

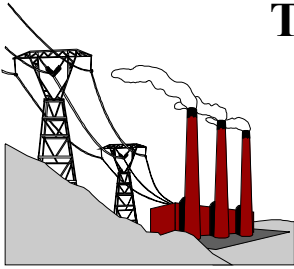
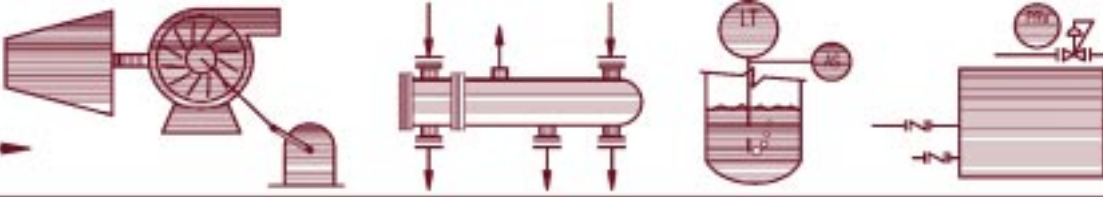
ENERGY SOURCE

A Newsletter published by

ESI Inc. of Tennessee

for Industrial Steam and Power Users

Winter 2001



To Generate or Not Generate?

That is the question that Wausau Papers in Groveton, NH recently answered.

*By: Jeffrey H. White, Vice President of Sales, ESI
David P. Auger, Purchasing Manager, Wausau Papers*

Editor's note: The following article discusses how Wausau Papers made the decision "To Generate or Not Generate?" A general article about this topic was presented in the Winter 2000 ENERGY SOURCE.

In 1993, ESI performed its first project for Wausau Papers: the installation of a new boiler and demineralized water system for their Brokaw, Wisconsin facility. In 1995, Wausau first approached ESI concerning their energy island for their Groveton, NH facility. Like many other Northeast manufacturing facilities, they were faced with high electrical costs compared to other facilities in the South and Midwest. At that time, Wausau contracted with ESI to perform an engineering study to evaluate their options regarding reducing their electrical costs. Since the facility was producing most of its steam and part of its electricity from #6 fuel oil, the study revealed combustion turbine cogeneration to be marginally attractive. After much review, rather than proceed with the project, Wausau elected to negotiate with the local utility for a better rate structure.

A few years ago, two announcements renewed Wausau's interest in potentially reducing energy costs: the announcement that a new natural gas line was to be installed across New Hampshire and the announcement that electrical deregulation was pending for the state. With these two events as the driving force, Wausau once again commissioned ESI to review their options. In order to determine the best recommendation, the first thing that ESI had to do was gather information on the current operating conditions. Fortunately, Wausau maintains excellent utility records, making this task relatively simple. Table I summarizes the information required by ESI to make a proper evaluation.

Currently, Wausau's energy island consists of two boilers and a condensing steam turbine-generator: Boiler #1 is a 200,000 pph field-erected boiler that is fired by natural gas and #6 fuel oil. Boiler #2 is a 60,000 pph boiler, which was installed in 1960, fired by #6 fuel oil. This boiler is only utilized in case of an outage for Boiler #1. The condensing steam turbine-generator system can produce up to 6.2 MW.

ENERGY SOURCE

The *ENERGY SOURCE* is published quarterly for customers, employees, and friends of ESI, Inc. of Tennessee.

ESI is an engineering and construction firm that specializes in steam and power projects for industrial and utility clients.

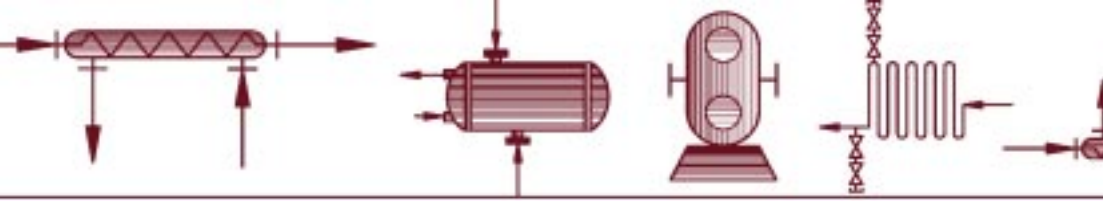
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Happy New Year

Deanna White
Managing Editor

The task of evaluating all the different options and combinations for a facility like this can be a little overwhelming. The minimum and maximum values for each of the operating parameters must be evaluated and considered along with the annual average values. This, coupled with the various options for combustion turbine configurations, led ESI to a two-step evaluation process. The first step involved a brainstorming session where the ESI and Wausau Papers team determined the most practical options to be evaluated. The options that were selected are shown in Table II.

