two stage-twin element, steam jet air removal package is used to remove non-condensable gases from the condenser and provide some feedwater preheat. A "hogging" ejector is also furnished for establishing condenser vacuum.

5. CONDENSATE PUMPS

Two (2) centrifugal, motor driven, condensate return pumps are provided to remove condensate from the condenser hotwell and return it to the deaerating feedwater heater of the boiler system. Each pump shall be capable of 225-gpm condensate pumping capacity.

6. COOLING TOWER

A field erected, multi-cell, PVC filled, mechanical draft cooling tower is provided to supply cooling water for the condenser, lube oil heat exchanger and generator air cooler. The tower is set on a concrete collection basin with sump. The tower location has not been finalized but is estimated to be located within 150-feet of the condenser cooling water connections. The tower will include the following features:

- Basic material – FRP.
- Fill – PVC.
- Motors – VFD service, TEFC with 1.15 service factor.
- Stainless steel hardware.

- Plenum walkway, cell partitions, basin covers and fan deck provided as applicable to tower design.
- Stairway from fan deck to ground level.

Initial cooling tower selection will be based upon the following:

- Wet bulb temperature – 60 degrees F.
- Approach – 10 degrees F.
- Range – 15 degrees F.
- GPM flow – 17,700-gpm

7. COOLING WATER CIRCULATING PUMPS

Two (2) circulating water pumps will be located at the sump of the cooling tower basin to deliver cooling water to the condenser and other auxiliary cooling water loads of the turbine-generator system. Each pump is rated for 55% of system maximum flow requirement.

8. TURBINE CONTROLS

The turbine unit will be equipped (either originally or as an upgrade) with modern, Woodward 505 type mechanical and electrical controls for normal operation, and will include the following basic features:

- Speed sensing and speed governor.
- Vibration monitoring.
- Annunciator for alarm and trip functions.
- Pressure and temperature gauges for monitoring operation.
- Inlet and extraction stream pressures and temperatures.
- Lube oil temperatures and pressures.

9. POWER PLANT PIPING

Pipe, pipe supports, valves, traps and other components are provided to complete the following piping systems:

- Boiler superheater outlet to turbine inlet.
- Turbine extraction steam piping from turbine to future process steam line connection at the building wall.

- Pressure reducing valve and desuperheating station to allow steam bypass around to turbine inlet to the process steam line.
- Cooling water circulation between condenser, cooling tower and turbine-generator heat exchangers.
- Condensate return piping from condenser to deaerator.
- Cooling water chemical treatment addition piping.
- Turbine-generator equipment drains and vents piping as required by turbine-generator unit design.
- Interconnecting lube oil piping between turbine oil reservoir and connections at the turbine and generator unit.

B. STATION ELECTRICAL SYSTEMS

The electrical system consists of the turbine driven generator and other apparatus to provide electrical power from the generator terminals to an interconnection point with the local utility electrical distribution system. All power produced by the turbine-generator system will be exported from the plant, with station operating power requirements being satisfied by existing mill power supply connections.

The interconnection point with the local utility will be the line side of a three phase line disconnect (89L) immediately after a provided line breaker (52L).

1. GENERATOR

The used steam turbine-generator set will include a 60 hertz, synchronous generator, rated to adequately match the steam turbine unit. The unit will be 3-phase, 60 HZ, water to air cooled, with static excitation.

2. SWITCH GEAR

The generator switchgear will be comprised of vertical sections located within the turbine building that house the generator breaker, termination compartments, neutral grounding, protective relaying, system monitoring and metering devices necessary for operating the generating equipment.

3. DC POWER SUPPLY

A DC power system consisting of batteries and charger is provided to actuate circuit breaker controls, control power and other essential loads.

4. GENERATOR INSTRUMENTATION AND RELAYING

Protective relaying and metering will be provided for the turbine-generator equipment, consisting primarily of (items in parenthesis are ANSI/IEEE device references):

- Synchronizing device (25), synchronizing check relay (25M) and selector switch (SS).
- Undervoltage relay (27), overvoltage relay (59), exciter field overvoltage relay (59F), and over/under frequency relay (81).
- Loss of field relay (40), negative sequence relay (46), reverse power relay (32), generator voltage controlled time overcurrent (50/51VG), generator phase sequence undervoltage relay (47G).
- Generator differential relay (87G), lockout relay (86G), generator stator temperature relay (49G), ground voltage relay (59GD), and main generator breaker (52G).
- Voltmeter switches (VS), ammeter switches (AS), synchronizer selector switch (43SS), voltmeters (VM), ammeters (AM), watt meters (WM), watt hour meters (WHM), varmeters (VARM), frequency meters (FM) as required.
- Voltage regulator (90VR), speed/load governor (65TG), field excitation equipment.

The intertie point with the electric utility will be the “line side” of the line breaker in the switchyard. The power line from the breaker “line side” and any additional metering, line protection or other equipment required by the electric utility or as a result of the existing power distribution network, is not included.

5. MOTOR CONTROL CENTER

A motor control center for the electrical generation support equipment is provided. Each motor is provided with a separate breaker, magnetic contactor, indicating lights, auxiliary relays, and start-stop button.

6. MOTORS

Power plant motors are TEFC, rated at 460 volts, 3-phase, 60 hertz, with a 1.15 service factor.

7. GENERATOR CONTROL PANELS

These will be located adjacent to the turbine controls and include the voltage regulator, breaker control switches, relays and indicating meters for voltage, current, power, reactance, power factor and synchronizing needs, as well as control devices for the generator power and control devices.

