System Integrator Configures Decentralized “Control Room” For Managing Oil Production from Anywhere in PC Network

VIENNA, AUSTRIA — OMV Energie is one of Austria’s largest energy companies, with vertically integrated operations that include oil drilling and production, gas production and distribution, pipelines, oil refining, petrochemical manufacture and retail marketing of petroleum products.

Despite annual sales approaching $7 billion, OMV is not considered a giant in the world oil industry. To make sure it prospers in an extremely fast-moving industry, management is making aggressive use of the latest in automation technology to increase operating efficiency and reduce costs so that it can be nimbly competitive in a global economy.

OMV operates about 1,000 production wells spread over a 500 square kilometer area in the region north and northeast of Vienna. It operates pipelines and 38 pumping stations to move the crude oil from production fields to a central refinery where multiple grades of gasoline are produced to supply the company’s familiar blue and green logo retail gas stations throughout Austria, the Czech Republic and Hungary.

Austrian petroleum resources typically are of the high quality light crude variety, but reserves are dwindling so producer companies must make the best use of them. OMV used to operate more than 1,600 well sites in Austria but as the world price for oil has come down in recent years, the company decided to take some out of production and make more flexible and efficient use of its remaining reserves. As part of this effort, the company hired Vienna-based system integrators BASYS – Büro für Automatisierungs- systeme to create a decentralized control room capability that would let OMV personnel manage any operation from any point within its computer network. BASYS engineers developed a system that added production capabilities to existing token ring networks used for office automation. The enhanced architecture combines programmable logic controllers (PLCs) that run well production, personal computers (PCs) that provide supervisory control from anywhere in the company, a redundant database server system that manages the entire process model, and a redundant communications server system that facilitates interaction between all elements.
Sophisticated Networking

OMV already had four PC-based token ring networks at its headquarters and at regional offices in Austria for office automation applications. In addition, the company had an IBM 3745 computer for corporate information systems. These networks were interfaced to each other via a 64 kilobit leased line backbone and via radio links to remote sites. BASYS engineers used this as the foundation for the new production systems, adding the Wonderware InTouch™ human-machine interface (HMI) software from Wonderware Corporation, of Irvine, Calif., to provide the supervisory control capabilities. Both the office applications and the production systems run on off-the-shelf PCs using Microsoft Windows.

Each of the 38 well sites is equipped with a Bernecker & Rainer PLC, running an OS9 32-bit, multi-user, multi-tasking operating system for Motorola 68000 systems. The PLC does all the on-site production work for running of the wells, measurement of oil, water and gas content of the output, and product quality testing. The PLC communicates via radio link or 1200 bps dialup lines to the central communication site in Gänserndorf, which houses the database server and the communications server.

The database server consists of two redundant HP Hewlett Packard UNIX-based systems running an Oracle 7.1 database. The communications server is a redundant pair of Digital Equipment Corp. Pentium-based PCs running Windows NT. All communications with the remote PLCs is via serial connections; the PCs are connected in a token ring network. All interaction with the database server is via structured query language (SQL) access. An interface is also provided to the company's IBM 3745 mainframe for historical data archiving. The MMI application uses DDE and NetDDE transfers to provide data for process visualization on the PC-based view stations.

The entire process model for the OMV operation is contained in the database server so that all current values and alarms are stored there and available to anyone in the network (with appropriate security clearance). The process model consists of 250,000 I/O data points. The Wonderware InTouch system used to supervise it has about 10,000 tags and 150 MMI screens. One unusual aspect of the system design is that the PLCs are not programmed using registers, but are set up on an object-oriented basis.

“We have defined the 300 kilobytes of data on each PLC as an object model so that, rather than sending program updates as register data, an entire program can be downloaded as an object,” explained Robert Widmer, BASYS software engineer. “In this way, program integrity is guaranteed since no existing program will be overwritten if anything should disrupt transmission between the server site and the remote well site. If a data model changes, the PLC knows to do an automatic re-boot and confirms its occurrence. A typical model contains about 150 elements and the PLC program is updated only if the complete model has been received successfully.”

The data model for the PLCs includes object security for each user. It consists of a user name, a password, security level bits, etc. “It includes so much different data — in terms of overall parameters, message alarms, commands, differential devices and so forth — that we assemble it in objects to facilitate handling,” Widmer said. “Each well in a production field has its own ID number, but there are many parameters associated with it so we group this data dynamically and provide an object index. To access
data we would ask for conversation 29, from object 21, it might have 100 items in it. This can be done at every computer on the network and it just runs in the background.

Another unusual aspect of the system design at OVM is that each PLC runs its site independently. There is no central control room for supervising of the well production operations. The entire system can be managed by any technician from the decentralized Wonderware InTouch view stations, which can be anywhere on the network — either on one of the four token ring network centers or via modem.

