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THE NEXT TECHNOLOGICAL REVOLUTION

BY BOB YEAGER, CLASS OF 2007

As the "brains" of the modern power generation facility, the distributed control system (DCS) is integral to providing power producers with the necessary insight into equipment and processes on not only a unit or plant level, but also across an entire fleet of plants. Armed with this insight, power producers are able to make informed decisions about how best to manage competing environmental, operational and financial objectives.

A MOVE TO OPEN SYSTEMS TECHNOLOGIES

Over the last decade, we've seen an explosive increase in the power, speed, flexibility and reliability of control systems. Looking back, much of this can be traced to a move away from proprietary, vendor-specific architectures toward the incorporation of open systems technologies which take advantage of the rapid evolution of technology indicative of the computing industry. Commercially available, off-the-shelf components are now widely incorporated into current control system architectures, encompassing operator workstations, process controllers, networks and various operating system elements. As a result, today's DCS not only performs its primary control function even more reliably that its proprietary predecessor, but allows for far greater flexibility.

CONTROL AND INSTRUMENTATION TRENDS

As I take a look at where we are today, then look ahead to the future, I see a couple of control and instrumentation trends that currently – or soon – will have a significant impact on power plant operations and profitability.

One of these is in the area of simulation. While simulators have been around for quite some time, they have historically been somewhat difficult and costly to maintain. In the past, if a power plant wanted to use a simulator as a training tool for operators, the only option was to acquire controllers and workstations identical to those utilized in the system. Then, in order to keep the simulation accurate and realistic, every time the DCS was expanded or upgraded, a similar investment had to be made in the simulator. To make matters worse, because the simulator was essentially comprised of duplicate hardware, it was not uncommon for it to be periodically raided by control system engineers looking for "spare parts."

CREATING "VIRTUAL" SIMULATORS FOR REAL-TIME POWER PLANT SIMULATION

By adopting PC architectures for DCS controllers, it is now possible to create a "virtual" simulator in which the actual control system application software can reside on a desktop PC. A few years ago, one PC was able to emulate up to five controllers. Today, it can emulate as many 20 controllers, and with the continued growth of computing power, I anticipate even more than that in the future. With its virtual architecture, a simulator is now far easier and less expensive to maintain than ever before, making it a more practical and valuable asset.

As a result of this technology trend, at Emerson we're seeing more and more power generators specify simulation capability with their DCS. And, we're seeing simulation being used more fully – to train operators on a completely new system before startup to ensure a smooth technology transition without interruption to service or performance; for on-going education of existing employees; and for qualifying new employees for safe plant operation.

This is particularly important as older, more-experienced operators near retirement age. But beyond operator training, simulators are now commonly used for engineering analysis – to verify control system logic prior to system startup, for example and to test control system changes before actually implementing them on the DCS.

But that's only the beginning. In the future, I envision that the simulator will actually reside in the control system. In this configuration, the simulator models will perform real-time tracking of actual plant control logic and operating conditions. As such, the simulator will act as a test bed, allowing operators to test control schemes on the simulator, then immediately download them to the control system. The result: a synchronized control and simulation architecture for real-time simulation of a power plant.

For power generators, this "merging" of the simulator and control system not only offers opportunities for improved efficiency, but also improved reliability and the ability to meet financial objectives by reducing human error that could potentially lead to unplanned outages.

INTELLIGENT PROCESS OPTIMIZATION AND EMBEDDED ADVANCED CONTROL

Another area growing in importance due to the availability of a rich stream of data is intelligent process optimization and embedded advanced control. Utilizing advanced mathematical techniques such as fuzzy logic, advanced analytics and model predictive control, these sophisticated applications continuously track actual plant operating conditions, learn as they accumulate experience, and then adjust process setpoints to optimize production based on a defined goal. Advanced control and optimization technologies are now commonly being employed in power plants to help utilities achieve optimized equipment performance for emissions compliance, temperature control, efficiency and overall continuous operational improvement.

At Emerson, we've successfully applied this technology to help units accurately hit targeted setpoints with minimal megawatt overshoot, thereby reducing fuel costs; quickly ramp to targeted setpoints, allowing them to generate revenue as quickly as possible; and more closely follow load demand, allowing them to compete in the ancillary power services market. There is no doubt that advanced control applications will continue to have an impact on the industry, particularly as power generators strive to respond to ever-changing and more stringent environmental regulation.

The introduction of intelligent field devices and digital bus technology in more recent years represents another step change in the industry. With these technologies and the wealth of data they deliver, plant-wide asset management systems have become an integral part of the control system architecture, allowing power generators to proactively, rather than just reactively, respond to changing plant conditions.

Incorporating powerful microchips, smart devices such as transmitters and actuators can measure and report more than one variable from the process, while also providing that data at much higher resolution than possible with conventional field devices. By constantly performing self-diagnostics and reporting on their health, they have become part of a powerful asset management system that alerts operators to emerging problems before they impact the process.

Digital bus technology is just now gaining wide acceptance in the power generation industry as new plants are being built in response to increasing demand and aging infrastructure. By allowing multiple, intelligent devices to reside on a single "digital" communications bus, power producers are realizing significant savings during plant start-up and throughout the life of the plant.

During the plant start-up/commissioning phase, this technology not only significantly lowers wiring costs but streamlines device installation, communications verification and troubleshooting. Over the long term, the wealth of information being delivered from the digital bus can be used to optimize plant operations and maintenance activities, as well as avoid costly unplanned outages.

Smart devices and digital bus technologies are certainly two of the most significant advancements in the industry's ongoing quest for improved plant reliability and availability.

WIRELESS: THE NEXT REVOLUTION

The next technological revolution that will impact plant performance is wireless – a technology that will have further implications on reliability and availability. A wireless solution cost-effectively extends the full benefits of a digital bus-based plant architecture to locations that were previously inaccessible. Going wireless can eliminate the need for drilling through concrete decks, installing conduit and cable trays and pulling wires. But even more importantly, data from wireless devices can be seamlessly integrated into the control system, offering insight into additional plant and process data for control and asset optimization. This translates into further operational efficiencies and performance improvements.

Wireless devices employ self-organizing mesh networks in which each device can act as a router for other nearby devices, passing messages along until they reach their destination.

Part of the beauty of wireless, from an implementation standpoint, is that it is flexible and scalable. It is not an "either/or" scenario. Far from it. Power producers can adopt this approach wherever it makes sense for their plant.

The developments mentioned here are among those that have elevated the control system's importance not only within a particular unit or plant, but throughout a power generator's broader enterprise, as well. Not only are traditional functions, such as process trending, alarming, logging and historical data collection easier to accomplish, but this data is easier to share beyond the control room, making the control system an integral part of the corporate IT infrastructure. With the enhanced data collection, management and analysis capabilities inherent with a more powerful platform, opportunities for process improvement within a unit, a plant and even a fleet become easier to identify and to implement.

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