C. SWITCHYARD EQUIPMENT

The following equipment and arrangement is anticipated to be compatible with the local electric utility requirements and system protection needs, but may require adjustment following a detailed design review.

The proposed intertie with the local electrical utility network is the utility side of a Wellons furnished line breaker.

The following equipment is provided for interconnection to the electric utility network:

- Lockable three phase disconnect (89L) and support structure on the high side of the power transforment.
- Line breaker (52L) on the electric utility side of the main power transformer.
- Generator circuit breaker (52G) located in the power plant switchgear.
- A used and reconditioned oil filled, generator voltage delta to 69KV wye, outdoor substation class main power transformer, rated at approximately 18MVA, located in the power plant switchyard. The unit will be provided with taps 2.5% above and below the high side nominal voltage.

Any electric utility interconnection requirements, metering and relaying, interconnection studies, interconnecting power lines and other equipment, devices or services required for interconnection of the power plant to the local utility network are not included.

The system is not “black-start” capable and will require imported power for initial operation until the power generation system can carry station load.

VII. CIVIL AND STRUCTURAL FACILITIES

The Civil and Structural Facilities portion of the project encompasses the buildings, foundations and other related work after sub-surface preparation, soils analysis, site contouring and similar work has been performed by Purchaser. Purchaser to provide soil conditions suitable for 3000-psf load bearing.

A. BUILDING

A steel framed, uninsulated boiler room, insulated turbine room, metal sided building is provided for housing the boiler system, turbine-generator set, switchgear, condenser, controls and other auxiliary and mechanical equipment. The building would be of ridge-roof type construction having a partition wall between boiler and generator, and includes:

- Factory painted metal siding (choice of standard colors) with manually controlled vents, and translucent day lighting panels on walls.
- Windows, doors and penetrations to outside, as required.
- Maintenance laydown areas for turbine-generator consisting of concrete over "Q" decking suitable for 300-psf load.
- Catwalks, ducts, platforms, railings, stairs, ladders as necessary to reach manual controls, and maintenance and inspection areas of Wellons standard design (expanded metal to 50-psf live load).
- Plant lighting and 120-volt convenience power.
- Restroom, with toilet, sink, shower and change space is provided.
- A control room is provided to house the boiler and turbine generator controls. The room will be approximately 15-feet by 20-feet, will be insulated and climate controlled and will have lights and electrical outlets installed. Space will be provided for desk and an office area for storage files. Primary construction will be of CMU.
- An electrical switchgear/MCC room is provided to house power plant switchgear and motor control centers. The room will be climate controlled and of CMU construction.
- A separate, enclosed, water treatment/chemicals area is provided for housing the water treatment system equipment.

B. CRANE

An electrically operated bridge crane is provided in the turbine-generator room with sufficient capacity to perform maintenance on the unit. Crane is equipped with electric motor travel and lift.

C. FOUNDATIONS

Engineering, design and installation drawings are provided for foundations installation. Foundations will consist basically as follows:

- Boiler and ESP equipment footings.
- Boiler breeching slab area for fans and breeching.
- Fuel storage bin footings.
- Boiler and Turbine building footings and floor.
- Turbine-generator foundation.
- Condenser foundation.
- Cooling tower foundation.
- Switchyard equipment slabs.
- Miscellaneous pumps and other equipment foundations.

D. GROUNDING GRID

A grounding grid system design shall be provided by Wellons. Purchaser to provide soils resistivity data as part of the soils testing to be performed.

VIII. PROJECT SERVICES

The intent of the Project Services section of this proposal is to define all of the services to be performed, including engineering, design, and installation of the equipment and material specified in this proposal, including the check-out of all systems, equipment and controls necessary for the complete and satisfactory operation of the steam generation system. Design and project review meetings will be held as required with Purchaser's representatives.

A. ENGINEERING-DESIGN SERVICES

Provide complete engineering drawings for equipment assembly and systems operation along with two (2) copies of the Operation and Maintenance Manuals. A recommended spare parts list is also provided where applicable. The design is based upon past systems installed or worked on by Wellons and will meet all applicable mechanical, electrical and civil engineering standards relating to plant design in effect at the time of this proposal. Any additional requirements, as they may be determined through the Purchaser's local engineers or construction organization, may require price additions or deletions, as necessary, to cover the changes.

B. FOUNDATIONS DESIGN

Foundation design is provided for all furnished equipment foundations based upon 3000-psf soil bearing conditions and soils test data furnished by Purchaser.

C. EQUIPMENT MECHANICAL INSTALLATION

All labor, tools, equipment and crane service are provided for mechanical installation of equipment provided by Wellons, including:

- Storage bin and conveyors.
- Fuel metering bins and feed screws.
- Cell furnaces and support steel.
- Erecting boiler on setting.
- Assembly and placement of fans, multiple cone collector, combustion air preheater, electrostatic precipitator with stack, and interconnecting breeching.
- Instrumentation and control devices.
- Boiler building and catwalks.

- Setting and alignment of turbine-generator equipment, condenser, pumps, air ejectors, heat exchangers and turbine building crane.
- Electrical switchgear and switchyard equipment, M.C.C. and control panels.
- Cooling tower.

D. SYSTEM PIPING

All labor, materials and tools necessary to complete piping as described in this proposal are provided.

E. ELECTRICAL WIRING

Engineering, design and system specifications are provided for field electrical wiring from pre-wired motor control panels to motors and control components and from the generator terminals to the line disconnect on the high side of the main power transformer.

Lighting fixtures in the boiler and turbine buildings, and in other interior equipment areas are provided.