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To Generate or Not Generate?

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Table I. Summary of information required for proper evaluation.

STEAM
<ul style="list-style-type: none"> · Operating Hours per Year for Each Boiler · Natural Gas Cost (\$/mmbtu) · Annual Maintenance Cost (\$/k#stm) · Number of Operators · Annual Cost per Operator · Water Cost (\$/k gal) · Chemicals Cost (\$/k#stm) · Operating Steam Pressure (psig) · Steam Temperature (°F) · Each Boiler Operating Efficiency (%) · Blowdown Rate (%) · Boiler Feedwater Temperature (°F) · Make-Up Water Temperature (°F) · Existing Steam T/G Operating Conditions · Average Condenser Load (pph) · Each Boiler Steam Flow (pph)
ELECTRICITY
<ul style="list-style-type: none"> · Power Cost (\$/kwh) · Back-Up Power Cost (\$/kw-mo) · Purchase Power Energy Cost (\$/kwh) · Annual Maintenance Cost (\$/kwh) · Number of Operators · Annual Cost per Operator · Maximum Plant Load (kw) · Average Hourly Plant Usage (kw) · Average Hourly Plant Purchase (kw) · Average Hourly Steam T/G Generation (kw)

With the options selected, ESI had to develop a capital cost estimate and the estimated operating cost for each option. The next step was to build a simple economic model which compared each of the options against the status quo to determine the Net Present Value and the Internal Rate of Return for each option. Wausau provided the final pieces of the puzzle by retaining a firm familiar with the electrical and natural gas markets, as well as the ongoing legislation surrounding deregulation, to provide a prediction of future electrical and fuel costs. The economic model for a twenty-year project life was completed and it was apparent which option would be the best for Wausau's particular circumstances. One of the keys to evaluating a cogeneration project is to find commercially available technology which can simultaneously satisfy the steam and electrical loads for the facility. The system which best satisfied both of these requirements was a nominal 7.0 MW machine matched with a heat recovery steam generator capable of supplemental firing to produce 170,000 pph of steam. This arrangement will allow

Wausau to essentially self-generate all of its own electrical power with the combined new combustion turbine and existing steam turbine-generator.

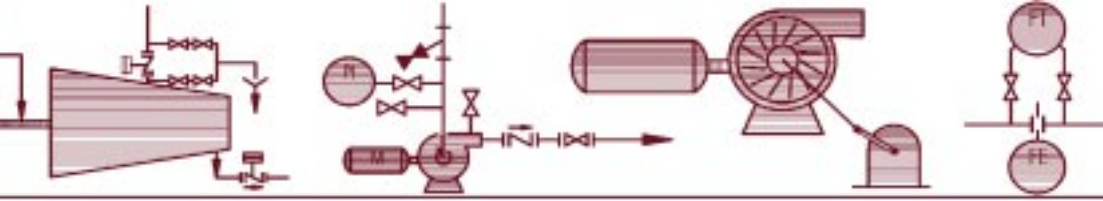
Table II. Options selected to be evaluated.

Option #	Number and Size of Units	Electrical Back-Up
Option 1	One (1) 7 MW Combustion Turbine	Utility
Option 2	Two (2) 6 MW Combustion Turbines	Installed Capacity
Option 3	Two (2) 7 MW Combustion Turbines	Installed Capacity
Option 4	One (1) 10 MW Combustion Turbine	Utility

The issue of electrical back-up was by far the most critical and difficult one to properly analyze. The anticipated frequency, duration, load, and pricing for utility back-up power had to be evaluated against installing sufficient spare capacity to provide back-up if operated disconnected from the local utility. Also considered was the possibility of load shedding and production interruptions to mitigate the capital requirements associated with installing back-up capacity. Ultimately, the analysis verified, as it usually does, that it is far more economical to utilize the utility in a back-up role, even though the back-up power rate is substantially higher than the normal rate. Except in the event of a catastrophic machine failure, it is very difficult to economically justify capital associated with back-up capacity. The key factor in this analysis is always the continuing duration of any demand charges triggered by the back-up power use.

