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SPECIAL FEATURE:
PROCESS AUTOMATION

Tembec has completed the first phase of a digital automation project with the ultimate goal of tying the mill together under one platform that is fully accessible to mill IT systems and the Internet

Digital Automation Controls Burner, NCGS, Coatings Plant at Tembec, St. Francisville

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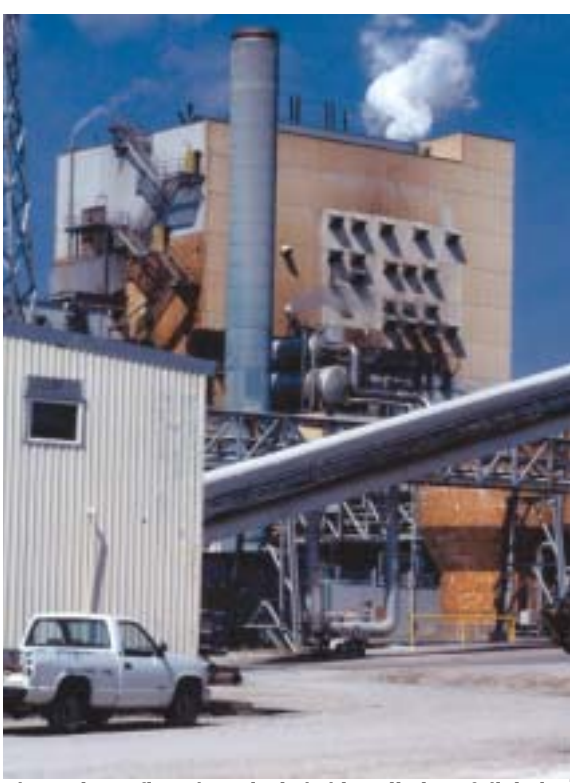
The Tembec Inc. paper mill in St. Francisville, La., is in the early stages of a multi-year project to upgrade the entire site from an older generation distributed control system (DCS) to modern digital process automation.The first phase of the project has been completed and is already benefiting operations.

The reasons for the upgrades? The memory and processing power of the mill's existing DCS were maxed out handling current requirements, and little freedom existed for adding desirable new functionality. Also, consoles were failing due to age. Replacement hardware was not available, and parts were hard to find.

Canada's Tembec Inc. purchased the St. Francisville mill from Crown Paper in mid-2001. The mill has an annual production capacity of 310,000 short tons of coated groundwood paper plus 118,000 short tons of specialty paper.

FIRST PHASE. The first phase of Tembec's automation project included replacement of a relay-logic burner management system (BMS) with an integrated, nonprogrammable logic controller (PLC) design for the mill's 425,000 lb/hr, black liquor-fired recovery boiler.Also, a sequence-of-events recor-der (SER) was incorporated within the new BMS to provide boiler trip event time-stamps to within 1 mS.



The project's first phase included installation of digital control for burner management and NCG collection, but Tembec will eventually convert its boilerhouse to full digital automation.

The project's first phase also included installation of automated collection systems for the mill's noncondensable gases (NCGs), plus the addition of an automated burner in the recovery boiler for incinerating these gases. Both the BMS and the NCG systems seamlessly and bi-directionally communicate with the DCS, which still operates the boiler.

In addition, there was an upgrade to digital automation in the batch plant that makes the clay coatings that are applied to the mill's lightweight coated papers. Although not directly powerhouse related, the coatings plant project illustrates how a unique control conversion technology will be used to help digitally automate the boilers in the near future.

ONE PLATFORM IS SUFFICIENT. The recovery boiler's original BMS, which handled the combination firing of black liquor and natural gas, employed conventional hardwired relays to provide the purge and light-off inputs to instruments and panel lights. Although the system worked according to code, the resolution of its rudimentary SER was too poor to identify the first-out event during a boiler trip.

To assure that trip failure sequences are pinpointed, it is typical for a utility engineer to choose a stand-alone, hybrid PLC/HMI/SER system communicating with the boiler process via a serial link. Tembec elected to replace its existing SER and proceed to a third-generation BMS, one that could be fully integrated into the boiler process to eliminate the need for a second PLC control platform.

DeltaV digital process automation supplied by Emerson Process Management was selected to upgrade the entire mill. The system consists—for the BMS and SER portions alone—of one redundant controller located in the control room adjacent to the boiler. The compact, DIN rail-mounted controller resembles a PLC in that its plug-in power supplies, central processing units (CPUs), and I/O (input/output) and SER cards reside on a single backplane and provide the logic and field-wiring interfaces. A dedicated Ethernet TCP/IP control network additionally ties the controller to a DeltaV PC operator workstation in the powerhouse control room. Local Emerson technical services personnel configured the workstation's 20 pages of BMS operating, alarm, and troubleshooting graphics. The new BMS replicates the former system's features and has been Factory Mutual-approved to meet burner management and flame safety shutdown requirements.

