NINNEKAH, OKLAHOMA — The plains of central Oklahoma, south of Oklahoma City, are wide open and windy year-round so the weather can have a bite to it even during the good months. Operations crews at the Mobil Chitwood Gas Processing Plant here used to get pretty cold making their rounds to turn equipment on and off and take readings from chart recorders and indicators for tracking the processing of natural gas.

But they don't anymore. Not since the company installed a supervisory control and data acquisition (SCADA) system built on personal computers, programmable logic controllers (PLCs) and the Wonderware InTouch™ human-machine interface (HMI) module within the FactorySuite™ package from Wonderware Corporation of Irvine, Calif.

The real benefit is that the entire plant can be run from a single control room, on just two PCs, and its operation can be so well coordinated that the plant runs more efficiently than ever before to supply natural gas to Mobil and other resellers. Both productivity and profitability are up, which makes Chitwood a flagship operation within the network of gas processing plants operated by Mobil.

Mobil Corporation is a major oil and gas company with operations in more than 100 countries. In addition to exploration, producing, refining and marketing operations, the company's other businesses include petrochemicals, plastics and land development. The Chitwood plant is operated by Mobil Natural Gas Inc. (MNGI), an integrated midstream gas gathering, processing and marketing company.

“Chitwood is one of five gas plants operated by MNGI in Texas and Oklahoma,” explained Louis Sterne, electronics engineering advisor from MNGI’s office in Houston. “Here we take raw gas coming in by pipeline from producing wells throughout the area and use a cryogenic process to produce two products. We separate out the natural gas liquids and ship them via pipeline to our refinery in Beaumont, Texas. The dry natural gas that remains is sold by our Houston marketing group and shipped by pipeline to a number of industrial and gas distribution companies.”

This entire operation is now managed on a pair of Compaq Prolinea PCs located in the main control room, each with a large screen (21") Viewsonic monitor. These replace two CVU5000 systems that were part of the original system. Plant Manager Paul Brewer and his staff worked closely with system integrators Control Dynamics, Inc., based in Silsbee, Texas, to create the system.
They retained the use of two existing Texas Instruments 565 PLCs for control of the process compression as well as for managing process operations on the cryogenic skids, the CO2 fractionator, the amine unit and the molecular sieve beds. They also made sure to get the plant operators involved in the design of the HMI screens, so that they paralleled real world layout of the plant. Use of the new system was intuitive to operators, and the results are obvious in processing productivity.

**A Straightforward Process**

Natural gas is a byproduct of oil well production. The gas is received at the Chitwood plant via multiple pipelines and manifolds. The inlet compressors are run by gas-fueled engines and are used to maintain both incoming flow rates and steady back-pressure on the lines from the fields.

“The gas is first compressed and sent to the molecular sieve beds for dehydration,” Brewer said. “The two dehy beds are on adsorption for eight hours, while one tower is heated and another tower cooled for four hours each. The cryogenic process depends on ‘bone-dry’ gas, so we can’t afford to have it interrupted for any reason. The MMI system allows us to track the PLC’s automatic switching of cycles and to know where we are at any given point in time. This upgrade has been very valuable for our plant operators.”

The animation of the molecular sieve bed screens was critical. The old HMI would only change the label on four towers as the cycle evolved and associated bar graphs showing time-in-cycle were misleading because they were linked only to certain portions of the cycle. “The new HMI has animated piping on the towers that shows the four main process cycles, with an integral label that shows the actual time-in-cycle data, so the operators can truly tell at a glance what the mole sieve status is,” Brewer added.

“The gas is then split between two cryogenic skids,” explained John Muldoon, plant operator. “Skid #1 utilizes propane refrigeration to cool the incoming gas. Skid #2 does essentially the same process, except that it has no propane chilling. After taking a pressure drop across the expander, most of the ethane and heavier components are separated out as a liquid and leave from the bottom of the tower. The residue gas that remains goes overhead, to the top of the demethanizer tower. A rotary compressor attached to an expander wheel is used to boost the residue gas pressure to meet recompression suction pressure requirements.

