Chevron Uses InTouch® Software for Supervisory Control & Monitoring of More Than 500 Offshore Wells in Gulf of Mexico

New Orleans, LA — Boating and navigational skills are no longer part of the unofficial job requirements for offshore personnel at Chevron U.S.A. Production Company's offshore sites in the Gulf of Mexico. That's because Chevron engineers have implemented a supervisory control and data acquisition (SCADA) system that allows them to manage more than 500 different platforms and associated well sites remotely, from a single control center based in downtown New Orleans — so no one has to go from platform to platform to shut down facilities when a hurricane or tropical storm enters the Gulf.

These and many more system changes are saving Chevron millions of dollars every year in more efficient production as well as reduced costs related to weather emergencies.

The company is nearing completion of a three-year implementation program to upgrade systems linking remote platforms, unmanned well sites and pipelines over a 1,000-square-mile area in the Gulf. This wide area network (WAN) functions like a central nervous system. A local area network (LAN) of personal computers (PCs) in the SCADA control room in New Orleans is the nerve center and is linked via microwave communications to major network of programmable logic controllers (PLCs) and PCs. Each of these distributed networks is linked in turn to as many as 50-60 surrounding unmanned sites that use Remote Terminal Units (RTUs), flow controllers and other devices for interfacing to the wells. The entire system incorporates approximately 20 offshore PLC and PC networks that monitor more than 70,000 data tags throughout the Gulf of Mexico facilities.

Chevron engineers have been able to develop this complex network at low cost by using off-the-shelf hardware and software. It all works together seamlessly in an open architecture that provides the high performance required for the SCADA application because the entire operation runs under the InTouch® human-machine interface (HMI) software from Wonderware, a business unit of Invensys Systems, Inc. The end result is that each operating group can monitor and manage the operation of its own physical equipment and facility sites, yet the New Orleans staff has an easy-to-use and effective way to collect real-time production data and transfer it into multiple corporate databases to feed Chevron's business and commercial applications. The system has provided the company with a way to integrate a multitude of different systems that had been acquired over nearly a half century.

Upgrading 40-Year-Old Systems

“Many of our offshore production facilities date back to the 1950s and 1960s in their platform architecture and the layout of the well facilities,” explained D.L. (David) Kempkes,
electrical engineer for the company’s Bay Marchand Profit Center. “We typically have a crew of four-to-ten men in each of our fields and they are responsible for running process platform operations, plus anywhere from ten-to-sixty surrounding well sites over a five-to-ten square mile area.

“It used to be a very labor-intensive process,” Kempkes said. “Personnel operated the field by boat to monitor wells, run well tests, gather data for production reports and re-open wells after a shut in. Obviously, it wasn’t a very efficient system and it resulted in high operating costs and frequently inaccurate data.”

“If a hurricane or tropical storm approached, we would shut in production and evacuate personnel,” Kempkes added. “This takes anywhere from three hours to three days, depending on the size of the field—and it involves a comparable amount of time to go around and re-start everything. With an opportunity cost as high as $250,000 an hour, that’s a lot of lost time and money due to hurricane evacuations.”

The first level of enhancement was the addition of facsimile machines at each platform so that the handwritten reports could be sent in over phone lines. This saved some time, but it was still manually oriented. “The next level of improvement was the use of portable data terminals for gathering production data,” said Alex LeDoux, electrical engineering advisor for the South Timbalier/South Pass Profit Center.

“The data was downloaded locally and then sent in batches to the MIS databases in New Orleans,” LeDoux explained. “Finally we decided to make the upgrade to PLCs at the platforms and RTUs or flow computers at each remote site, all connected via microwave and radio communications. This offered us some great efficiency improvements, because we could monitor whether well sites were open or shut and collect data more easily on their production rates. Plus we could actually begin to control well testing and other critical tasks. By overlaying the InTouch software as the common user interface, we could tie all this diverse equipment together so that it functioned as a single system.”

The SCADA system was launched with a pilot project in the South Timbalier 52 oil field. It consisted of a mother platform with ten satellite platforms. The initial installation was used solely to monitor production status of the wells.

Chevron has standardized on the Square D communications protocol in the Gulf of Mexico, so regardless of what hardware is used — whether it’s a Square D PLC, a Siemens RTU or an Applied Automation flow computer — as new hardware components have been added, Chevron has had its suppliers standardize on the one protocol to simplify communications.

