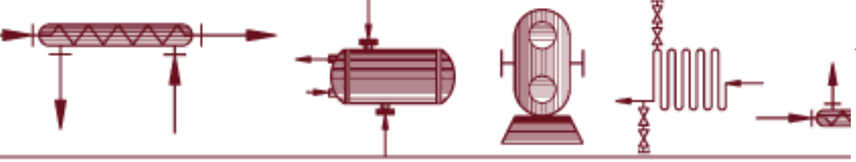


Can We Talk?... *Continued from Page 4*

Ethernet Communications

Ethernet communications is the option favored for new installations due to the fact it is easier to use and it is high speed (100 Mbps). Let's look at a typical situation facing you as a Controls Engineer. You have two new control systems that you want to connect to an existing plant data collection system. All three have Ethernet ports, so they can all talk to each other. Right? Wrong! There are many "flavors" of Ethernet, so just because they have Ethernet ports, doesn't mean they will transfer coherent data between them. First, we have to be able to connect the devices together and then they have to speak the same language.

As with serial communications, there are protocol choices for Ethernet communications. While there are many different Ethernet communication protocols, the two most commonly used in industrial applications today are Modbus/TCP and Ethernet/IP. Modbus/TCP uses the relatively simple Modbus instruction set commonly used in serial communications for use over Ethernet. The simplicity of Modbus also limits the capabilities, but the openness and carryover from the serial Modbus communications has allowed this protocol to gain a significant installed base. Ethernet/IP is a more complex protocol, but this also allows greater capabilities. Rockwell Automation/Allen-Bradley PLC's utilize Ethernet/IP as its standard Ethernet protocol.

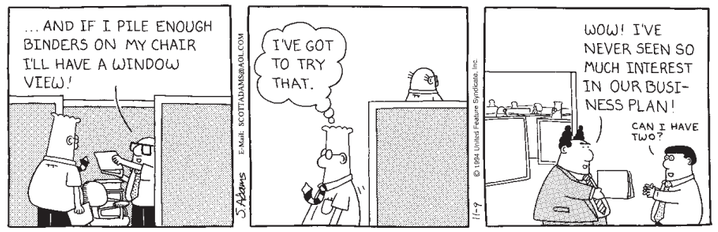
Again, as with serial communications, there are hardware options that must be considered, including the physical cable and the connectors. Ethernet typically uses copper cables such as a coax or more commonly a Cat 5 cable with an RJ45 connector. Cat 5 cables are used for distances up to 328 feet and in areas where there is little electromagnetic interference.

Fiber Optic Cabling

Fiber optic cabling is a hardware option that can be used for both serial and Ethernet communications. While there are added costs and additional hardware associated with fiber optic networks, there are many benefits. Fiber optics can be run over a mile without repeaters; it provides electrical isolation from voltage spikes and ground loops; it is immune to electromagnetic interference.

So Can We Talk ?

As you can see, there are many communications options that must be considered by Controls Engineers when they are involved in a control systems upgrade or a plant expansion. It is critical that the Controls Engineer clearly identify which options are best for the project, because with the data sharing requirements that today's facilities demand to remain productive and competitive, "Talk" is NOT cheap!



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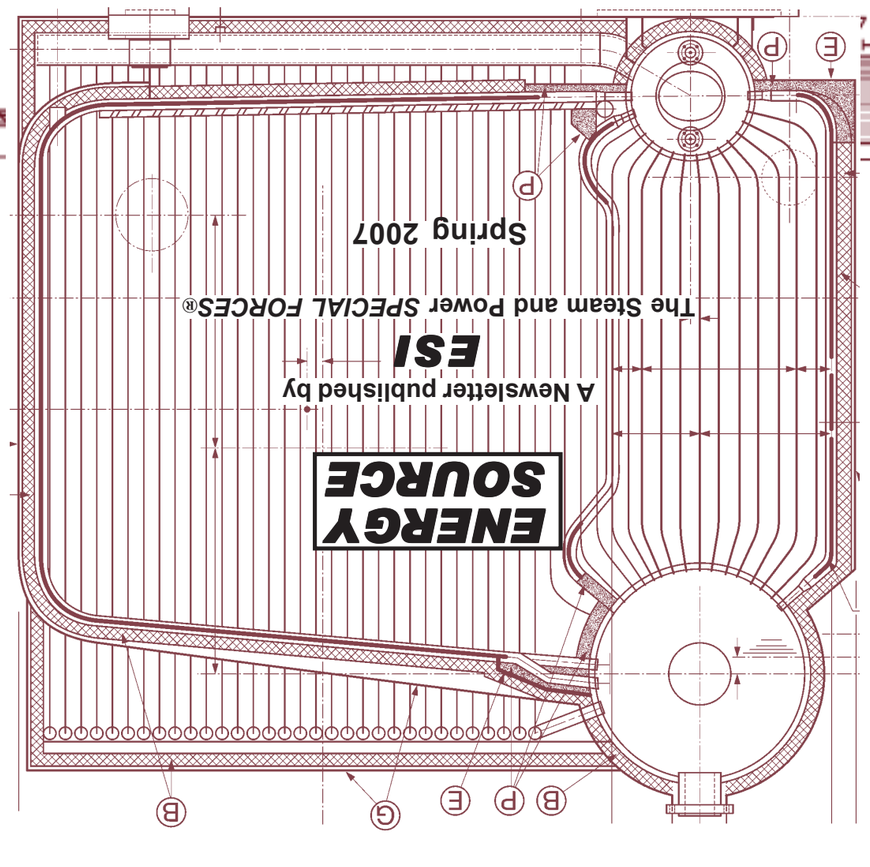