EVENTS DISPLAYED QUICKLY. Each discrete input channel on the controller's four 16-channel sequence-of-events cards produces four items of information: description, channel type, device tag, and state named set. The card scans input signals using an extremely fast 250-µs cycle, generating an event if any signal changes state.

The noted change is inserted into an event message, and the message is relayed to the controller's CPU. Here, it is time stamped and sequenced to within a 1 mS resolution. The message is then forwarded to the operator workstation as an alarm for chronological display and recording.

CAN ENCOMPASS ALL MILL FUNCTIONS. Although the Tembec BMS/SER application is a relatively small control area of only about 200 tags, DeltaV technology is scalable in terms of controllers, workstations, and networks to as many as 30,000 tags—far more than the whole mill would require. DeltaV is the centerpiece of the PlantWeb open, field-based process automation architecture that also includes analog and discrete bus technologies, instrumentation capable of truly distributed logic and control, a predictive maintenance tool for managing instrumentation assets, a plant modeling tool, and a process optimization tool.

Additionally important to Tembec was the automation's low first-point cost, which made the BMS/SER project economically feasible. Added positive factors were its quickly-learned Windows-based graphical configuration, OLE for process control (OPC) tools for connecting incompatible equipment, acceptance of off-the-shelf PC software, enhanced multivariable and advanced control capabilities, and Internet communications.

Tembec did investigate two alternatives for upgrading millwide control. The first was to replace the existing DCS front end (the consoles, controllers, and I/O) with still-in-production DCS equipment from the original vendor. The second—the chosen method—was to leapfrog DCS technology altogether and substitute digital automation as the front end. Although the DCS alternative demonstrated a slight advantage in hardware costs, calculated life-cycle costs were much lower with the newer technology.

NCGs COLLECTED FOR INCINERATION. Stricter EPA regulations require the St. Francisville mill to more positively incinerate NCGs produced during the papermaking process. NCGs were previously routed to the lime kiln, a piece of equipment that is intermittently out of service. The recovery boiler, on the other hand, has higher uptime. A new collection system of pipes, valves, and ducts extending throughout the mill was built to route concentrated NCGs (C-NCGs) and dilute NCGs (D-NCGs) to this boiler.

The C-NCG system is vacuum driven, and the gases are admitted to the boiler through a newly installed burner, while the D-NCG system is fan driven, and the gases are simply dumped into the inlet air stream. Logic for the C-NCG burner, being part of the BMS, resides in the BMS controller. A separate controller, of some 250 tags, drives the NCG system. It resides on the same network as the BMS controller, however, and uses the same operator workstation.

Also located on the Ethernet network is a DeltaV application workstation loaded with DeltaV Connect, OPC Server, and OPC Mirror software packages. These programs permit the operator workstation to also serve as a console on the DCS network, providing transparent and bi-directional data exchange between the two control systems. In fact, if so programmed, the DCS could monitor and operate the new BMS, SER, and NCG systems, while the DeltaV workstation could view and operate DCS boiler functions.

Thus far in the Tembec powerhouse, the application station passes all DCS data to DeltaV in preparation for console conversion. It also passes critical data exchanges between the DCS and the upgraded BMS and SER. Eventually, when the powerhouse DCS is being replaced, the three software packages will be called upon to help configure a complete set of DeltaV boiler operator, application, and engineering workstations. These workstations could be commissioned without boiler shutdown and will operate in parallel with the DCS operator consoles prior to the consoles being deactivated.

The boilerhouse's eventual conversion to full digital automation is being planned as a two-step project. First will be the switch to the above-referenced workstation human machine interfaces (HMIs)—but with the DCS I/O panels and controllers left in place. The second step, several months later, will be the replacement of the I/O panels and controllers using special pre-fabricated, pre-installed control and transition cabinets. The two-step process will allow Tembec to deal with obsolescence issues more efficiently and spread upgrade costs over time.

CONVERSION PROVEN IN COATINGS PLANT. A highly successful two-step upgrade has recently been completed in the mill's coatings plant. First replaced were three troublesome DCS consoles by three DeltaV operator workstations and an application workstation, followed nearly a year later by replacement—during a six-hour plant powerdown—of the plant's DCS controllers and nearly 1,000 I/O channels. Conversion to digital automation was necessary because the mill's two paper machines for LWC products were being modified to increase manufacturing flexibility. The coatings plant, in turn, had to be made more flexible as to coating types, ingredients, and recipe generation and handling.

As in the powerhouse, the Connect, OPC Server, and OPC Mirror software packages enabled the three new operator stations to become virtual controller interfaces for the DCS controllers and I/O, with full functionality maintained. Control blocks mirrored equivalent DCS control blocks. Event reporting, history collection, and enhanced alarming were included.

