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New product gets painless automation

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A totally retrofitted manufacturing facility featuring the latest automation technology has just begun producing a new product at Baxter Caribe[1], Guayama, Puerto Rico. Built on a fast-track schedule, the commercial-size plant was redesigned, constructed, commissioned, validated, and started up in less than a year. Essential to the tight schedule was an automation system that itself could be developed quickly and easily.

The new plant is also serving as a test bed for state-of-the-art automation products and strategies that can be applied to a larger plant on the same site slated for a controls modernization.

Automation right-sized

The process for the new product consists primarily of reactors, distillations, vessels, and scrubbers. It includes both batch and continuous elements, although no special batching software is used. The scalable automation—DeltaV™ from Fisher-Rosemount (Austin, TX)—was exactly sized to the plant to minimize cost and space requirements.

FIG. 1: Chemical operator Edwin Gonzalez at the Fisher-Rosemount DeltaV™ automation control console for the modernized plant at Baxter Caribe Inc., Guayama, Puerto Rico.

The controller runs several hundred I/O points and consists of a set of redundant CPU and power supply modules, discrete and analog I/O modules, and a series of communications modules and modems—all mounted in a single cabinet. Two PC operator stations, a PC engineering workstation, and the controller are tied together by an IEEE 802.3 Ethernet network. The computers' operating system is Microsoft Windows NT. The automation can be expanded simply by plugging in more I/O modules or adding bus modules.

Although not active yet, a FOUNDATION fieldbus H1 module is included to serve fieldbus instrumentation now being added to fine tune the process and test fieldbus technology. Baxter Caribe plans to investigate AS-i or DeviceNet discrete bus modules for communicating with solenoid valves, starters, switches, etc. The company is anxious to evaluate fieldbuses to minimize I/O module counts, conserve cabinet space, and reduce the wiring, conduit, and seals between the plants' control rooms and the FM Class 1/Div 2 manufacturing environments.

Required an aggressive schedule

The process for making the new product is similar to that used to make products in the other plant, and requires the same level of quality and purity. The DCS running the older plant does an excellent job of automating the process and produces a very high quality product. However, the new process is more thoroughly automated and presents operators, engineering and maintenance departments, and management with more information for optimizing the process and reducing costs. It was also easier and faster to develop, install, and configure.

To assure the new plant was running within a year, portions of the design, construction, and startup had to be performed on a very aggressive schedule. A systems integration firm was retained to provide the initial configuration and to build, wire, and factory-test the controller cabinet and operator console. The hardware was shipped to the site and installed early in the plant construction phase, allowing devices to be connected, process section by process section, as construction proceeded. Each section was commissioned, started up, and corrected independently, again, before construction was completed.

Baxter Caribe engineers and technicians performed all testing and startup work, and produced three study lots themselves; no one from the systems integrator was—or had to be—present. However, the automation vendor's representative, Coneco de Puerto Rico, is nearby and has control engineers on staff for 24/7 hands-on backup response within two hours or so.

Fast, easy graphical configuration

Configuration using graphical methods was prepared remotely on the integrator's PC, and relayed to the plant's control engineers for review and loading into the stations. In the past, forms-based configuration had to be written on site using a $30,000 DCS minicomputer station bought for the control system.

The graphical configuration of the new process was prepared in Windows using IEC 61131-3 function block diagram (FBD) and sequential function chart (SFC) languages. Documentation was created automatically by simply screen printing the loop diagrams. What you see

is what executes, and what you print exactly matches what you see. (Manually keeping the 3000 loop diagrams current for the older plant has been a costly headache.) Windows configuration and perfect documentation have been a boon to process validation. The plant's validation engineers are as comfortable on the workstations as our controls engineers.

The completed configuration was simulated (in software only) on a desktop PC by triggering signals and watching the tags, graphics, colors, and so on respond. Validation was speeded because, after loading the workstations and wiring up devices, it was only necessary to check that tags were actually connected to the correct devices in the field. Software simulation—which was not possible with the older DCS until all control elements were wired—was a major reason the project was completed two weeks ahead of schedule.

Scripts for repetitive tasks

Another improvement is the use of scripts—simple SFC operating sequences that rarely change—to enable essentially single-keystroke alignment of the various sections of the process train. Scripts also automate the opening and closing of valves when charging a reactor. Traditional batch control is, therefore, unnecessary. Because the scripts are prepared graphically, they can be altered easily after management approval of established change control procedures. In fact, flexibility in all aspects of configuration has been of immense importance in learning and fine tuning the process.

The new automation system's larger memory allowed us to create our own control strategies by incorporating custom function blocks, in addition to the standard blocks available in the configuration software's library. For example, we created special blocks to perform calculations unique to our process.

More power, more opportunities

We found that modern, scalable automation offers an advantage often not recognized immediately—bulked-up processing power, memory, and disk storage, plus ready upgradability. There has been a tug-of-war in the older plant between process optimization and user friendliness—not enough computing capacity exists to develop both fully. We have had to lean toward user friendliness to train new operators and minimize operator error. With the new automation system, engineering is now free to study and optimize the process as much as it wants.

For example, Baxter Caribe chemical engineers are optimizing the process using OSI PI[2] historian software, residing in the engineering workstation, to collect data from test batches. At the same time, the plant's control engineers are calling on the historian to investigate measurement variations and to troubleshoot the process. From the efforts of both departments, new instrumentation is being added to ready the plant for commercial production. Although manufacturing reports are being prepared manually at present, the plant plans to link the historian to an IT computer running MRP SQL and employing electronic signatures for verification.

The modern automation system provides more information to help operators and maintenance run the process better, and keep it running. Faster troubleshooting of complicated valve interlocking schemes, where as many as 15 conditions must be met for a valve to operate, is one benefit. If a valve fails to respond in the older plant, determining why is a complicated task. In the new plant, the operator simply pulls up a screen detailing the interlock conditions for that valve, and which conditions aren't being met. A pcAnywhere[3] package connects key plant personnel to the process for off-hours troubleshooting.

On-site engineers and technicians eliminate the need for maintenance contracts or help in modifying configurations. Fewer spare parts must be stored for the new system, reducing costs. Most modules can be upgraded in firmware while still in the rack. If an operator station fails, a preloaded hot spare is being maintained in engineering for swapout in minutes.

Less time and money in training

Training benefits have proved to be enormous. Our control engineering new-hires previously required three to four weeks of DCS vendor training, plus three to five months of plant experience before I felt comfortable letting them change a live process. A recent new-hire needed only a week of training on the new system and a week of plant experience before he was making changes. Part of the reason was the graduate's ready familiarity with PCs and Windows. Another was the automation's graphical configuration. Operator and maintenance training is likewise speeded, for the same reasons. Obviously, the cost and convenience advantages of faster training are substantial.

The next step

We are looking at some type of asset management software to further boost labor and manufacturing efficiencies. For instance, when instruments are changed in the older plant, instrument technicians spend most of their work time manually configuring the smart transmitters with a hand-held programmer. Asset management would automatically and continuously inspect and store the latest configuration of every instrument, allowing us to always download the latest data to a new instrument. Such software would also track and alarm instrument and loop performance, providing an early warning of impending problems and reducing the configuration time for a new instrument. ◆

References

[1]Unit of Baxter Healthcare Corp., I.V. Systems Div.,
[2]Oil Systems Inc., San ALeandro, CA
[3]Symantec Corp., Cupertino, CA