“We have one master network for each of the three New Orleans profit centers (Bay Marchand, Main Pass and South Timbalier/South Pass), plus two InTouch development systems, but they are all connected on the company’s NetWare LANs as well as on the real-time data side,” LeDoux mentioned.

“A card in each computer talks to the Square D protocol over the Square D Industrial Network to a rack of communication cards. From there we link via modems, using the company microwave network, to the various sites in the Gulf. We have 20 major sites connected to New Orleans, and our center in Lafayette, LA, has another 12 sites. Since these major sites can forward messages to other locations in their fields, we’re connected to hundreds of facilities, Gulf-wide,” LeDoux said.

“Major structures typically have dedicated microwave links to the New Orleans SCADA Network Center and they route to satellite sites via different communications links over the Square D Industrial Network,” Kempkes remarked.

“So we have a total of more than 500 PLCs, RTUs and other remote devices connected to the network of five PCs here in New Orleans. Wonderware’s Square D SY/MAX and SY/LINK I/O servers provide the common interface for sharing data with our business systems. This approach has let us easily separate the networking from the production control systems,” Kempkes noted.

**Variety of Production Operations**

The applications are divided into two primary categories. The first is operation of the main production platform in each area, which contains a large and varied amount of production equipment and safety systems, rotating equipment, vessels, and so forth. Additional supervision is performed for the
remote platforms and single-well caissons, which control flows for just one well with no production equipment. Every operation is different.

“We've got field locations for high-pressure gas production and others for oil production, and each one involves totally different operational procedures,” LeDoux explained.

“The different locations deal in different types of data and what the system needs to do will vary, so there isn’t necessarily one ‘typical’ installation. The Wonderware system allows each group to apply the technology in the way that benefits them the most. It’s not a cookie-cutter operation, and it has allowed each group to automate data reporting in a way that matches its own needs. Yet it is capable of feeding the corporate databases in a manner that meets the company’s needs.”

Now, when supervisors do their reporting every day, instead of getting a technician on the boat to go from site to site and file written reports, control room operators can just scroll through two screens to get a well summary, or scan up to 50 individual screens for detailed data on which wells are open or shut, whether there has been an equipment upset or other operating problem, and daily production volumes. Using the InTouch HMI, operators can run well tests and normalize and collate the test data. Then they can automatically transfer the data into corporate databases for use by the MIS groups to manage all production activities throughout the Gulf.

“Our first use of Wonderware’s InTouch software was on our major oil and gas production platforms to monitor and control electronic safety systems, production metering, well testing and process equipment,” Kempkes said. “Systems were then expanded to do data trending and capability reports.

“Our satellite structures have little or no process equipment on them, so we’re in the process of installing RTUs to monitor and control the wells,” Kempkes added. “This capability of total field monitoring is giving us a handle on our actual downtime and helping us manage our transportation needs.”

“We use alarming for many safety-related issues,” said J.S. (Scott) Strawn, electrical engineer for the Main Pass field. “This includes detection of combustible and toxic gases as well as logging temperatures and pressures that may get out of tolerance. Of course, we alarm with shutdowns, because if a well shuts down, people need to know that right away. We have even implemented a system to pre-alarm conditions before shutdowns occur.”

“The Wonderware system can link a wide range of equipment so that it can be monitored and reported on remotely,” LeDoux said. “We now can do trending and analysis on our compressor performance, on environmental, safety and health systems, and other applications.

“What we've found is that we can use the InTouch HMI as an umbrella for all of these systems and have connectivity through the PLCs, all talking the same protocol -- just like the connectivity we have on the raw data side. We use Wonderware’s NetDDDE connectivity software and DDE Servers to gather SCADA information on all sorts of diverse systems. Whatever data can't be provided automatically, operators can enter at a keyboard and, because the InTouch HMI provides a consistent operator interface, it's all in the same format and can be dealt with more easily. People prefer that to having multiple separate systems with different user interfaces. We can give them the same look and feel across their whole day-to-day operations,” LeDoux remarked.

The screens are designed and nested in a “natural” order that follows an operator’s normal work flow. The main overview screen lists the various Gulf locations. A second screen is dedicated to alarm logging, and a video splitter card lets supervisors keep both screens visible simultaneously.

Operators simply select a particular field to get a graphical representation of the platforms in that field. From there, they can go to a platform-level detail and view all the surrounding well sites. The next level details individual wells, including data on surface safety valves, tubing pressure, casing pressure, and flow line pressure. Subsequent screens provide real-time data on production systems and emergency shutdown status. An alarm summary log and historical trends complete the picture for operators.