F. PAINTING

All metal surfaces are shipped with a shop coating of finish paint per Wellons standard practices. After assembly of equipment, touch-up paint is applied.

Paint colors for equipment shall be:

• Fuel conveying equipment	Tan
• Furnace cell doors	Black
• Furnace cells	Light brown
• Combustion chamber	Light brown
• Boiler	Light brown
• Deaerator	Aluminum
• Pumps, tanks, un-insulated duct work	Aluminum
• Building steel	Light brown
• Decks and stairs and platforms	Light brown

- Hand rails, toe guards, ladders — Safety yellow
- Turbine-generator set — Blue
- Drive Guards — Safety yellow

G. OSHA REQUIREMENTS

Equipment manufacture and installation will conform with applicable OSHA standards.

H. INITIAL START-UP AND TRAINING

Experienced representatives are provided for a period of up to thirty (30) man-days, not including travel time, to adjust and assist in start-up of equipment and to provide operator training. This thirty (30) man-day period shall begin upon completion of boiler boil-out. Setting and testing of the generator protective relays and testing of the turbine-generator system also occurs during this time.

I. EXTENDED SUPPORT SERVICES

For the twelve (12) month period following start-up, Wellons will provide an Extended Support Service to the Purchaser. The intent of this service is to assist the Purchaser in achieving reliable system operation and corresponding electrical power generation.

Extended Support Services include:

- Monthly site visits by Wellons Field Service Technicians and Specialists to observe operation and system adjustments, inspect equipment condition, review operating and maintenance logs, and answer questions from operating personnel.
- Periodic monitoring of boiler and turbine systems operation via modem connection.
- Boiler system water treatment program monitoring and recommendation. As part of this service Wellons Water Technology will provide the necessary treatment chemicals, with monthly invoicing.
- Operating and system maintenance surveys followed by specific recommendations based upon each site visit and the results of system monitoring.

- Long term maintenance planning and scheduling support.
- Supplemental operator training during scheduled site visits as needs are identified from periodic visits and monitoring.

J. GENERAL

Wellons, Inc., reserves the right to use either union or non-union labor. However, the installation price is based on non-union labor. If union labor is required, the price of installation is subject to review.

Standard work schedule is based on a five (5) day work week, eight (8) hour days, exclusive of Saturday's, Sundays, and holidays. Time worked other than this schedule at the direction of the Purchaser to accelerate completion shall be in addition to the contract price

IX. PURCHASER TO PROVIDE

A. EQUIPMENT UNLOADING

Purchaser will unload materials prior to arrival of Wellons' construction crew at job site, and will provide storage area, necessary security and weather protection near construction site. Unloading requirements will be limited to items that can be handled by fork lift truck.

B. SITE PREPARATION

Removal of all above and below ground obstructions in work area and bring site to grade with minimum soil bearing capacity of 3,000-psf.

C. FUEL SPECIFICATIONS

Fuel receiving, processing and conveying equipment to carry fuel into the fuel storage bins as follows:

- Fuel particle size - to provide the best combination for handling fuel through the conveyors and bins, fuel particles should be no greater in size than three inches maximum, with average of 3/4 inch or less.
- Fuel moisture content - maximum moisture content should be maintained at or below forty percent (40%) wet basis (percent water of original green weight) to assure trouble-free combustion and to maintain the rated capacity of the system.
- Ash and dirt content - for best operating results, ash and dirt content should be maintained at or below two percent (2%) dry weight. (Wood ash content is normally below one percent (1%) dry weight for wood-fuels.)

D. INTERCONNECTIONS

Connections by Purchaser include:

- Clean raw water supply to boiler building and cooling tower.
- Waste and drain piping to connections at building wall and cooling tower.
- Electric utility - 480/3/60 at the load distribution panel.
- Steam supply and condensate return piping systems from connections at building wall to and from any process loads.

- Fuel input to storage bins.
- Electric utility interconnection at the line side of the furnished line disconnect.

E. PERMITS

As the permits authorizing construction and operation are issued to Purchaser, the Purchaser shall be responsible for securing these permits. Wellons, Inc., will work closely with Purchaser during the permitting process.

F. SITE FACILITIES

All furnishings, final grading, roadways, fencing and landscaping of the facility, and any fire protection, sprinkler systems and emergency, exterior, or outside yard lighting shall be by Purchaser.

G. CHEMICALS

All water treatment chemicals (see Extended Support Services, Section VIII-I) other than boiler boil-out compound.

H. SECONDARY EMISSIONS CONTROL AND MONITORING

Any additional equipment, CEMS systems or other controls and systems for reducing, controlling or monitoring gaseous and particulate emissions from the boiler system, not specified as in Wellons' scope of supply, as may be required by governing authorities.

I. OUTSIDE YARD LIGHTING REQUIREMENTS

J. DRAINAGE PROVISIONS

Any required surface drains from the boiler area and any required surface finish of site area.

K. EMISSIONS TESTING

Any required emissions testing.

X. BUDGETARY PRICE SCHEDULE

The following pricing is presented on the basis of the proposed base work scope and options. Changes in scope by additions or deletions will result in corresponding budgetary price adjustment.

A. BASE BUDGETARY ESTIMATE

One (1) Wellons 150,000PPH capacity steam generation system, including two (2) A-30-40 fuel storage bins and an electrostatic precipitator, and a nominally rated 17,000KW steam turbine-generator system and auxiliary equipment, integrated as a complete electrical power generation system, with installation services, per proposal.

Net Price Estimate…….$34,100,000.00.

Any order placed as a result of this budgetary estimate is subject to review and price adjustment, if necessary, at the time of final order placement.

