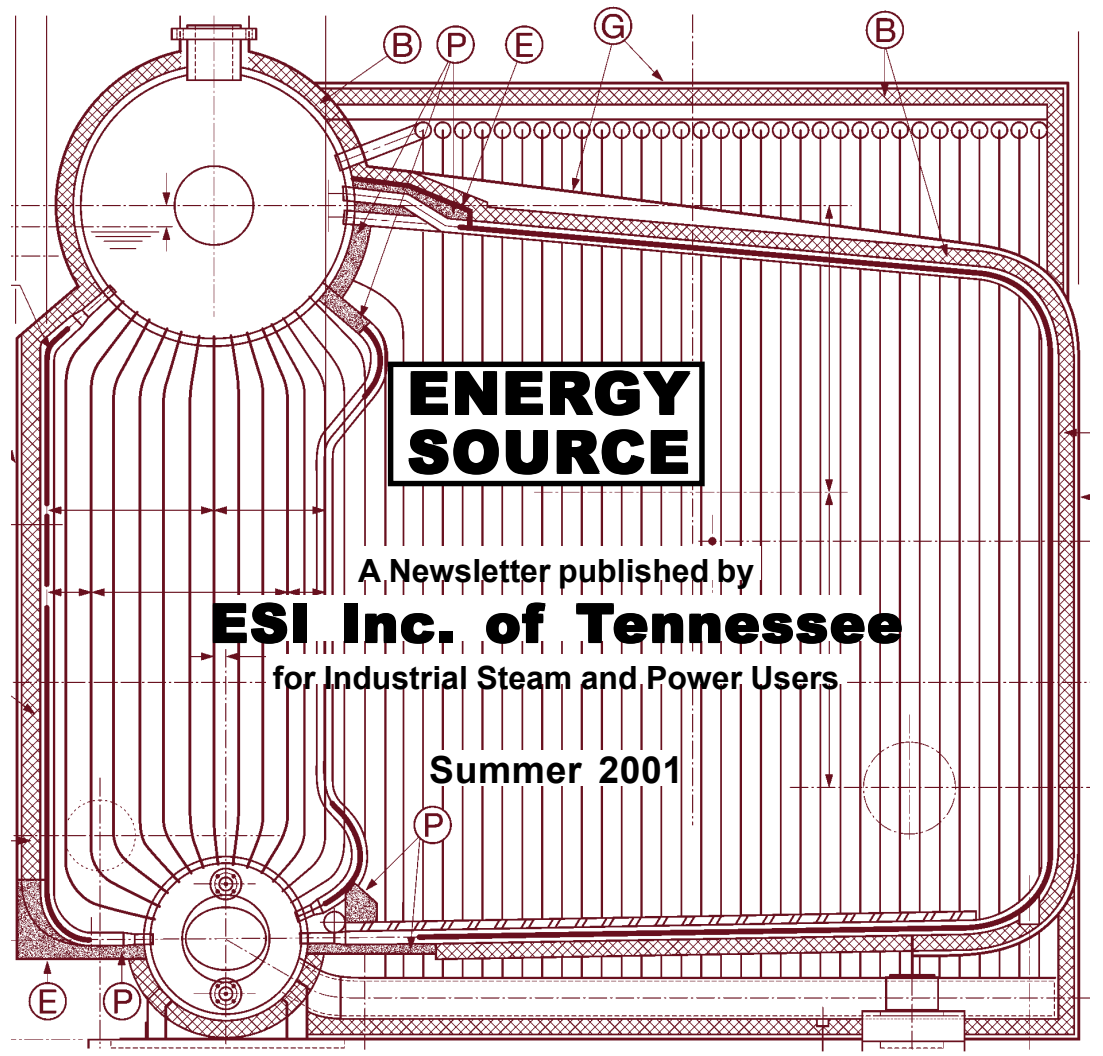


ENERGY SOURCE

A Newsletter published by

ESI Inc. of Tennessee

for Industrial Steam and Power Users

Summer 2001

How To *Connect* With Your Utility

By: Mark D. Lassetter, P.E., Technical Manager, Electrical & I/C Engineering

Once a decision has been made that cogeneration is economically viable for your facility, the electrical connection to the utility must be examined closely. This "interconnection" is the critical interface between the utility and the customer. When a customer owns and operates its own electrical generation source and is electrically connected to the utility, this is known as *Parallel Operation*. Before a customer can operate in parallel with the utility, the proposed generation installation must be reviewed and approved by the utility.

Standards and Practices

Each utility has very well-defined procedures for this approval process, which includes the standards and practices that must be followed before any customer can generate in parallel with that utility. The Federal Energy Regulatory Commission (FERC) has authority over any interconnection to the electric power system and The North American Electric Reliability Council (NERC) has published standards and practices for interconnection with which the utilities must comply. The primary goals of these requirements are safety for the customer and the utility personnel, and reliability of electrical service.

Interconnection Study

Typically, the first step in the process of parallel operation is to request from the utility an *Interconnection Study*. In this study, which is normally paid for by the customer, the utility will determine the following:

- Requirements for electrical equipment and protective relaying
- Impact to the transmission system
- Impact to other customers
- Preliminary interconnection cost estimate

