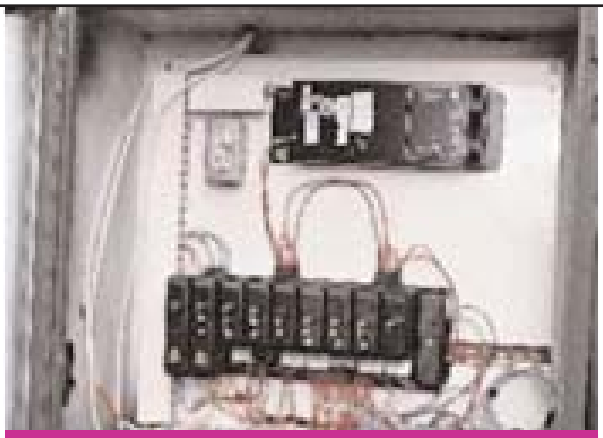
DeltaV™ System Pilot Project Leads to Automation Update for Eli Lilly Recombinant DNA Product

RESULTS

- Reduced first loop engineering cost by magnitude of 10
- Reduced training time
- 25% reduced configuration time
- 50% reduced system installation and check out time
- Reduced implementation time
- Reduced validation time/cost



System installation and checkout took about half as long as a conventional DCS having an equivalent channel count.

APPLICATION

Batch pharmaceutical bacterial fermentation

CUSTOMER

Eli Lilly and Company. In 1982, Lilly's Humulin product (biosynthetic human insulin) became the first pharmaceutical product in the world made by bacteria genetically engineered through recombinant DNA technology. Other well-known Lilly pharmaceuticals include the antidepressant Prozac and the antibiotics Ceclor (cefaclor) and Vancocin (vancomycin hydrochloride). As a point of history, the company was the first to mass produce penicillin using fermentation technology.

CHALLENGE

Until recently, process automation at Lilly usually involved dedicated, single-product manufacturing facilities validated to meet FDA regulations and then run as long as possible without change. Large- and medium-size facilities might be run by distributed control systems (DCSs), and smaller areas by programmable logic controllers (PLCs).

Pharmaceutical manufacturers are reluctant to change controls because to do so requires revalidation, a costly effort due to lost production and intensive documentation. Lilly's medium-size Humulin fermentation production area, for example, has run for 15 years with the original controls. Although the production equipment has many years of life left, spare parts for the controls are becoming harder to find. The automation and some of the instrumentation must shortly be replaced and the controls revalidated. Systems from Fisher-Rosemount and Foxboro, as well as some systems designed in-house, have all been used at various times since the early 1970s.

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SOLUTION

Flexible manufacturing a goal

Lilly's approach to pharmaceutical manufacturing is moving away from such dedicated facilities. The pace of product development is accelerating, especially in efforts to target specific diseases with tailored products derived from biosynthetic reactions. The company is now building facilities with smaller, more flexible process areas that can be linked in various configurations or switched from one product to another. Process revalidation is still an issue, but the advantages of production flexibility outweigh the cost. Up-front design using S88 (ISA S88 batch control standard) modularity also helps reduce costs.

Scalable automation ideal

The move to install flexible new facilities, and also to upgrade numerous older facilities, is altering the way Lilly approaches automating its processes as well.

Until recently, the cost of the first channel in an automation system was in the range of $500,000. Today, new scalable automation cuts this cost to $50,000 or less. A DCS can now be considered for small applications that just a year ago would have required hybrid PLC/operator interface (OI) equipment. Today's scalable automation has been a proven performer for medium-size production facilities.

To test the suitability of scalable automation, Lilly temporarily disconnected a portion of a legacy DCS system running an advanced bioreactor inoculant tank in an R&D pilot facility.