**Cost Savings**

This system obviously means a big difference in the ability to handle large and complex workloads. In the Bay
Marchand State Field, for example, more than 120 wells are on production. Managing all of these wells and six process facilities is a big chore with the added complexity of the wells being gas-lift, low-gravity oil wells, in which gas is injected in the well to force out the production fluid.

“The problem is that if you over- or under-inject gas-lift gas, total fluid production and system back pressure are greatly affected,” Kempkes said. “By having a tool to effectively optimize our wells, reduce transportation costs, and provide automatic documentation, we increased profitability by $8-10 million in 1993 — and we should continue to realize higher profitability every year because our operations are now optimized.”

“Just by improving our monitoring, we can provide supervisory control faster to respond to changing situations,” LeDoux noted. “We’ve increased our production efficiency from an average of 83 percent of capacity to 88 percent. That net five percent translates to about another $5 million a year, so we’re talking about significant revenue when you add it up.”

“None of these things is that big by itself, but when you apply it to 120 wells, a little bit for every one of those wells sure adds up,” Straw added. “We can see the data now, so we can manage it better.”

One new application innovation the team has implemented is using the HMI and PC-based multimedia capabilities to drive the public address system on platforms. The PLC generates an alarm, which goes to the HMI, which then displays and logs it, and then scripts it into a routine for the Play Sound utility. A voice announcement then goes from the sound card and the PC to the structure’s public address and alarm system.

“This will sound a horn on the platform, then mute the horn, and a recorded voice will tell platform crews what the alarm is,” LeDoux explained. “Even if nobody is sitting in front of the SCADA computer and monitoring it at the time, the crews will know what’s happening and they can go right to it. That’s an important thing, too, because some of these platforms are 2-4 deck structures, with long stairways between levels.

“The computer’s up on the top deck, but a crewman may be down on the bottom deck,” LeDoux said. “If he gets a voice alarm telling him exactly what the nature of the problem is, he can choose to take care of it immediately or get to it later if it’s not critical. The operators really like this because they don’t have to run downstairs or upstairs quite as much. Time management is the issue because we’re now able to do more with less.”

“It also serves another purpose that saves huge amounts of money when there’s a possibility of a hurricane evacuation,” Kempkes noted. “Obviously we have hurricane problems in the Gulf of Mexico, but now we can evaluate each structure’s situation individually, leaving them online and monitoring them from the New Orleans control center,” he said. “Before the hurricane threat becomes imminent, we can ‘shut in’ remotely. If it doesn’t, we can stay online. If it’s a tropical storm that poses a threat to only certain offshore locations, we can shut those down and leave the rest online.”

“From a personnel standpoint, we have to get our people out of there from 24 to 48 hours before the storm’s imminent,” LeDoux added. “So, even if it’s only another day or two of maintained production, you’re talking pretty big bucks. During tropical storm Alberto in July 1994, we remotely produced more than a third of our offshore locations for more than 24 hours.”

**Consistent Version Upgrades**

The pilot project started in 1991, using version 3.2 of the InTouch HMI software. “We moved from 3.2 to 4.1 and now 5.0 — and each new version has given us more capabilities to make our job easier,” LeDoux said.

“As an example, the InTouch HMI’s use of indirect tags has allowed us to develop one screen for conducting well tests on 120 sites, instead of having to build 120 screens, one for each well,” LeDoux said. “We also reduced our database time from a 60-minute compilation to about a minute and a half when we switched to version 4.1.”

The consistency of successive software generations also means that the same graphical user interface is used for all Chevron crew members on the offshore platforms.

“We attempt to integrate our systems consistently, making it easy for operations personnel to manage the different systems,” Kempkes said. “It’s easier for them to learn, and the same procedures are used in all our field locations, so people can move from site to site without a learning curve. Many of the same graphics are used everywhere, so it all looks the same to everyone who deals with data.”

“We selected this software because of the low cost and high speed of development, but it’s always giving us more capability,” LeDoux said. “A future enhancement we’re investigating is linking the InTouch system to our Oracle production, so we can automatically transfer data between the two. The technology is there, and we have many tools that we didn’t have before. That’s one reason why we’ve created a SCADA Management Team, to consider all the possibilities for future enhancements and lay out a plan. We have a much longer-term view now,” LeDoux concluded.