ESC engineering

project brief

Upgrading Can and Bottle Lines **optimizes packaging operations**

The Colorado plant of a major American brewing company is regarded as a model of efficiency and leading-edge technology within the brewing industry. Many of the process best practices in use at all of the company's breweries were designed and tested at the Colorado facility. For this project, several can and bottle lines were upgraded to improve the brewery's efficiency and maintain its reputation as a technology leader.

SUMMARY:

Can and Bottle Line Upgrades and Integration with Plant MES

GOALS:

- Replace aging controls and equipment
- Increase line flexibility, efficiency, and productivity
- Reduce downtime
- Empower operations and maintenance staff

SYSTEM COMPONENTS:

- New Programmable Logic Controllers (PLCs)
- Existing Human Machine Interface (HMI)
- New communications network
- New interface message boards

HIGHLIGHTS:

- Reduced downtime
- Increased productivity gains

APPLICATION:

The Colorado plant produces approximately eight million barrels of beer annually, some of which is packaged for market using multiple can and bottle lines. Five lines—three for cans and two for bottles—were identified to receive improvements.

The brewing company approached ESC engineering to implement the line upgrades because of ESC engineering's long, established relationship with the brewery and its experience with packaging machinery and line controls.

ESC engineering found that the existing line controls were supervised by aging Allen-Bradley PLC-3 controllers and proprietary communication networks. This arrangement limited flexibility among lines and made it difficult to implement changes quickly. Disadvantages were especially apparent in controlling and sharing equipment common to all lines, as well as sharing information between the lines and the production management and scheduling systems.

Each line consisted of multiple "discrete systems," such as bulk container depalletizers, empty container conveyors, fillers, labelers, etc. Each system was controlled by a PLC-5, with each PLC communicating back to a supervisory PLC-3. The supervisory PLC used a combination of remote I/O and Data Highway Plus networks for communication between the respective systems. As new equipment—such as palletizers, robots, and stretchwrappers—was added, it became increasingly difficult to accommodate the additions and to share information among systems.

To meet the needs of the production scheduling system and the ever-changing equipment landscape, ESC engineering recommended changes that would utilize both new and existing technology.

REQUIREMENTS:

- Replace obsolete PLC-3 controllers, multiple communication networks and proprietary networks with current technology supportable by plant technicians
- Increase flexibility in the system to accommodate equipment additions and changes in packaging requirements
- Improve data sharing to allow all line components to share data uniformly, on the line as well as upstream to the MES application layerrol components

CHALLENGE:

Because the bottle and can lines had to remain in continuous operation, extensive planning was necessary to execute the transition from the existing configuration to the new design layout. ESC engineering was challenged to remove each line's supervisory PLC and convert individual line components while causing minimal disruption to packaging operations.

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SOLUTION:

ESC engineering's approach was based on removing the lines' PLC-3 and myriad of communication networks. ESC engineering recommended a design that would convert the controls on each machine and system to an Ethernet-based PLC. At the time of the project, the brewing company specified PLC-5, resulting in the use of PLC-5/40E processors throughout the lines.

To increase productivity, efficiency and flexibility, ESC engineering reconfigured and re-controlled each line using individual controllers for every discrete piece of equipment and line function—from the bulk container depalletizers at the beginning of the line through the case palletizers in the warehouse. A line supervisory PLC was added to handle interlocking, alarming and handshaking between the new line PLCs. By adding an Ethernet switch and network to each line, ESC engineering was able to configure individual PLCs to report alarms, production data, quality control functions, process losses and downtime to a central reporting system, making crucial information accessible to everyone from line operators to management staff in remote locations, including other breweries.

On each line, ESC engineering also installed a large format "scoreboard," or messaging display, to show shift, production data, and fault conditions on the line. Strategic placement of the scoreboard allows operations and maintenance staff working on the line to quickly diagnose faults and respond appropriately. In addition, the system upgrades support the downloading of production and material schedules directly to the machine HMI, enabling operators to respond quickly to schedule changes by pre-staging materials for an upcoming production run.

Due to production constraints, none of the lines could be down for an extended period of time. Therefore, the new communications infrastructure was installed ahead of the upgrade, while the line was still running. Over a period of several weeks, using weekend and cleaning outages, ESC engineering installed the PLCs one or two at a time, with the new code in place. Old functions were deleted from the supervisory PLC-3 until all equipment had been replaced. At that time, ESC engineering demolished each line's existing central PLC-3 controller and corresponding data highway.

In every piece of equipment—usually 15 pieces per production line—the remote (slave) rack and adapter was replaced with a PLC 5/40E processor to control machine functions. An HMI was added to key pieces of equipment on the line where a line operator would typically be present, and new remote I/O and Ethernet networks were installed and configured to ensure efficient communication between all equipment and the plant floor.

Throughout the project, ESC engineering developed standard arrangements of data to provide for a uniform and consistent method of data sharing between the systems on the line and the higher-level production monitoring systems.

RESULTS:

As a result of the upgrades, the production lines are able to run more efficiently, with less downtime. Accurate fault diagnosis enables production staff to respond quickly to changes on the line, while centralized, accessible production data enables all levels of staff—including quality control, operations and maintenance personnel—to access critical information. Additional programming supports automatic maintenance reporting, which helps the maintenance planning group to schedule equipment service based on hours of operation, runtime, or a specific number of recurring issues.

FOLLOW-UP:

ESC engineering successfully converted three can lines and two bottle lines over a period of approximately 18 months. The new communications infrastructure, installed with spare capacity, has allowed for new equipment to be added, and for two of the can lines to "share" depalletizers, case packers and palletizers, and to pass data not only among individual pieces of equipment, but between production lines. Data gathering and reporting is more accurate and occurs in real-time, creating much more flexibility in production scheduling, planning, and resource allocation.

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