The customer will normally have to provide information such as: a detailed one-line electrical diagram of the proposed installation, and the technical equipment specifications for the generation source and the main step-up transformer. The one-line diagram must illustrate all the proposed electrical equipment, in particular the means of disconnecting from the utility, and all the protective relaying.

After completion and release of the Interconnection Study, the customer should review the results carefully and discuss any issues with the utility prior to proceeding with the project. The requirements could have

Continued on Page 2

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.

Complimentary subscriptions to the *ENERGY SOURCE* are available by calling 770-427-6200 or visiting our web site at www.esitenn.com. If you have any suggestions or comments about the newsletter feel free to call us or e-mail us at energysource@esitenn.com.

Deanna White
Managing Editor

How To *Connect* With Your Utility... *Continued from Page 1*

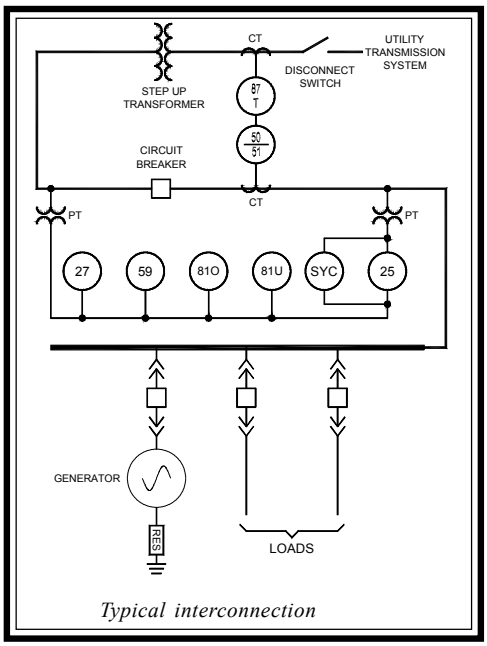
significant costs associated with them and if upgrades must be performed to the transmission system by the utility, there may be a delay in the project schedule. In addition, the study itself could take up to a year to be completed. All these factors that could affect schedule must be considered during the planning stages of a project.

Operating Criteria and Protective Relaying

To ensure that the customer's generating equipment does not cause problems to the electric service the utility is providing to other customers, the utility has set certain acceptable ranges for the following operating criteria:

- Voltage
- Flicker
- Frequency
- Power factor
- Harmonics
- Fault current

As part of the interconnect study, the utility will specify the protective relaying required at the interconnection. These devices are utilized to monitor many of the factors listed above, and are in addition to devices provided with the generation equipment. If during parallel operation by the customer, one of these monitored factors exceeds the allowable range, the interconnection between the utility and the customer will be opened to protect the integrity of the electric service.