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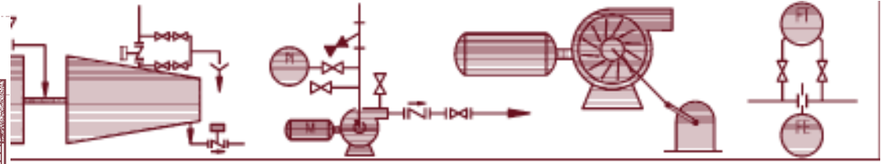

What Are My Fuel & Technology Choices?

By: William L. Reeves, P.E., President, ESI
Jeffrey H. White, P.E., Vice President – Engineering, ESI

Editor's note: This article is the second in the series "What Are My Fuel & Technology Choices?". The first article, presented in the Spring 2006 ENERGY SOURCE, introduced the four primary commercially available technologies for firing solid fuels including pulverized coal, stoker-fired, bubbling fluid bed, and circulating fluid bed. The following article discusses the differences between these technologies.

What Are The Differences Between These Technologies? The table on the following page provides some basic information regarding the differences of the four primary technologies (Pulverized Coal, Stoker-Fired, Bubbling Fluid Bed (BFB), Circulating Fluid Bed (CFB)) for firing solid fuels in a boiler. While the data does not cover every conceivable fuel and technology combination, it does provide information about each technology's general performance and relative capabilities. It should be noted that each advance in combustion technology has provided the end user with greater design fuel flexibility and lower emission rates. However, these advances have come at a higher boiler capital cost and more complex operation.

A few areas within the chart should be noted when analyzing the differences between the different technologies. They include:

- BFB's and CFB's offer much more flexibility for types of design fuels and variability within the same fuel. For example, BFB's can be designed to fire fuels with moisture contents as low as 30% (with in-bed surface or high flue gas recirculation rates) and at the same time combust materials with moisture contents as high as 70%. Stoker and PC boilers cannot handle such wide variations.
- BFB's and CFB's offer the end user much lower emission limits without the addition of post combustion emission control technology. This is primarily due to the relatively low combustion temperatures at which these technologies operate. Depending on the facility's final emission requirements, the end user may have to install only minimal or no back end emissions clean-up equipment to comply with the emission standards. This can often help to overcome the higher capital costs of these technologies. Stoker or PC boilers can also be designed to comply with emission standards. However, additional equipment must be installed to meet compliance, and the additional operating costs become a factor that must be considered in the economic evaluation. In the end, it becomes an issue of economics.
- PC and stoker-fired boilers offer the end user a much greater ability to respond to load swings without the use of supplemental natural gas or fuel oil burners. In many process plants where the batch utilization of steam is part of day-to-day operation, the ability to respond to these swings is paramount. The limited ability of CFB's and BFB's to respond to swings stems from the amount of energy that is held within the boiler's "bed". Once the mass of material is up to temperature, the ability to quickly and controllably affect the combustion rate is very limited.

Continued on Page 2

ENERGY SOURCE

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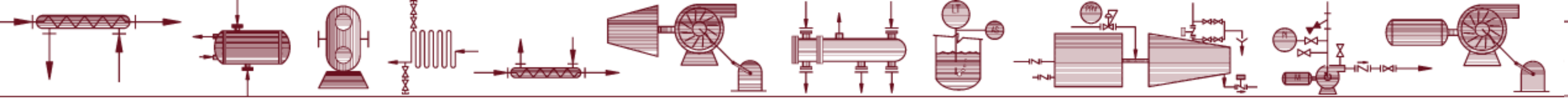
ESI is the Steam and Power *SPECIAL FORCES*® providing clients with innovative, cost-effective, and environmentally-friendly solutions.