The next step in the project development was to perform a more detailed economic and engineering analysis of the option selected. Throughout this process, ESI worked with the Wausau Papers' energy team to ensure a thorough understanding of the facility's

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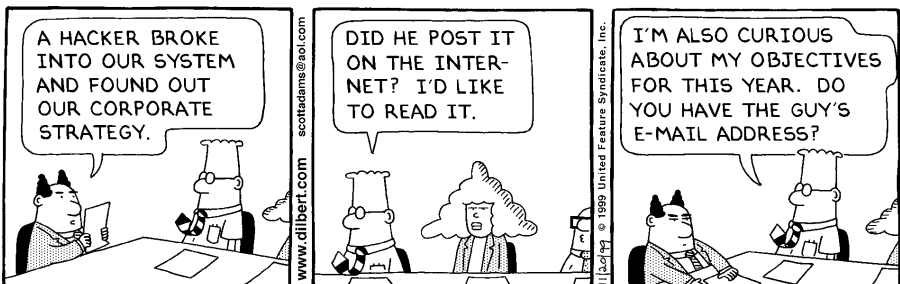
DESIGN TIPS

The ground floor slab of an industrial building is critical to its function and appearance. A slab that is badly cracked is unattractive and can obstruct normal building traffic. The keys to minimizing these problems are to consider both the in-situ soil conditions and the actual loads for which the slab is to be designed.



Following are a few design tips:

- When specifying slab design loads, consider laydown and storage area loads as well as equipment and fork-truck loads. These, along with the soil conditions, will dictate the slab thickness and reinforcing.
- Depending on the design conditions, soil supported slabs may be reinforced with wire fabric, rebar or fibers. If wire fabric is used, specify mats rather than rolls for ease of installation and require that the fabric is supported or pulled up into the top third of the slab cross section. Additional reinforcing may be added perpendicular to re-entrant corners of slab openings in order to prevent cracking along the diagonals.
- Make sure that an adequate number of control/construction joints are placed in the slab to minimize shrinkage cracking. Control joints that are saw cut into the slab should be made as soon as the freshly placed concrete will support foot traffic.
- No slab system will perform well unless the sub-base is correctly prepared. A geotechnical engineer should be contacted early in the project and given the design parameters for the slab. His recommendations for soil preparation should be made a part of the bid documents of the concrete construction package.
- Even a slab that is well designed and placed on a properly prepared sub-base will have problems if not cured properly. Be sure that the chosen curing method is compatible with the expected climate.

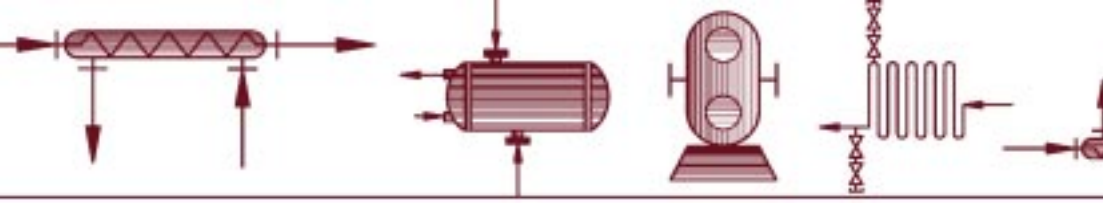


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HISTORY OF ESI

By: William L. Reeves, P.E., President, ESI

In over 20 years of business and developing close personal and business relationships, we often get questioned about the background and history of ESI. In response to the inquiries of our readers, we have decided to tell you a little about ESI and our history.

ESI is a design engineering and construction firm that specializes in the design and construction of steam and power facilities. Steam, power, and utility work is the only kind of work that ESI does, so we are very specialized in our project experience and expertise. Our driving purpose is to be the best at what we do, the *SPECIAL FORCES™* of the steam and power business.

ESI began in 1979, primarily performing the conversion of industrial clients from firing gas and oil to coal. In the early 80's, the dramatic difference in energy fuel costs between gas/oil and coal provided a substantial economic driving force for these conversion projects. In the mid 80's, the drop in gas/oil prices and more stringent environmental regulations essentially ended the coal conversion business.

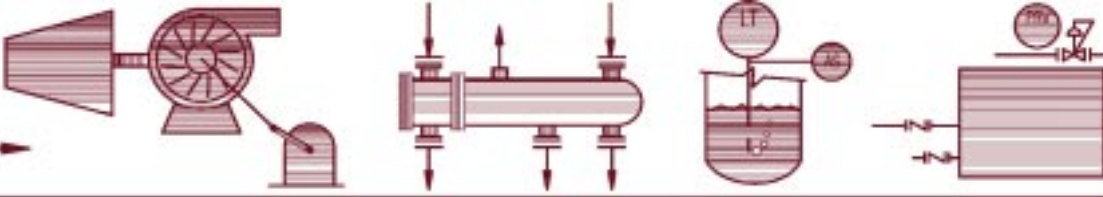
ESI was forced to make a transition in our business to performing gas/oil, wood waste, plant waste, and other alternative fuel burning projects. Our primary business became performing major modifications to existing wood-fired boilers. At that time, most operating wood-fired boilers had been installed in the past three decades by the forest product industries. These boilers were actually coal-fired designs and subsequently, were very inefficient in burning wood waste. In the 80's, clients began focusing on taking advantage of the energy value of this waste wood, as well as responding to increasing environmental pressures to operate with reduced emissions. ESI performed several wood-fired boiler enhancement projects by adding water-cooled surface, installing complete new front walls, designing and installing state-of-the-technology fuel feed and overfire air systems, water-cooled stokers, etc. These modifications improved combustion efficiency, increased steam capacity, and eliminated emission problems that allowed these customers to delay installing new boiler capacity and other environmental equipment projects. We were also often successful in making wood-fired power boilers track plant process load swings, thus eliminating the requirement to combination fire gas and oil with wood waste.

