

Speed, flexibility and US\$20,000 savings achieved in Ultra Clean Coal pilot plant using modular Allen-Bradley Distributed Starter Systems

Australian engineering group Process Design and Fabrication meets a tight installation schedule with new control system by Rockwell Automation and delivers 20% below the estimated installed cost.

Background

Process Design and Fabrication (*Pdf*) is a significant supplier of customized process and manufacturing systems and facilities throughout Australia and Southeast Asia. Established in 1963, the company has grown to service the chemical, pharmaceutical, food and beverage, and general manufacturing industries. In particular, *Pdf* has extensive experience in integrating and refining process technologies into engineering solutions.

In 2001, *Pdf* was commissioned by Australian company White Mining to convert a lab-scale batch procedure for producing Ultra Clean Coal (UCC) into a pilot stage continuous process. The object of the process is to strip the ash content of coal—usually in the order of 10%—to levels of less than 0.2%. White Mining, in collaboration with the national Commonwealth Scientific and Industrial Research Organisation (CSIRO), developed the process with the aim of using coal as a gas turbine fuel—a more efficient combustion process than burning coal to produce

steam for steam turbines. The purpose of minimising the ash content is to eliminate detrimental corrosion and erosion on gas turbine blades.

The resulting pilot plant—located in the Hunter Valley town of Cessnock in the heart of the New South Wales coal fields—is designed to achieve UCC production rates of up to 350 kilograms per hour. The plant is operated by White Mining subsidiary, UCC Energy Pty Limited. Basically, a slurry of finely ground coal is pumped through a series of chemical treatments and intermittent filtering stages, thereby reducing the ash content of the coal.

Challenge

According to UCC Energy senior project engineer, Graeme Lothringer, unlimited flexibility of the overall plant design was essential. “This is completely new technology,” he says. “It’s important that we have the ability to move equipment around—and add it in, where necessary.” Flexibility was also required for ease of scaling up the plant in the future.



Pdf senior electrical project engineer, Neville Taylor, adds that many of the design decisions had to be based on speed of deployment. “It was an extremely fast-tracked project,” Taylor says. “In many cases, the mechanical engineers would decide on a piece of equipment—such as a particular pump—and the electrical engineers would come along behind and add it into the electrical drawings.”

The plant automation system also demanded a combination of complicated sequential and analogue process control, given the number of lengthy process stages and multiplicity of cascaded PID control loops.

Solution

In order to meet the required speed and flexibility of deployment, *Pdf* designed the pilot plant based on equipment that could be installed in certain sections of the plant while others were still being designed. In addition, UCC Energy had specified the use of Rockwell Automation control equipment in the plant. “We wanted to minimize the likelihood of mistakes—Rockwell Automation is a robust system and met our criteria,” says Lothringer.

This steered the design team in the direction of Rockwell Automation’s unique Allen-Bradley Distributed Starter technology, a uniquely flexible motor control solution based on field-located motor starter modules daisy-chained together across the plant floor using DeviceNet fieldbus technology. According to Taylor, around 120 individual motor starter mini-cabinets—associated with the assortment of pumps, agitators and conveyers forming the foundation of operations—are distributed throughout the plant, linked to a central controller by six DeviceNet networks.

“In order to use a standard form-2 motor control center (MCC), we would have needed to know the complete design beforehand,” Taylor says. “And, not only would it have been extremely difficult to make any changes at a later date, there would have been the issue of limited cabinet space. As it is, I could go out there tomorrow and connect the Distributed Starter for a new pump into the nearest DeviceNet cable—at the same time other parts of the plant were in operation.”

Taylor explains that there were variations on four main types of motor starter configurations used in the UCC pilot plant—these were optimized for a range of motor sizes, from the 45 kW air compressor right down to the smallest 0.37 kW belt drive. In addition to star-delta and direct online starters, two different sizes of variable speed

drives (VSD) were required: the compact Allen-Bradley Bulletin 160 and the multi-featured Bulletin 1336 series.

Also connected to the DeviceNet networks are two Allen-Bradley Flex I/O panels that provide I/O connection points for the digester temperature probes, three solenoid valve panels, and miscellaneous level and flow switches.

At the heart of the UCC pilot plant automation system is the sophisticated Allen-Bradley ControlLogix controller. “ControlLogix can handle sequential logic beautifully and the process logic very well,” says Taylor. “There’s a significant amount of analogue process control in this plant—it would have been quite a lot for a standard PLC to handle. However, the function block programming capability of ControlLogix made configuring the analogue functionality easy.”



According to Taylor, ControlLogix also offered exceptional flexibility in terms of network attachment ability, allowing Ethernet communication with the two plant human-machine interfaces (HMI), both of which are PCs located in the plant control room. The main supervisory control and data acquisition (SCADA) PC runs Rockwell Software's RSVIEW32 with Active Display, with the other acting as a client.

Results

Commenced in mid-July 2001, construction of the UCC pilot plant was completed in just 100 working days. Taylor attributes the use of the Allen-Bradley Distributed Starter System as a prime reason for the rapid installation. "The distributed starter system allowed us to build and design in parallel," he says. "Using more traditional methods we would have ended up a month behind schedule."