ALL PERMITS, ADDITIONAL TAXES, BONDING, OR SPECIAL REQUIREMENTS FOR PERMIT APPROVAL ARE IN ADDITION.

Budgetary Estimate No. 8089

January 18, 2008

XI. SHIPMENT AND DELIVERY

A. SCOPE OF SUPPLY

One (1) 150,000PPH Wellons steam generation facility with fuel storage and handling and ESP, and nominally rated 17,000 KW electrical power generation system, with associated project services, as described in the proposal.

B. SHIPMENT

Prices shown are F.O.B. City of Ft. Bragg, California.

C. DELIVERY

Estimated at eighteen (18) months from order placement to initial generator breaker closure. Twenty (20) months to full commercial operation.

FACILITY NAME: **FORT BRAGG BIOMASS POWER FACILITY**

ALL AMOUNTS IN $000S

KEY ASSUMPTIONS AND SUMMARY RESULTS

FIRST YEAR OF OPERATION			2011
GROSS OUTPUT (MW):			16.46
Station Service (% produced)		9.50%	1.6
OUTPUT AVAILABLE FOR PRODUCTION			14.9
CAPACITY FACTOR:			
NET OUTPUT (MW):	8,200	93.6%	13.9
Hours (365*24=8,760)			

CAPITAL:

CONSTRUCTION COSTS	$	39,014
INTEREST DURING CONSTRUCTION		3,023
INTEREST EARNINGS		0
ISSUANCE COSTS		$841
TOTAL CAPITAL COSTS:		**$42,878**
less: discounts		**$0**
Net Capital Costs		**$42,878**
NOTE: COST PER MW		$3,075

Federal Subsidiaries	
Federal	$0
State	$0
	$0

DEPRECIATION			Tax Life	Book Life-SL
Boiler / Steam Generati	60%	$25,727	7	10
Electrical Generation	35%	$15,007	20	10
Land Improvements	5%	$2,144	10	10
		$42,878		

FINANCING ASSUMPTIONS:

EQUITY	30%	$12,863
DEBT	70%	$30,014
TERM, YEARS	20	
INTEREST RATE	7.8%	
ISSUANCE COSTS	2.0%	$780

OPERATING ASSUMPTIONS:

		Year 1	Escalation	
ELECTRIC RATE ($/kWh)		$0.096	1.5%	
STEAM RATE ($/Mpph)		$0.00	0.0%	
STEAM VOLUME (Kpph)		0		
GREEN TAGS ($/kWh)			2.6%	
FUEL COSTS				
Mill Waste	Volume BDT	55,000		
Mill Waste	($/BDT)	$27.50	2.6%	
Forest Residuals	Volume BDT	45,000		
Forest Residuals	($/BDT)	$52.80	2.6%	
OTHER FUEL	Volume BDT	25,800		
OTHER FUEL	($/BDT)	$39.00	2.6%	
Total Fuel Volume - Bone Dry Ton		125,800		
STEAM PURCHASES				
STEAM VOLUME (Kpph)		0		
STEAM RATE ($/Mpph)		$0.00	2.6%	
ASH HANDLING & DISPOSAL COSTS				
Percent ash		5%		Weighted average of wood and paper fiber ash
Water		20%		Assumed moisture content for dust control
Cost per ton:				
Handling at plant, truck loading, etc.		$0	2.6%	
Freight		$8.00	2.6%	(3 loads per hour at 15 tons/load)
Tip fee or disposal fee, per ton		$7.00	2.6%	
Other		$0.00	2.6%	
Total Cost Per Ton		$15.00		
GAS				
Burner Size (mmbtu/hour)		30		in thousands
Gas cost in $ per mmBtu		$9.25	2.6%	
Gas use time per start (Hours)		6		
No. of starts per year		6		
STAFFING				
Set FTE's, Salary and Benefit costs on Staffing tab.				
Salary & Wages			2.6%	
Payroll Taxes & Benefits			2.6%	

CONSUMABLES-PER NET MW YEAR			
Cooling Tower	5200	2.6%	Corrosion inhibitors, biodispersents,
Boiler Water Treatment	2600	2.6%	Corrosion inhibitors, oxygen scavenging
Bulk Chemicals, water treatment	1000	2.6%	Lime, Caustic Soda, Magnesium Hypochlorite
Boiler bulk chemicals	0	2.6%	Limestone, Ammonia, Mag Oxide, Mag Hydroxide
Sand	0	2.6%	Applies to fluidized bed boilers only
Consumables	6200	2.6%	Batteries, gloves, uniforms, rags, lube oil, grease, etc.
Fuels	2600	2.6%	Gasoline, Diesel
CEM Chemicals	600	2.6%	
Reagents & Lab Equipment	300	2.6%	
Other	0	2.6%	
	$18,500		

ENVIROMENTAL			
Emissions Testing	$20,000	2.6%	Criteria Pollutants Only
Environmental Audit	$15,000	2.6%	
Fees, Permits	$2,500	2.6%	Based on emission fees per MW
Safety Equipment	$10,000	2.6%	
Employee Safety	$200	2.6%	Per employee per year
Safety Training	$500	2.6%	Per employee per year
Environmental consultants	$12,000	2.6%	
Well monitoring, tests	$10,000	2.6%	
Trade Organization Membership	$8,000	2.6%	
Legal Costs	$25,000	2.6%	

Insurance			
Product & Gen Liability (Based on $,000's Sales	$0.180	2.6%	For $10,000,000 Liability Umbrella
Property Insurance (per 1,000's less Land Impr.)	$1.500	2.6%	
Mgmt & Admin Workers' Comp (% of PR)	5%	Escalator built into Payroll Dollars	
O & M Workers' Comp (% of PR)	10%	Escalator built into Payroll Dollars	