Typical interconnection

The types of protective relays that are typically required for parallel operation are presented in the table below. Additional devices, including relays, meters, and telemetry, may be required depending on the installation and the operating parameters.

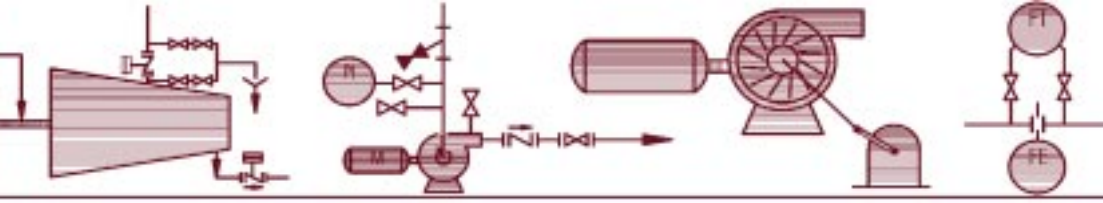
Type of Protective Relay	Device #
Over Voltage	59
Under Voltage	27
Over Frequency	81O
Under Frequency	81U
Over Current - Instantaneous	50
Over Current - Time	51
Transformer Differential	87T

Disconnection and Synchronization

To electrically isolate the customer from the utility, a disconnect device must be installed. This device is located at the point of interconnection with the utility, usually on the high side of a step-up transformer. At a minimum, a switch must be provided that is accessible to utility personnel, has a visible air gap, and can be locked in the open position. This switch only opens the connection between the customer and the utility and does not provide any protection from possible fault conditions. To facilitate immediate and automatic disconnection from the utility, a circuit breaker can be installed at the interconnection. This circuit breaker can be utilized to clear any fault conditions detected by the protective relaying.

To have the ability to re-close the circuit breaker to re-establish parallel operation, the customer must have the capability to monitor certain parameters on

Continued on Page 5



DESIGN TIPS

Some extra thought given to the layout and function of a new industrial facility during the proposal stage can result in a more efficient and cost-effective design. It is usually desirable to incorporate design enhancements into the initial design rather than to ask for them as an adder to an existing contract. Incorporating enhancements in the initial design are more cost-effective and schedule-friendly.

The following are a few areas that may benefit from this approach.

- A nice enhancement to a metal-clad building is a short (4'-0") masonry or concrete apron wall around the perimeter. This will offer protection for the portion of the wall that suffers the most damage from moving equipment, fork trucks, snow removal, etc. The cores of the block can be filled with vermiculite to maintain the insulating properties of the wall.
- When specifying roof design loads for a new structure, consider including collateral loads to accommodate piping, electrical raceway, etc., that will be hung from the joists. Bar joists can be a cost-effective alternative to steel beams for supporting roofs and floors. Bar joists are efficient and economical but are not well-suited for areas of the plant that require heavy loads to be suspended from the roof.
- Some industrial processes create environments that are more corrosive than others. This is particularly true in water treatment facilities. Be sure to specify coatings that will adequately protect the structural steel for the environments in which they will exist for extended life of the plant. Most paint manufacturers can recommend appropriate coatings for any environment. Remember that no painting system is effective without proper preparation of the surfaces to be coated.
- Adequate access to equipment is essential to the proper operation and maintenance of any industrial plant. Take time to solicit input from your operations personnel when laying out the design of a new facility and choose an engineering firm that has hands-on start-up experience to ensure that these needs are considered.
- In the early design phase of a project, duct, piping, and electrical raceway routing details are usually unknown. However, inadequate consideration given to these requirements usually results in compromises or interferences later in construction. Setting aside routing areas, pipe chases, etc. for the larger utility runs and clearly marking these areas on the general arrangement drawings can serve as a heads up to the other design disciplines and help mitigate any problems.
- Now that computer aided drafting has become the norm, it is important to make sure that the owner and engineer's software, release number, layering conventions, and CAD standards are compatible. A little time spent addressing these issues early on will assure the smooth transfer of project design drawings into the owner's document control system.