In the late 80's, ESI purchased the Bahco bark drying technology, which complemented other technologies to improve wood-fired boiler operations. ESI actively began performing projects in the pulp and paper industry which included handling and disposal of paper mill sludge. ESI's broad handling experience with difficult materials such as waste wood, paper mill sludge, and other plant waste materials has been a fundamental capability that has brought clients to ESI to apply that expertise in specialized applications.

In the 90's, ESI was involved in several projects that represented both first-of-a-kind applications and emerging commercial technologies. These projects included:

- A paper mill sludge conversion facility that receives, handles, dries, and converts 1300 tons per day of 60% moisture content paper mill sludge into steam, power, and a glass aggregate product for commercial sale.
- A carbon burn-out facility that reduces the high carbon content of utility fly ash caused by low NO_x burner conversion while simultaneously recovering the energy into the utility boiler heater cycle.
- The recommissioning and retrofit of a chemical recovery boiler with an open bottom bubbling fluid bed technology to increase steam capacity while simultaneously burning paper mill sludge, wood waste, and tire-derived fuel.

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operational requirements. ESI developed specifications and obtained bids for all of the system's major components. ESI and Wausau developed a detailed economic model that mirrored the facility's accounting systems. This model contained information on the capital cost estimate that ESI developed, the analysis that other consulting firms provided on the future natural gas and electric prices, as well as the project sensitivity to higher and lower than predicted prices. At the same time, ESI analyzed how different operating parameters affected the system design and its ability to supply the necessary steam and power. This resulted in a matrix of the different operating parameters in which monthly high, average, and low steam and electrical demands were tracked against monthly high, average, and low ambient air temperatures to determine if the selected configuration could properly respond under each of these operating parameters.

The option selected met all operating required parameters. ESI then provided a detailed document which included the revised financial model, as well as detailed general arrangement drawings, process and instrumentation drawings, and descriptions of all equipment and services necessary for a complete project. Included in the analysis were the cost of items such as the engineering performed to date, re-permitting the facility, training of all operations staff, a centralized control for both the new and existing system components, interest during construction, spare parts, and potential lost revenue associated from possible start-up problems.

Once this document had been properly reviewed by all concerned parties, Wausau received project approval from its Board of Directors. Although a five-year project development cycle is not ideal, both ESI and Wausau are excited to finally have a project approved that will have such a positive impact on the future economic viability of this facility.

If your company is evaluating the financial benefits of a potential cogeneration project or is considering signing a long-term power contract, ESI would be happy to perform a low-cost study which would assist you greatly in that evaluation. We can be contacted at 770-427-6200 or by e-mail at energysource@esitenn.com.

History of ESI *Continued from Page 4*

- A power boiler retrofit to process and burn 3% solids paper mill sludge in suspension along with conventional fossil fuels.

ESI owns its own office building located in Kennesaw, Georgia, which is a suburb of Atlanta. We originally started in Chattanooga, Tennessee in 1979 and moved to Atlanta in 1984. Many of the people who started with ESI in the early days are still with the company. Jack Brown, Don Ryan, and Ginny Hicks continue to serve in management of their respective areas. Tim Goins, Stig Larsson, Mark Lassetter, Becky Lewis, Tim Lunde, Mitch Mason, Tony Miller, Jon Nix, Arlon Ward, Chuck Ware, and Jeff White have been with the company for over 10 years. ESI is also proud of our alumni who have gone on to new opportunities, many of which to own and operate their own businesses. Doug Kindred is now the President of Amerex Industries, a supplier of environmental pollution control equipment to ESI. We pray for success and good fortune to those who have gone on to other endeavors.

We have many fond memories of our company history, but probably none better than the opportunity to develop many close business and personal relationships with our customer representatives. We truly owe our success to your faith in our abilities, the opportunity you have given us to serve you, and your unending support. Thanks to all of you from all of us at ESI.

Stay Tuned! In the Spring Issue, ESI will present our Mission, Core Values, and Operating Code of Ethics.