ANNUAL ESTIMATED MAINTENANCE		Years 1 - 5	After 5 Yeats	
Routine Maintenance	$750,000	2.6%	3.0%	Formulas Located on OVERALL sheet.
Major Maintenance	$150,000	2.6%	NA	
	$900,000			

CAPITAL EXPENDITURES / IMPROVEMENTS			
CAPITAL EXPENDITURES	$50,000	2.6%	Rolling Stock Replacement

Utilities			
Additional Electrical Usage	$30,000	2.6%	
Gas	$0	2.6%	See separate gas cost table.
Water	$50,000	2.6%	
Sewer	$50,000	2.6%	

Property Taxes		
Tax Rate on Assessed Value	1.2%	
Discount on PP Tax tab any State property tax relief.		Note 17

TAXES	Rate	Escalation
STATE RATE	8.8%	
FEDERAL RATE	35.0%	
Federal Tax Credit ($ per kWh)	0.01	3%
Years Eligible for Tax Credit	10	

Notes:

1. Calculated from MW listed and annual capacity factor. Basis for capacity factor is 8,200 hours/yr at full load.
2. Steam sales price calculated to recover cost of current boiler O&M costs
3. First year cost of @ $.096 cents/kwh, escalating at 1.5% annually.
4. First year blended rate cost of $38.91/Bdt.
5. Gas for startup only as calculated on gas page. Escalaction at 2.6% annually.
6. Staffing shown at 16 employees, with costs shown on Staffing tab.
7. Calculated as a percentage of salaries
8. Primarily chemicals for water treatment and emission control. Escalated at 3% annually
9. See Table of Environmental Costs. Escalated at 3%.
10. Routine maintenance escalated at 3% annually.
11. Major maintenance is a reserve account that allows T-G overhaul every 6 years and superheater replacement every 12 years
12. Estimate for capital improvements.
13. Details shown in Fuel & Ash Disposal tab, with an average escalation at 2.6% annually.
14. All equipment purchased as part of initial capital cost, replaced from annual capital expenditure budget.
15. Incremental 750 kw of auxiliary power purchased from FEC at 4.85 cents/kwh
16. Incl general liability, property damage, workers' comp. See Table on Insurance. Escl @ 2.6%.
17. Amount shown is 1.2% property tax on $42,877,740 investment, discounted by state tax relief, fixed amount.