“All the liquids that come off the bottom of the cryogenic skids are piped over to our CO2 fractionator,” he continued. “Generally we just use this as a surge vessel to keep proper head pressure on the pumps, but when market prices warrant it, we can reject ethane and sell it as a gas. After the liquids go through the fractionator, they pass through the amine unit where the CO2 is removed from the liquid product. The liquids have to be treated to remove the corrosive components in order to meet pipeline specifications.”

Another critical element of the process is the set of nine engine summary pages that give operators an instant view of the status of each engine. “Each page tells exactly what each engine does and the service of each cylinder,” Muldoon said. “A quick glance at the graphics screens indicates whether the unit is operating, the temperature of each cylinder, and whether the unit is used for propane, low pressure or recompression services.”

Using the engine HMI screens, the maintenance staff can actually predict engine problems before they occur. “This is one of the most useful tools we have on our engines,” Muldoon said. “We can tell when the valves are starting to go out just by the temperature trends. When we have spark plugs laying down or coils not firing, we can spot the trend and take action before it gets bad enough to shut down the engine.”
A flow summary page gives operators a quick view of the entire inlet and outlet flow system. “We can tell how much gas we’ve got coming into the plant from each system along with the associated pressures,” Muldoon added. “Our people can quickly eyeball plant conditions to know if there’s something wrong. We can then notify the appropriate people to go check their stations. We alarm situations where conditions go out of bounds, like having too high a liquid level in the system.”

An outlet HMI screen shows how much actual liquid and gas product is being shipped to pipeline purchasers. “We set our controls according to daily customer orders received from Houston, and that sets the pace for how we distribute our residue product on any given day,” Brewer said. “The HMI system helps us hold it within those tight specifications.”

In addition to the on-line production equipment, the local staff can monitor all the support systems that enable proper operation of the skids, fractionator, amine unit and mole sieve beds. “We have different graphics pages that show how much liquid storage we have as well as pertinent information on our air compression and hot oil delivery systems,” Brewer explained. “In addition, we have several different reports that are produced on demand. The reports can be printed at various plant locations across the local area network or at remote offices using NetDDE and fast file transfer protocol.”

Many New Capabilities

A wide array of new supervisory control capabilities was built into the system because the principal developers, Dan Crouch and Anthony George of Control Dynamics, worked closely with Mobil plant operators to make sure the InTouch screens paralleled their former manual approach. Although the system only uses about 3,500 tag names in the database, it provides far more power than the old PLC-based system. As one example, the prior system only allowed operators to tune one PID loop at a time, and switching to the next PID loop faceplate could take 2-3 minutes. This was a burden when restarting the process after a shutdown, according to Crouch.

“We built a flexible faceplate overview that is configurable by each operator so he can look at multiple PID loops at one time,” Crouch said. “Launching a startup of the plant doesn’t happen very often, but it’s important that they be able to look at multiple stages of the operation simultaneously. There are more than 30 process loops that are critical to the operation, especially on startup, but under the old system only one loop could be viewed at a time. Now, when they have an electrical storm that causes a plant shutdown, they can restart everything in a matter of minutes rather than several hours.

“We’ve given them the ability to set up as many as 10 PID loop faceplates on this single screen just by pointing and clicking with the mouse,” he added. “And they can be a different 10 than another operator might want. Using both nodes in the control shed, they can switch among up to 20 PID loops as needed. We’ve also given them simple things like a single key to touch to return to the previous screen, so if they go do something else, they can go right back to where they were.”

Quick Operator Acceptance

The Chitwood plant operators took to the new system like ducks to water. “If you had told our operators a few years ago that they’d someday be able to control virtually everything in the plant from the control room, they’d have said you were crazy,” Muldoon said.

The HMI graphics are so easy to use, in fact, that Brewer had set aside two days for operator training when the system was brought on-line late in 1994 — but according to Brewer everyone was ready to use it within a couple of hours.
“We’ve created multiple security access levels to the system to prevent inadvertent changing of values or parameters by unauthorized staff,” Muldoon added. “Each operator has his own log-in code and a password that he can change at will. He also has a log-off code to protect him if he’s out of the operating room during busy hours.”

“Another nice feature we’ve built into this system is modem access so that we can make small changes to the system in response to Mobil staff requests,” George said. “This not only makes it easy for us to enhance the system quickly and efficiently, it saves the customer time and money.”