Visit us on-line @ www.esitenn.com

President Bush Visits Future Wood-Fired Combined Heat and Power Plant

By: Jeffrey H. White, Vice-President of Sales, ESI
Shimon Weiman, Project Engineer, Cinergy

President Bush visited the future site of the largest wood-fired combined heat and power plant serving a district energy system in the United States, Thursday, May 17, 2001, prior to his address of the National Energy Plan. ESI is proud to announce that it has been selected as the Engineer for this plant located in St. Paul, Minnesota. The plant will be built by Trigen-Cinergy Solutions, and owned and operated by St. Paul Cogeneration, LLC.

"This is clearly a situation in which everybody wins. By using chipped tree trimmings to generate electricity, we greatly reduce our burning of coal and oil. This will significantly cut air emissions and reduce greenhouse gases that contribute to global warming."
Anders Rydaker, President of District Energy St. Paul

"This project demonstrates you can have it all – more energy and a cleaner environment. The President, in coming to St. Paul and touring the District Energy facility, helps showcase the fact that a long-term energy solution consists not just in increasing supply, but also in promoting efficient technologies and environmental improvements."
James E. Rogers, Chairman, President and CEO of Cinergy Corp.

"This is a highly efficient and environmentally superior project. The project displaces old fossil fuel generation and makes renewable energy readily available to local consumers at economically attractive prices."
Rich Kessel, President and CEO of Trigen Energy

The future facility will offset energy that is currently being provided by older coal-fired boilers. The facility includes one 310,000 pph boiler fired by a combination of wood waste and natural gas, one 30+ MW steam turbine, extensive material handling equipment, and state-of-the-art emission controls equipment including SNCR, precipitator, etc.

This electrical generation technology is among the most energy-efficient solutions. The combined heat and power process captures more than 50 percent of the waste heat generated by traditional generation systems and converts it to steam. Therefore, this process can operate at more than two times the efficiency of conventional electricity-only power plants, resulting in twice the useful end-energy for the same raw energy input.

There are several environmental advantages to the new facility. First, the wood-burning facility will reduce sulfur dioxide emissions by 80 percent and particulates by 50 percent. Carbon dioxide, the chief greenhouse gas that contributes to global warming, will be reduced more than 283,000 tons per year. An additional advantage is that over 280,000 tons per year of wood waste will be used to power the facility rather than be sent to landfill.

ESI and Trigen-Cinergy are excited to begin the engineering and construction of a facility which will have such a tremendous impact both environmentally and economically on the local area. Engineering is underway and plant construction is expected to begin in January of 2003.

For additional information, please visit us on-line (ESI @ www.esitenn.com and Cinergy @ www.cinergy.com) or call Jeff White with ESI at 770/427-6200. We look forward to hearing from you!

How To *Connect* With Your Utility... *Continued from Page 2*

both sides of the circuit breaker. This can be accomplished with a synch check relay (device # 25). This relay compares the voltage magnitude and phase angle on both sides, and will automatically close the circuit breaker when they are within permissible limits. This will protect the customers' equipment from possible damage.

Typical electrical substation.

Conclusion

In today's energy market, cogeneration has not only become economically viable, but desirable as well. Customers are finding that in addition to generating for their own electrical needs; a strong market exists for them to sell power to the utility. However, this also means that requests to the utilities for interconnection will be increasing. The review and approval process for a project by the utility could take a significant amount of time; therefore, the sooner the process is started, the better the chances of avoiding a costly schedule impact to the project.

DILBERT reprinted by permission of the United Feature Syndicated, Inc.