Engineering the coatings plant console conversion was straightforward because the original tag database could be bulk edited. The legacy system's database was simply exported to an Excel spreadsheet for import into the Connect software's database. No retyping saved time and precluded transcription errors.

Additionally, copy-and-paste simplicity was helpful in display configuration—a major project that required three controls engineers several months to create approximately 60 pages that closely resemble the replaced graphics. Keeping the graphics similar made for a rapid learning curve for operators. Also helpful was the fact that only one week's training was sufficient for the engineers to learn how to configure both the graphics and the database.

Conversion from consoles to workstations was transitioned gradually with the plant on line and with both interface methods energized and working in parallel. The Connect software seamlessly polled DCS feedback loops, analog and discrete I/O, multistate device control, operating status, configuration information, and on-line tuning. Automatically sent from the new HMIs to the legacy controllers were operating parameters (mode, setpoint, output) and tuning changes. Changes made to the legacy controllers from the legacy consoles were automatically updated in the Connect database. Likewise, the Connect interface sent information, such as ex-ception reports, to the legacy consoles.

SWITCHING CONTROLLERS IS DIFFICULT. Tembec needed to convert the coating plant's DCS controllers and I/O as well because the batching application's logic was prone to hang up. E&I technicians often had to be called to troubleshoot and clear a Hold caused by a malfunctioning valve as an example. Troubleshooting could take hours. On occasion, process engineers even had to be brought in to plumb the logic's obscure code to find the source of a problem. It was also nearly impossible to bypass a non-critical interlock in the DCS.

Replacement of the controllers and I/O panels was a more difficult task than replacing the HMIs. It became an intense, six-week engineering, simulation, and installation project to meet a planned mill shutdown schedule. Line by line, the complex batch code had to be translated completely into a graphical configuration. The 1,000 channels of I/O had to be converted and wired to the new I/O. Every loop and point had to be accounted for. Last, mill management required the actual cutover be accomplished during a single six-hour plant powerdown.

The most practical way to replace the controllers and I/O within the required timeframes was to employ the FlexConnect pre-fabricated transition system from the Munger Co. This method required Tembec to install two new control cabinets adjacent to the existing DCS controller and I/O cabinets. One of the new cabinets contains the factory-mounted, -wired, and -tested digital automation. Factory-mounted banks of FlexConnect signal-converting interface panels fill the second cabinet. The new cabinets were installed ahead of the cutover date, as were connectorized cables from the interface panels to the new automation's I/O cards.

PLUG-IN CABLES ARE RE-LANDED. At the point of cutover, sets of existing connectorized cables originating on the DCS field termination panels were simply detached at their DCS I/O board destinations and instead plugged to the FlexConnect interface panels. No cable splicing or reconnectorizing was required. The transition cabinet remains until field wiring is replaced, if ever.

The prefabricated plug-in approach to controls migration additionally provided a unique fallback capability. Should problems have

Operator Elvin Stewart (left) and senior process control engineer Denny Efferson in the control room for the coatings plant, which was converted to digital automation to support manufacturing flexibility upgrades to the mill's two LWC machines.

arisen during cutover, conversion to and from the old and new hardware could have been accomplished in an hour or two in either direction. Fallback was vital to Tembec because dissimilar controller and I/O systems cannot be operated in parallel, as with HMIs.

Physical cutover in the coatings plant was accomplished in about an hour. Testing using power from the uninterruptible power supply took the remaining five hours. Pair order was maintained in the cables, which meant signal transfers from cable to cable were consistent. Even so, every point and loop was checked. Startup was uneventful, and the plant immediately began making a batch of coating.

Had field wiring been run directly to the new automation, upgrading the controllers and I/O would have taken at least another month, cost perhaps an additional $100,000 in installation alone, and required an extensive plant shutdown for cutover. Cabinets housing the disconnected DCS controllers and I/O panels will either be emptied and reused in the future for new controls hardware, or they will be removed for more space in the control room.

NUMEROUS BENEFITS SEEN. Besides the versatility and flexibility gained from the digital automation in producing coatings, process problems arise less often today. When they do, operators are provided a descriptive message plus diagnostic tools to help them clear the problems themselves. On-line documentation, such as AutoCAD drawings, is also available by double-clicking on a faceplate, for example, to bring up a loop diagram.

The digital automation's ability to accept common PC software is also proving a help. For example, an Excel spreadsheet has been developed that captures and prints flows. Operators take this sheet into the field to check that the values are correct. Tembec engineers are presently writing a Visual Basic routine to automatically produce coatings plant batch reports.

Future mill control upgrades will also focus initially on replacing DCS consoles, starting with the oldest first. Replacement of controllers and I/O panels will follow as parts begin to fail or if enhanced control requirements will help reduce costs, boost paper output or quality, or in general improve the mill's processes. Eventually, the intent is to tie the entire mill together under one automation platform fully accessible to Tembec IT systems and the Internet. ■

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