If you have any suggestions or comments about the newsletter feel free to call us at 770-427-6200 or e-mail us at energysource@esitenn.com.

Deanna White
Managing Editor



What Are My Fuel & Technology Choices?... *Continued from Page 1*

Characteristics	PC with Low NOx Burners	Stoker	BFB	CFB
Types of Fuel	Coal	Coal, Wood, Sludge	Wood, Biomass, Sludge, Waste	Coal, Wood, Biomass, Sludge, Petroleum Coke, Waste
Fuel Flexibility (Note 1)	No	No	Yes with High Moisture Fuels	Yes with High BTU, Low Moisture Fuels
Types of Coal (Note 2)	EAPP, HSMW, & PRB	EAPP, HSMW, & PRB	Not Preferable (Note 1)	EAPP, HSMW, & PRB
Size of Coal (Note 3)	Mine Run	1-1/4" x 0" max 25% below 1/4"	Not Preferable	Mine Run
Wood & Sludge Maximum Fuel Moisture Content	Not Applicable	55%	65%-70%	Preferably below 50%
Uncontrolled NO_x Emissions (lbs/mmbtu)	0.35 - 0.40	0.40 - 0.55	0.15 - 0.20	0.10 - 0.15
Controlled NO_x Emissions Technology & Emissions (lbs/mmbtu) (Note 4)	SNCR - 0.175 - 0.20 SCR - Below 0.175	SNCR - 0.20 - 0.25 SCR - Below 0.20	SNCR - 0.075 - 0.10 SCR - Below 0.10	SNCR - 0.075 SCR - Below 0.075
Inherent SO_2 Emissions Control Capability	No	No	Yes	Yes
Requirements for 90% SO_2 Emissions Control	Wet or Dry Scrubber Addition	Wet or Dry Scrubber Addition	Lime or Limestone Addition to Fluid Bed	Lime or Limestone Addition to Fluid Bed
Uncontrolled CO Emissions (lbs/mmbtu) (Note 5)	0.10 - 0.25	0.10 - 0.30	0.10 - 0.15	0.10 - 0.15
Uncontrolled VOC Emissions (lbs/mmbtu)	0.007 - 0.010	0.007 - 0.020	0.007 - 0.010	0.004 - 0.007
Load Swing Response Capability	Excellent	Good	Satisfactory	Satisfactory

Note 1: A Bubbling Fluid Bed (BFB) boiler and Circulating Fluid Bed (CFB) boiler can be designed to burn a wide range and variety of fuels. However, once a design has been established for a specific fuel or combination of specific fuels, the capability of the BFB or CFB to burn other fuels which vary dramatically from those considered in the design may be limited. The BFB by design is inherently a better application for higher moisture lower BTU fuels. As such, the design limits the amount of low moisture high BTU fuels that can be fired and still maintain bed temperature control without the addition of in-bed surface.

Note 2: EAPP is Eastern Appalachian coal that is generally less than 1.5% sulfur, low moisture, and low ash content. HSMW is High Sulfur Midwest coal that is generally 1.5-3.5% sulfur, medium moisture, and medium ash content. PRB is Powder River Basin coal that is generally less than 0.5% sulfur, high moisture, and low ash content.

Note 3: Mine run coal can have a maximum top size or not be screened or sized, which would generally require on-site crushing to ensure no material handling issues. The stoker product coal is double screened and generally washed to produce the tight sizing criteria with less than 25% of the coal below ¼" in size. The stoker product generally costs $10-$15 more per ton than mine run. Trucking versus rail costs vary depending upon the location of the facility and the source of the coal; however, generally truck delivery is $10-$20 more per ton.

Note 4: An SCR is capable of achieving a NO_x removal efficiency of 90% plus. The BFB capability to control NO_x below 0.10 lbs/mmbtu heat input is dependent upon the fuel nitrogen content.

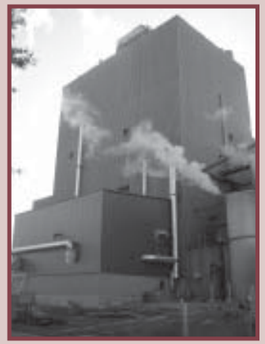
Note 5: The simultaneous control of NO_x and CO emissions is interdependent. The lower end of the stated CO emissions can be achieved when uncontrolled NO_x emission control is not as stringent and visa versa.

ESI hopes this discussion regarding the differences in the commercially available technologies has been informative. The next article in this series, which will be presented in the Summer 2007 issue of the *ENERGY SOURCE*, will discuss the key factors that must be evaluated to select the best technology for a specific fuel. If you are currently evaluating solid fuel firing options, give the experts at ESI a call. ESI could perform a low cost engineering study to assist in the evaluation of your options and determine the best path forward. If you already have the scope determined, ESI provides ± 25% budget pricing as a complimentary service to our clients. For additional information , please contact Jay Garrett with ESI today at 770-427-6200 or info@esitenn.com. We look forward to hearing from you soon!