He adds that not only does the system offer ultimate flexibility, the use of networks such as DeviceNet significantly reduces wiring and simplifies connections. "The total installed cost for the combined Distributed Starter/DeviceNet solution was 20% below the budgeted estimate for a centralized form-3 MCC," says Taylor. "This corresponds to a savings of around US\$20,000 on this job."

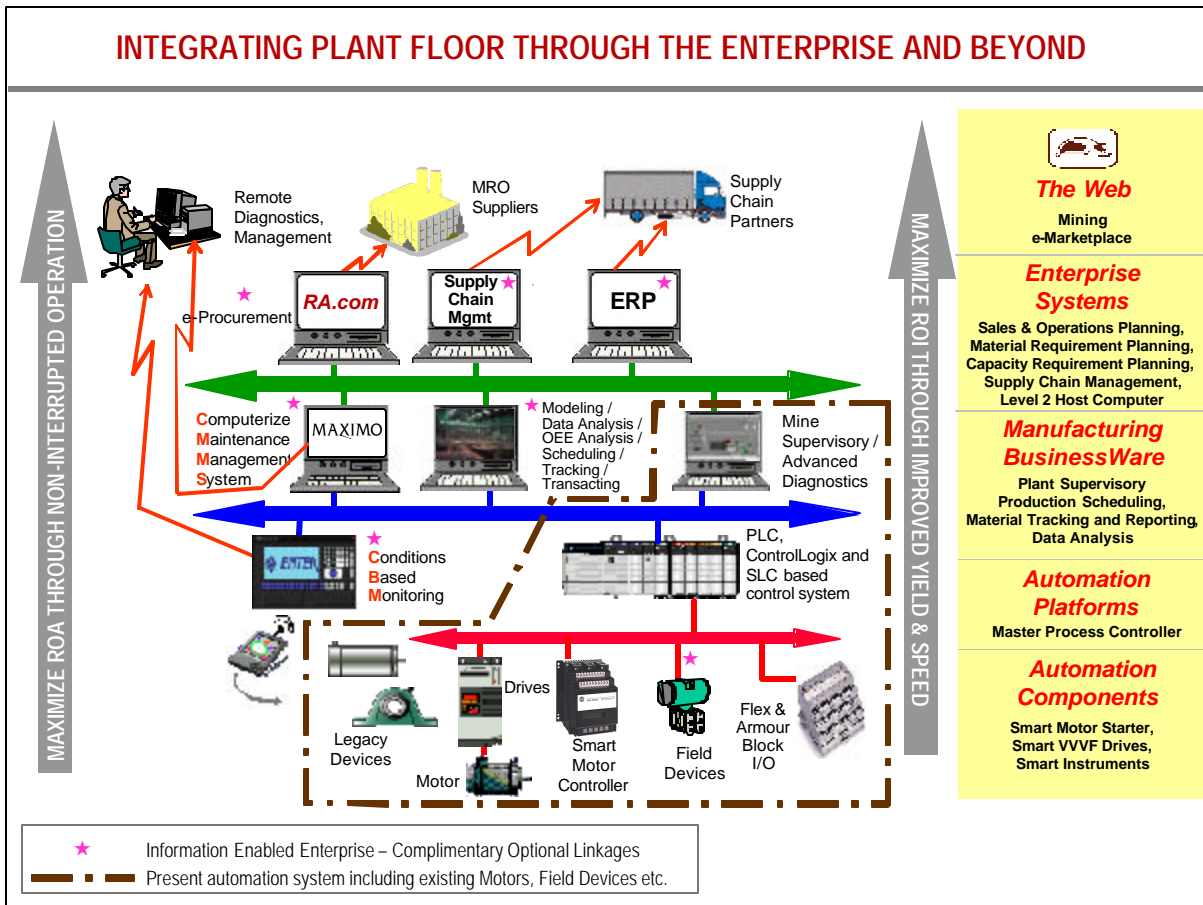
According to Taylor, other less tangible—yet real—benefits of using the Distributed Starter System include optimal workflow efficiency and deployment of resources. In addition, equipment for the plant was selected with scale-up in mind. "All the networks have spare capacity at the moment—and there's room to add communications modules to the system," he says. "The programming is all modular too, which would make it easy to configure for a parallel line."

According to UCC Energy's Lothringer, the foundations for a commercially viable clean and 'green' fuel technology are now firmly in place. "It was absolutely essential for this plant to accommodate potential modifications during operation—it's the whole purpose of a pilot plant," he says. "We must have the flexibility to make adjustments as we go."

The architecture on the following page depicts Rockwell Automation's concept of an Information Enabled Enterprise. The area outlined with a brown dash line represents the present automation level under discussion in this document. The remaining portion illustrates a host of solutions that Rockwell Automation can provide today to integrate the plant floor to the enterprise and beyond.



INTEGRATING PLANT FLOOR THROUGH THE ENTERPRISE AND BEYOND



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