The fermentation research facility was selected for several reasons. First, we avoided putting product at risk as we might in production. Second, success in a pilot environment should translate to success in production because production operations are more stable. Third, success in a fermentation operation should make for success in chemical operations. Bacteria are unpredictable, making fermentation a bigger control challenge compared to chemically building pharmaceuticals. Last, a lack of control flexibility becomes readily apparent in a fermentation pilot plant where processes change constantly, control modifications must be made, and instrumentation is more extensive.

Production facilities next

The system was received in mid-March, configured and installed by mid-April, and checked out by mid-May—a fast turnaround. The controls remained in place until October for various tests, including a Modbus serial communications module connected to another legacy system, after which control of the inoculant tank was returned to the original legacy system.

Spurred by success in the pilot plant, Lilly is presently configuring a 350-channel DeltaV™ system to replace the obsolete controls running the 15-year-old Humulin fermentation operations. Three controllers

will be distributed among the operations and interface with three operator workstations. The old control system's air-conditioned room will be emptied and put to other use. New smart instruments with HART communications will provide advanced diagnostics for critical measurements.

Lilly also plans to upgrade a fermentation purification process and an antibiotic operation with the new scalable controls, and it is looking toward applying the technology to an entirely new product.

Compared to older process automation systems, configuring the scalable automation was more intuitive and about 25% faster-even considering the learning curve.

Advanced bioreactor inoculant tank at Eli Lilly R&D pilot facility
Windows Explorer-like drag-and-drop editing meant we were well along the learning curve before configuration began. Efficiency was further boosted by the automation's graphical, rather than procedural, configuration format. Our primary language was function-block diagram. This language, with its lines linking control templates, proved ideal for PID loops. Sequential function charts handled the stepped logic for valve actuations and the like. Structured text proved best for calculations, of which fermentation has many.

Unusual for graphical environments, the program executed exactly as drawn; there was no compiling or translating the graphics into another language. This exactness makes the control program inherently self-documenting and should help validation because information is easier to explain. We can quickly prove to someone visually that a particular calculation lies within a particular block that drives a particular valve.

The DeltaV system's Windows-like environment permitted more than one control routine to be displayed during configuration, which is useful when finding which might be best. For instance, we could alternately activate two routines during simulation or start-up to find which gave the best response time. Such comparisons are very difficult with older automation.

Also speeding configuration was an ability to save single and composite control templates, screen drawings, etc., and reuse them through copy-and-paste or embedding. A library of more than 60 standard function-block templates included with the automation helped as well. One week of training plus context-sensitive help allowed us to become as proficient in configuring as three weeks of training on a conventional DCS.

System installation and checkout took about half as long as a conventional DCS having an equivalent channel count. Power supply, controller, I/O modules, and separately wired terminal strips simply snapped into the rack's passive backplane. Windows-based plug-and-play auto-recognition–a tremendous time and error saver—extends to the controller and smart field devices and automatically configures

the workstation's I/O database. The devices wired to each channel can be readily seen in the graphics; an open channel immediately indicates that a device has been miswired, as we learned on one occasion.

Liked by scientists, too

Graphical configuration and plug-and-play features are ideal for Lilly R&D operations because instrument setups change so often—and also because the company's scientists are hands-on people. Many of the scientists can program a conventional DCS. They like to get into the automation; read and understand what is happening; change a calculation, logic, etc.; and watch how the change affects the process. During the months the scalable automation was in place, the graphical interface allowed users to better sense what was happening in the inoculant tank, and it allowed them to more easily make changes once they became familiar with the controls.

We are especially interested in evaluating the new OLE for process control (OPC) standard to enhance communications between flexible production areas. OPC provides data exchange standards and constructs beyond OLE and allows information to be easily shared among programs, much like Microsoft Office. In addition, OPC provides more robust, secure, and object-oriented code and greater error checking.

Also interesting to us is the potential for applying advanced control in a scalable system. Neural networks, fuzzy logic, self-tuning loops, and gain scheduling have not been available before in low-cost automation. Further, it might be possible with OPC to import third-party expert systems and other special programs.

Author Information

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