Bear Island Paper
Ashland, Virginia

New 5 MW Power Generation Facility

ESI is pleased to announce that the new 5 MW Power Generation Facility began operation in October 2006. ESI was the EPC Contractor for this new 5 MW power generation facility at Bear Island Paper. This facility includes a backpressure steam turbine generator designed to provide 5.35 MW with throttle conditions of 350 psig/655°F superheated steam and an exhaust pressure of 75 psig. This turbine has a single extraction for process steam use. The facility consists of the complete turbine system including steam turbine, generator, reduction gear, lubrication oil system, control oil system, bridge crane, and all interconnecting piping and electrical systems. This system was housed in a new engineered structural steel building.



New 5 MW Power Generation Facility at Bear Island Paper.

Instrumentation and Controls Upgrade

ESI was also the EPC Contractor for the complete re-instrumentation and upgrade of controls for the existing 20 MW wood-fired and coal-fired power boiler at the Bear Island Paper Facility. The field-erected wood-fired and coal-fired boiler was upgraded from the mostly original 1972 vintage pneumatic and stand alone electronic controls system. The boiler system was capable of only manual operation and utilized strip charts, totalizers, and analog meters for all monitoring and recording. The control system was consolidated into a single Modicon Quantum PLC allowing the boiler to be operated in automatic responding to the plant's steam header needs. Operator interface was provided utilizing GE Cimplicity Software. This upgrade required replacement of almost all instrumentation for boiler monitoring and operation as well as integration into the new control system and complete retuning of the system. The controls changeover was completed in October of 2006. The changeover took place in stages over a period of nine months to allow the conversion to occur with minimized loss of production, taking place during previously planned monthly outages.

Evergreen Community Power
Reading, Pennsylvania

New 30 MW Cogeneration Facility

ESI is pleased to announce that we have been selected as the Engineer for a new 30 MW Cogeneration Facility being installed for Evergreen Community Power in Reading, Pennsylvania. Phoenix Technologies USA is the EPC Contractor for this project. The system will consist of a new biomass fired Circulating Fluid Bed (CFB) Boiler and an extraction/condensing turbine. ESI is excited about this new project and will provide additional details as the project progresses.

Can We Talk?

By: Mark D. Lassetter, P.E., Manager – Electrical and I/C Engineering, ESI
Randy S. Roberts, P.E., Senior Controls System Engineer, ESI

Can your control systems talk? Every year, control system upgrades are being performed at facilities throughout the world. Also, due to plant expansions, new distributed control systems (DCS) and programmable logic controllers (PLC) are being installed. Another common change that occurs in most facilities is the need for a plant-wide data collection system. The Controls Engineer is now given the task to ensure that all these upgraded or new systems can "talk" to each other.

In the past, most control systems were stand-alone "islands". They would control and monitor only the equipment with which they were installed. If different control systems needed to share information, the simplest way was to "hardwire" the information between them. Now the requirement to share much larger amounts of information makes the "hardwire" method expensive and impractical. Fortunately, the control system manufacturers have made it much simpler for systems to "talk" to each other. However, there are many factors that must be considered before a new system is specified and bought or an existing system is upgraded.

A few items to consider:

- If you are keeping and upgrading an older control system, which communications platforms does it support?
- What is the distance between the control systems that need to communicate with each other?
- How much information needs to be shared between the control systems?
- Will these systems be expanded in the future?
- Will other systems be added in the future?

There are many communication options available, but the two currently utilized the most are serial and Ethernet communications. The rest of this article will discuss these two communication options in more detail.

Serial Communications

Serial communications are relatively slow (115 Kbps), but this may be your only option when dealing with older control systems. When looking at a serial communications network, one must consider the distance the communications cabling must be run and how many devices are going to be on this network. The two most common forms of hardware utilized for serial communications are RS-232 and RS-485. RS-232 is limited to a maximum of 100 feet without repeaters, and other devices cannot be added to the network. RS-485 can run a maximum distance of 4000 feet without repeaters and allows up to 32 devices on the network. Your first thought might be to automatically utilize the RS-485, but remember; you must first confirm what type of communications your older system will support!

In addition to hardware considerations, there are also protocol choices for serial communications. The protocol is the "language" that is spoken over the communications network. The most common protocols still in use in serial communications are modbus and DH+. Modbus has become the "preferred" protocol for serial communications due to its simplicity and openness. However, Rockwell Automation/Allen-Bradley PLC's will commonly utilize DH+ to network multiple PLC's together or to other systems.

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