FORT BRAGG BIOMASS POWER FACILITY **CASE 1 - $42,877,740 Overall Capital Cost**

14.9 Gross Available MW 93.6% Capacity Factor

PRICING FACTORS	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total	
Sale Price-c/kWh	9.60	9.74	9.89	10.04	10.19	10.34	10.50	10.65	10.81	10.98	11.14	11.31	11.48	11.65	11.82	12.00	12.18	12.36	12.55	12.74		Note 3
mWh generated	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150		
Steam sale $/kpph	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00		Note 2
Blended Fuel cost $/Bdt	$38.91	$39.92	$40.96	$42.02	$43.12	$44.24	$45.39	$46.57	$47.78	$49.02	$50.29	$51.60	$52.94	$54.32	$55.73	$57.18	$58.67	$60.19	$61.76	$63.36		incl freight
Revenues																						**Notes**
Energy	$11,726,367	$11,902,263	$12,080,797	$12,262,009	$12,445,939	$12,632,628	$12,822,117	$13,014,449	$13,209,666	$13,407,811	$13,608,928	$13,813,062	$14,020,258	$14,230,562	$14,444,020	$14,660,680	$14,880,591	$15,103,800	$15,330,357	$15,560,312	$271,156,615	Note 1
Steam Revenue	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	Note 2
Green Tag Sales	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Other Revenue	$0																				$0	
Total Revenues	$11,726,367	$11,902,263	$12,080,797	$12,262,009	$12,445,939	$12,632,628	$12,822,117	$13,014,449	$13,209,666	$13,407,811	$13,608,928	$13,813,062	$14,020,258	$14,230,562	$14,444,020	$14,660,680	$14,880,591	$15,103,800	$15,330,357	$15,560,312	$271,156,615	
Expenses																						
Purchased Steam	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Wood Fuel	$4,894,700	$5,021,962	$5,152,533	$5,286,499	$5,423,948	$5,564,971	$5,709,660	$5,858,111	$6,010,422	$6,166,693	$6,327,027	$6,491,530	$6,660,309	$6,833,477	$7,011,148	$7,193,438	$7,380,467	$7,572,359	$7,769,241	$7,971,241	$126,299,737	Note 4
Gas	$9,990	$10,250	$10,516	$10,790	$11,070	$11,358	$11,653	$11,956	$12,267	$12,586	$12,913	$13,249	$13,594	$13,947	$14,310	$14,682	$15,063	$15,455	$15,857	$16,269	$257,776	Note 5
Salaries	$799,700	$820,492	$841,825	$863,712	$886,169	$909,209	$932,849	$957,103	$981,988	$1,007,519	$1,033,715	$1,060,591	$1,088,167	$1,116,459	$1,145,487	$1,175,270	$1,205,827	$1,237,178	$1,269,345	$1,302,348	$20,634,952	Note 6
Benefits	$421,388	$432,344	$443,585	$455,118	$466,951	$479,091	$491,548	$504,328	$517,441	$530,894	$544,697	$558,859	$573,390	$588,298	$603,594	$619,287	$635,389	$651,909	$668,858	$686,249	$10,873,216	Note 7
Consumables	$257,964	$264,672	$271,553	$278,613	$285,857	$293,290	$300,915	$308,739	$316,766	$325,002	$333,452	$342,122	$351,017	$360,143	$369,507	$379,114	$388,971	$399,085	$409,461	$420,107	$6,656,352	Note 8
Environmental Costs	$146,060	$149,858	$153,754	$157,752	$161,853	$166,061	$170,379	$174,809	$179,354	$184,017	$188,801	$193,710	$198,747	$203,914	$209,216	$214,655	$220,236	$225,963	$231,838	$237,865	$3,768,841	Note 9
Routine Maintenance	$750,000	$769,500	$789,507	$810,034	$831,095	$856,028	$881,709	$908,160	$935,405	$963,467	$992,371	$1,022,142	$1,052,806	$1,084,391	$1,116,922	$1,150,430	$1,184,943	$1,220,491	$1,257,106	$1,294,819	$19,871,326	Note 10
Major Maintenance	$150,000	$153,900	$158,517	$163,273	$168,171	$173,216	$178,412	$183,765	$189,278	$194,956	$200,805	$206,829	$213,034	$219,425	$226,007	$232,788	$239,771	$246,964	$254,373	$262,004	$4,015,486	Note 11
Capital Expenditure	$50,000	$51,300	$52,634	$54,002	$55,406	$56,847	$58,325	$59,841	$61,397	$62,994	$64,631	$66,312	$68,036	$69,805	$71,620	$73,482	$75,392	$77,353	$79,364	$81,427	$1,290,168	
Ash Hndlg, Disposal	$113,220	$116,164	$119,184	$122,283	$125,462	$128,724	$132,071	$135,505	$139,028	$142,643	$146,351	$150,156	$154,061	$158,066	$162,176	$166,392	$170,719	$175,157	$179,711	$184,384	$2,921,457	Note 13
Site Lease	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Equip Lease	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	Note 14
Utilities	$130,000	$133,380	$136,848	$140,406	$144,056	$147,802	$151,645	$155,588	$159,633	$163,783	$168,042	$172,411	$176,893	$181,493	$186,211	$191,053	$196,020	$201,117	$206,346	$211,711	$3,354,438	Note 15
Insurance	$176,178	$181,084	$186,130	$191,322	$196,663	$202,158	$207,812	$213,630	$219,616	$225,775	$232,113	$238,635	$245,347	$252,255	$259,364	$266,681	$274,211	$281,962	$289,940	$298,153	$4,639,031	Note 16
Prop Tax	$514,533	$514,533	$514,533	$514,533	$514,533	$514,533	$514,533	$514,533	$514,533	$514,533	$514,533	$514,533	$514,533	$514,533	$514,533	$514,533	$514,533	$514,533	$514,533	$514,533	$10,290,658	Note 17
ODC & PC Mgmt.	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Other Expense	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
Total Op'n Expenses	$8,413,733	$8,619,437	$8,831,119	$9,048,336	$9,271,235	$9,503,288	$9,741,511	$9,986,067	$10,237,126	$10,494,862	$10,759,452	$11,031,080	$11,309,933	$11,596,206	$11,890,095	$12,191,804	$12,501,543	$12,819,526	$13,145,973	$13,481,110	$214,873,436	
Net Operating Income	$3,312,634	$3,282,826	$3,249,678	$3,213,673	$3,174,704	$3,129,340	$3,080,606	$3,028,382	$2,972,540	$2,912,949	$2,849,476	$2,781,982	$2,710,324	$2,634,356	$2,553,925	$2,468,876	$2,379,048	$2,284,274	$2,184,384	$2,079,202	$56,283,179	
Depreciation	$4,287,774	$4,287,774	$4,287,774	$4,287,774	$4,287,774	$4,287,774	$4,287,774	$4,287,774	$4,287,774	$4,287,774	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$42,877,740	
Financing (Principal not part of Net Income)																						
Principal Debt	$674,266	$726,521	$782,827	$843,496	$908,867	$979,304	$1,055,200	$1,136,978	$1,225,094	$1,320,039	$1,422,342	$1,532,573	$1,651,348	$1,779,327	$1,917,225	$2,065,810	$2,225,910	$2,398,418	$2,584,295	$2,784,578	$30,014,418	
Interest Expense	$2,326,117	$2,273,862	$2,217,556	$2,156,887	$2,091,516	$2,021,079	$1,945,183	$1,863,405	$1,775,289	$1,680,345	$1,578,042	$1,467,810	$1,349,036	$1,221,056	$1,083,158	$934,573	$774,473	$601,965	$416,088	$215,805	$29,993,247	
	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$3,000,383	$60,007,665	
Net Income, before taxes	($3,301,257)	($3,278,810)	($3,255,652)	($3,230,989)	($3,204,587)	($3,179,514)	($3,152,351)	($3,122,797)	($3,090,524)	($3,055,169)	$1,271,435	$1,314,172	$1,361,289	$1,413,300	$1,470,767	$1,534,303	$1,604,574	$1,682,309	$1,768,296	$1,863,397	($16,587,807)	