“We refer to this architecture as our ‘distributed control center,’” Widmer said. “All security is done at the database, which defines the users and their application rights. Whenever users log in on any station, from anywhere in the field, they have the rights to do whatever they’re permitted to. All rights reside with the users, no matter where they’re located. The MMI is used primarily as a visualization tool. There are some pumps and equipment operators can start or stop, for maintenance or repairs, but the MMI is used mainly for alarms and visualization. Whatever actions are taken are made through the database so we can log all activity and know which user did what at any time.”

The benefit for OVM is that where they used to have a real-time system, with ASCII terminals, now they have full Windows with a graphical user interface. It was running on old hardware that had to be updated because the company could no longer get spare parts. The initial benefit sought was the cost savings on the maintenance of the system, according to Eric Schneider, BASYS partner and general manager, but many other benefits accrued from the new implementation.

“The entire network now runs without operators, which allowed OVM to do more work with existing staff levels,” Schneider said. “They also now have automated alarms and parameter-setting so that operations can be run remotely from any site. There’s no need to travel to sites anymore — and with a modem they can do it from home, even on a weekend. Nobody has to drive to the plant to respond to an alarm on a weekend. Just use a portable PC right from home.

“It’s also much more cost-effective,” he added. “We’re planning on including a pager system for responding to alarms. At the moment there’s a 24-hour shift on duty at a pipeline management office in a small village called Auersthal, in lower Austria. Since this staff is on duty anyway, they monitor the alarms for us even though they don’t actually run the production system. Their job is to control three east-west pipelines from Russia to Italy, to France and Germany, and to Slovenia, but since they are already working in the pipeline office, they can monitor our alarms as well.”

**Complete Production System**

The new system is used for three purposes: to manage oil production, to evaluate its output, and to meter the whole system. “OVM can measure whether a well is good and they should produce more from it, or it’s not good and they should shut it down,” said Ernst Rohrschach, BASYS partner and general manager. “They can make judgements and management decisions based on these evaluations. They drill the oil out of these 38 stations, then meter the oil and water content, then mix it to whatever quality is needed. "They also separate output into its component products,” he said. “Gas and water have to be pumped down into the ground deposits again, because the water is toxic. The gas is used partly as a salable product and partly for re-injection to help pump out the oil. This gas injection task is also automated via a gas ‘ring’ that is used to optimize pressure and specify where the gas should be pumped.”

Each station has a buffer storage tank and flowmeter that is used to separate the water, oil and gas, then pass each through a flowmeter that provides an evaluation of content per barrel pumped. Twelve different measurements typically are used, and OVM is converting to the use of new three-phase, in-line instruments that will combine the 12 different measuring devices in one.

“The use of this sophisticated new instrument eliminates the holding tanks, too, providing the evaluation right in the production stream,” Rohrschach said. “At the moment they have to do periodic measurements on the tank contents, kind of like a buffer. They’ll soon be able to do it in-line. They will be able to treat the entire measurement as just another data object.

It will also check the meters and enter the results in the database, as a data quality check as well.”
Continually Growing Application

“We have a ‘living’ system that just keeps growing,” Widmer said. “We presently have a total of 38 stations to serve about 1,000 wells in the field. We currently have 16 serial lines among the remote sites, which run simultaneously at 1,200 to 19,200 bits per second, but we keep adding modem and radio links. The database server has six gigabytes of hard disk space, which is enough to store graphical representations of all production for about six months.

“OMV doesn’t archive data on this system, but transfers it to the IBM 3745 system — which includes off-line storage of all data gathered since they began production in 1945,” Widmer continued. “There are a lot of influences coming together through the project managers and they have to provide for every operating group. This system has been designed to be highly dynamic, to meet all these different functional requirements. Any one group’s results can affect the work of others, so it has to be a very open system because everything is fluid and changing over time.”

That’s why Widmer designed it as an object oriented system. All data comes from the PLCs in objects, through named pipes to other processes. The server reads those objects, decides which data is useful for other users and passes it along to users. The system’s data manager in parallel collects the objects and determines what data should be passed on to the database.

“Our decision to go with Windows NT was based on the communications requirements, because we could not have implemented this any other way,” Widmer added. “The whole process is handled in RAM. We have 60 megabytes of RAM on the server, which is unusual for a PC, but all data models of all 38 pumping stations are in memory, so users can read the current values for all stations at any time. We handle about 200,000 transfers and ‘commits’ to the database every day, so it’s important that we have quick updates and instant availability of data to all users.

“What makes Windows NT very good for process control like this is the multiple threading capability,” Widmer noted. “With 16 serial lines I can provide parallel communications to the stations. Serial lines are slow, so it’s no problem for the PC, but I don’t lose time because I can do them all at once in parallel, using multiple threads. The asynchronous I/O and multiple thread features of Windows NT make it easy to program.”

This flexibility is important to the future expansion of the system, Widmer noted, because OMV will soon be expanding into maintenance operations. The company has plans to put PCs into service vehicles so that the people who service and maintain the pumping stations can directly access the master database on-site, use the HMI to turn equipment on or off as needed, and get their next work order downloaded to know where they must go for their next call.