ACE Ethanol located in Stanley, NC - determined that an open control architecture based on FOUNDATION fieldbus™ provided the best platform for the future. FOUNDATION fieldbus is an all-digital, two-way communications system interconnecting field equipment, such as sensors, actuators and controllers, on a single network.

FOUNDATION fieldbus has many advantages over traditional Distributed Control Systems (DCSs) and PLCs. For example, the technology reduces the amount and complexity of wiring throughout a plant. Fieldbus can also transmit multiple variables, enabling a reduction in process variability, as well as device identification information. It also enables collection and transmission of instrument diagnostics, thus reducing unnecessary shutdowns and improving safety and regulatory compliance.

With an interoperable fieldbus network, control devices exchange data with each other, meaning that at least part of a control scheme can be located on the field network itself rather than in higher-level controllers. Fieldbus allows users to connect new instruments to a bus where the control system recognizes them with “plug and play” simplicity.

Most important, fieldbus returns PID control to the field at the device level, restoring single loop integrity, eliminating the need for redundant conventional controllers, and reducing the risk of costly downtimes.

**Integrating new and existing equipment**

ACE sought to eliminate the constraints of a proprietary platform and gain the freedom to choose best-in-class automation products from different suppliers. It wanted a solution integrating new

and existing instrumentation, wiring and control hardware and providing a manageable path to the latest technology. The expansion required an automation vendor able to install, commission and support a state-of-the-art fieldbus control system implemented at a flexible pace.

ACE decided to retrofit its existing control system with fieldbus communications, but leave conventional I/O in place where it made sense. Fieldbus technology would be installed alongside existing analog controls in the new, upsized Cook area, and used entirely for the new DDE.

Key to the project was implementing a robust Human Machine Interface (HMI) shared by both new and existing systems. Plant operators wanted a single HMI with common graphics, alarming and trending that could be served up to the plant network and accessed across the facility from standard Internet browsers.

After considering alternative solutions, ACE selected Smar’s SYSTEM302 enterprise automation system as the basis for its controls upgrade. Smar was responsible for installing a variety of new FOUNDATION fieldbus devices, converting existing 4-20 mA instruments to the fieldbus protocol, and integrating much of the plant’s conventional I/O to the new digital platform.

The open, integrated architecture enables true distributed control throughout the ethanol plant. The system takes full advantage of FOUNDATION fieldbus and other open technologies, and removes the constraints imposed by the original proprietary PLC platform. It seamlessly distributes control strategies to field instruments, enables flexible device networking, and allows free access to the process and devices by system software.

ACE was surprised by the ease of implementing fieldbus technology. The company’s control migration strategy called for digital instruments to be installed at a gradual pace—protecting investments in well-performing conventional I/O and eliminating the need for a large-scale shutdown. Because of the simplicity of fieldbus wiring and configuration, installation of new fieldbus devices was a simple task.

During system design, ACE requested that Smar reuse the control system’s current enclosures in order to save the time and expense of pulling new wiring for existing I/O. As a result, it specified that all new control panels be designed to fit into the existing enclosures.
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The enclosures housing most of the Cook area were located in the PB (Process Building), while the DDE panels were situated in the MB (Maintenance Building). New panels were provided for the two existing enclosures in both the PB and MB housing the control system computing hardware and serving as the termination points for the conventional I/O. Smar also added a new panel/enclosure in each area to serve as the termination points for the fieldbus I/O.

**Scalable control architecture**

For ACE Ethanol, the FOUNDATION fieldbus control system will deliver long-term competitive benefits. The flexibility of the fieldbus architecture allows ACE to reconfigure its process automation scheme to meet product and sales demands without major reinvestments. In the future, the new system will also provide the means to coordinate sales, accounting and other business functions with plant floor information.

The fieldbus architecture reduced I/O subsystem requirements in the DDE and Cook areas and made the plant control system very scalable. The system can be expanded or modified loop-by-loop as needed. In many cases, expansions can be carried out without additional wiring or interfaces.

Fieldbus technology also provided ACE with a “leaner” automation architecture containing less wiring and hardware than a traditional control system. Loop and wiring diagrams, panel drawings and cable schedules were greatly simplified. Plus, installation was easier than with a traditional system since several devices could be multi-dropped on a single pair of wires.

The fieldbus portion of the expansion included 10 fieldbus universal bridges, each interconnecting three H1 (31.25 kbit/s) device segments. There was also one pair of redundant fieldbus modules in the MB3 panel for the molecular sieves.

The control system encompassed 166 fieldbus devices from three different instrumentation suppliers, as well as 212 analog devices.

Engineers were able to upgrade some of the 4-20 mA devices with new fieldbus electronic boards without removing them from service. Fieldbus interoperability enables the digital devices to communicate and exchange data with each other without loss of functionality or integration.

The fieldbus bridges are self-contained, multifunction hardware components fully supporting the fieldbus network configuration. They act as a single, integrated unit of interface, linking device, bridge, controller, gateway, fieldbus power supply and distributed I/O subsystem. The bridge modules provide tight integration with intelligent devices and software from multiple manufacturers through the use of open standards, and connect to existing equipment through conventional I/O and other communications protocols.
ACE’s control room stations were upgraded to allow for maintenance of fieldbus devices using a new, Windows-based software tool. The software is designed for system and device configuration, system maintenance and system operation. It enables plant personnel to communicate with all instruments on the network, assign tags, configure the control strategy, adjust parameters, and download device configurations.

At the engineering station, personnel access logic co-processors using IEC 61131 programming software. Users configure the hardware for the co-processor and create control logic through the ladder structure language. They also create user functions, test applications, and interact with all universal fieldbus modules in the system.

A server-class station located in the technician’s office provides alarm and trend logging, and serves screens to web clients via Windows-based HMI software. The HMI provides access to plant operations and information across the company intranet and Internet, including Web pages containing production reports, HMI graphics, historical trends and alarms.

As part of the controls upgrade, ACE also deployed a new density control solution on the mash fermentation process in the Cook area. Engineers installed a unique, two-wire, loop-powered transmitter utilizing a two-level measurement technology to provide continuous, online density readings from the fermentation tanks. When inserted into the mash, the instrument calculates density from the difference in pressure at the two levels. An integral temperature sensor located between two pressure diaphragms compensates for the temperature variations in the process, and special software calculates an accurate density reading.

Results

ACE Ethanol faced a tight schedule for upgrading its process control system to coincide with plant expansion—production demands would not allow for lengthy downtime for installing new equipment. Design of the control system began in December 2003, and commissioning and startup were completed in July 2004.

Thanks to fieldbus technology, PID algorithms are now located in field devices for more secure, reliable control closer to the process. Operators have a user-friendly, Web-based HMI integrating new and existing automation systems across the facility, as well as trending capabilities enabling tighter control of operations. Significant cost savings were realized by not having to replace existing wiring, enclosures and field equipment when installing the fieldbus system.

Conclusion

With FOUNDATION fieldbus, ACE is assured of a secure, affordable migration path to modern control technology that will be supported by leading automation suppliers for many years to come.