BOOK INCOME STATEMENT

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total
YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Electric Rate ($/kWh)	$0.096	$0.097	$0.099	$0.100	$0.102	$0.103	$0.105	$0.107	$0.108	$0.110	$0.111	$0.113	$0.115	$0.117	$0.118	$0.120	$0.122	$0.124	$0.126	$0.127	
Steam Rate ($/mlbs)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	
Wood cost ($/BDT)	$38.91	$39.92	$40.96	$42.02	$43.12	$44.24	$45.39	$46.57	$47.78	$49.02	$50.29	$51.60	$52.94	$54.32	$55.73	$57.18	$58.67	$60.19	$61.76	$63.36	
kWh generated	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	122,150	
Green Tags	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	$0.0000	
REVENUES:																					
Electric Sales	$11,726	$11,902	$12,081	$12,262	$12,446	$12,633	$12,822	$13,014	$13,210	$13,408	$13,609	$13,813	$14,020	$14,231	$14,444	$14,661	$14,881	$15,104	$15,330	$15,560	$271,157
Steam Sales	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Green Tag Sales	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Federal Subsidies	$0																				$0
State Subsidies	$0																				$0
Total Revenues	**$11,726**	**$11,902**	**$12,081**	**$12,262**	**$12,446**	**$12,633**	**$12,822**	**$13,014**	**$13,210**	**$13,408**	**$13,609**	**$13,813**	**$14,020**	**$14,231**	**$14,444**	**$14,661**	**$14,881**	**$15,104**	**$15,330**	**$15,560**	**$271,157**
EXPENSES:																					
O&M	$3,406	$3,481	$3,559	$3,640	$3,722	$3,810	$3,900	$3,992	$4,088	$4,186	$4,286	$4,389	$4,496	$4,605	$4,717	$4,832	$4,950	$5,072	$5,197	$5,325	$85,652
Purchased Steam	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fuel	$4,895	$5,022	$5,153	$5,286	$5,424	$5,565	$5,710	$5,858	$6,010	$6,167	$6,327	$6,492	$6,660	$6,833	$7,011	$7,193	$7,380	$7,572	$7,769	$7,971	$126,300
Ash Disposal	$113	$116	$119	$122	$125	$129	$132	$136	$139	$143	$146	$150	$154	$158	$162	$166	$171	$175	$180	$184	$2,921
Total Op Expenses	**$8,414**	**$8,619**	**$8,831**	**$9,048**	**$9,271**	**$9,503**	**$9,742**	**$9,986**	**$10,237**	**$10,495**	**$10,759**	**$11,031**	**$11,310**	**$11,596**	**$11,890**	**$12,192**	**$12,502**	**$12,820**	**$13,146**	**$13,481**	**$214,873**
OPERATING INCOME	**$3,313**	**$3,283**	**$3,250**	**$3,214**	**$3,175**	**$3,129**	**$3,081**	**$3,028**	**$2,973**	**$2,913**	**$2,849**	**$2,782**	**$2,710**	**$2,634**	**$2,554**	**$2,469**	**$2,379**	**$2,284**	**$2,184**	**$2,079**	**$56,283**
INTEREST	$2,326	$2,274	$2,218	$2,157	$2,092	$2,021	$1,945	$1,863	$1,775	$1,680	$1,578	$1,468	$1,349	$1,221	$1,083	$935	$774	$602	$416	$216	$29,993
																					$0
DEPRECIATION	$4,288	$4,288	$4,288	$4,288	$4,288	$4,288	$4,288	$4,288	$4,288	$4,288	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$42,878
																					$0
PRETAX INCOME	**($3,301)**	**($3,279)**	**($3,256)**	**($3,231)**	**($3,205)**	**($3,180)**	**($3,152)**	**($3,123)**	**($3,091)**	**($3,055)**	**$1,271**	**$1,314**	**$1,361**	**$1,413**	**$1,471**	**$1,534**	**$1,605**	**$1,682**	**$1,768**	**$1,863**	**($16,588)**
TAXES	($2,590)	($3,932)	($3,180)	($2,642)	($2,258)	($2,249)	($2,248)	($1,783)	($1,337)	($1,361)	$193	$211	$230	$251	$275	$326	$381	$412	$447	$486	($20,366)
NET INCOME - BOOK	**($712)**	**$653**	**($75)**	**($589)**	**($947)**	**($930)**	**($904)**	**($1,340)**	**($1,754)**	**($1,694)**	**$1,078**	**$1,103**	**$1,131**	**$1,162**	**$1,196**	**$1,208**	**$1,224**	**$1,270**	**$1,321**	**$1,377**	**$3,778**

TAX INCOME STATEMENT

PRETAX INCOME	($3,301)	($3,279)	($3,256)	($3,231)	($3,205)	($3,180)	($3,152)	($3,123)	($3,091)	($3,055)	$1,271	$1,314	$1,361	$1,413	$1,471	$1,534	$1,605	$1,682	$1,768	$1,863	($16,588)
PLUS: BOOK DEPRECIATION	$4,288	$4,288	$4,288	$4,288	$4,288	$4,288	$4,288	$4,288	$4,288	$4,288	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$42,878
LESS: TAX DEPRECIATION	($4,346)	($7,587)	($5,685)	($4,305)	($3,303)	($3,222)	($3,157)	($1,953)	($796)	($796)	($796)	($796)	($796)	($796)	($796)	($733)	($670)	($669)	($670)	($669)	($42,543)
PRETAX INCOME	**($3,360)**	**($6,579)**	**($4,653)**	**($3,249)**	**($2,220)**	**($2,113)**	**($2,022)**	**($788)**	**$401**	**$437**	**$475**	**$518**	**$565**	**$617**	**$674**	**$802**	**$935**	**$1,013**	**$1,099**	**$1,194**	**($16,253)**
State Taxes	($296)	($579)	($409)	($286)	($195)	($186)	($178)	($69)	$35	$38	$42	$46	$50	$54	$59	$71	$82	$89	$97	$105	($1,430)
less: State credits	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
Fed Taxes	($1,072)	($2,100)	($1,485)	($1,037)	($709)	($675)	($645)	($251)	$128	$139	$152	$165	$180	$197	$215	$256	$298	$323	$351	$381	($5,188)
less: Federal credits	($1,221)	($1,253)	($1,286)	($1,319)	($1,354)	($1,389)	($1,425)	($1,462)	($1,500)	($1,539)	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	($13,748)
Net Taxes	($2,590)	($3,932)	($3,180)	($2,642)	($2,258)	($2,249)	($2,248)	($1,783)	($1,337)	($1,361)	$193	$211	$230	$251	$275	$326	$381	$412	$447	$486	($20,366)

PROJECT ONLY - CASH FLOW

PRETAX NET INCOME	($3,360)	($6,579)	($4,653)	($3,249)	($2,220)	($2,113)	($2,022)	($788)	$401	$437	$475	$518	$565	$617	$674	$802	$935	$1,013	$1,099	$1,194	($16,253)
PLUS: TAX DEPRECIATION	$4,346	$7,587	$5,685	$4,305	$3,303	$3,222	$3,157	$1,953	$796	$796	$796	$796	$796	$796	$796	$733	$670	$669	$670	$669	$42,543
LESS: Loan Principal	($674)	($727)	($783)	($843)	($909)	($979)	($1,055)	($1,137)	($1,225)	($1,320)	($1,422)	($1,533)	($1,651)	($1,779)	($1,917)	($2,066)	($2,226)	($2,398)	($2,584)	($2,785)	($30,014)
LESS: Net Taxes	$0	$0	$0	$0	$0	$0	$0	$0	$35	$38	$42	$46	$50	$54	$59	$71	$82	$89	$97	$105	$768
AFTER TAX CASH	**$312**	**$282**	**$249**	**$213**	**$174**	**$129**	**$80**	**$28**	**$7**	**($49)**	**($109)**	**($173)**	**($240)**	**($312)**	**($387)**	**($461)**	**($539)**	**($627)**	**($719)**	**($816)**	**($2,956)**

NET CASH FLOW - PROJECT ONLY																					
EQUITY	**(12,863)**																				($12,863)
CASH FLOW	**$312**	**$282**	**$249**	**$213**	**$174**	**$129**	**$80**	**$28**	**$7**	**($49)**	**($109)**	**($173)**	**($240)**	**($312)**	**($387)**	**($461)**	**($539)**	**($627)**	**($719)**	**($816)**	($2,956)
NET CASH (12,863)	$312	$282	$249	$213	$174	$129	$80	$28	$7	($49)	($109)	($173)	($240)	($312)	($387)	($461)	($539)	($627)	($719)	($816)	($15,820)
CUMULATIVE CASH FLOW	**($12,551)**	**($12,269)**	**($12,019)**	**($11,806)**	**($11,632)**	**($11,503)**	**($11,423)**	**($11,395)**	**($11,387)**	**($11,436)**	**($11,545)**	**($11,718)**	**($11,958)**	**($12,270)**	**($12,657)**	**($13,118)**	**($13,657)**	**($14,284)**	**($15,003)**	**($15,820)**	

NPV OF TOTAL BENEFITS for 10 Years:

5%	**($11,081)**
10%	**($10,721)**
IRR	**#DIV/0!**

NPV OF TOTAL BENEFITS for 20 Years:

5%	**($12,920)**
10%	**($11,536)**
IRR	**#DIV/0!**

TOTAL PROJECT BENEFITS (PROJECT +LP)

Project State Taxes		$0	$0	$0	$0	$0	$0	$0	$0	$35	$38	$42	$46	$50	$54	$59	$71	$82	$89	$97	$105	$768
Project Federal Taxes		$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$152	$165	$180	$197	$215	$256	$298	$323	$351	$381	$2,519
ADDITIONAL TAX CREDITS - LP																						
EXCESS STATE CREDITS		$296	$579	$409	$286	$195	$186	$178	$69	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
EXCESS FEDERAL CREDITS		$2,294	$3,353	$2,771	$2,356	$2,062	$2,063	$2,070	$1,713	$1,372	$1,400	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
TOTAL		$2,590	$3,932	$3,180	$2,642	$2,258	$2,249	$2,248	$1,783	$1,372	$1,400	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
NPV OF ADDITIONAL CREDITS:																						
5%	**$18,949.05**																					
10%	**$15,576.09**																					
TOTAL CASH FLOWS	(12,863)	$312	$282	$249	$213	$174	$129	$80	$28	$7	($49)	($109)	($173)	($240)	($312)	($387)	($461)	($539)	($627)	($719)	($816)	
EXCESS STATE TAX CREDITS		$296	$579	$409	$286	$195	$186	$178	$69	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
EXCESS FEDERAL TAX CREDITS		$2,294	$3,353	$2,771	$2,356	$2,062	$2,063	$2,070	$1,713	$1,372	$1,400	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	
TOTAL BENEFITS	**(12,863)**	**$2,902**	**$4,214**	**$3,430**	**$2,855**	**$2,432**	**$2,378**	**$2,328**	**$1,811**	**$1,379**	**$1,351**	**($109)**	**($173)**	**($240)**	**($312)**	**($387)**	**($461)**	**($539)**	**($627)**	**($719)**	**($816)**	

NPV OF TOTAL BENEFITS for 10 Years:

5%	**$6,965.33**
10%	**$3,438.69**
IRR	**18%**

NPV OF TOTAL BENEFITS for 20 Years:

5%	**$5,127.02**
10%	**$2,623.84**
IRR	**17%**