Phasing in DCS migration

By Victor Aparicio, Carlos Balanza, and Eduardo Zambrana

Bolivia's Carrasco gas plant of Empresa Petrolera CHACO has seen growth over the years. However, the need to update its distributed control system (DCS) was looming.

The company decided an update was imminent, and that move would be a great way to improve system and process efficiency, eliminate obsolescence, and reduce operation and maintenance costs. The best solution to meet these goals was to have all facilities under a new DCS system, optimizing control links.

The Carrasco plant's control system includes a DCS installed 11 years ago. All the plant's control signals and monitoring are collected in five cabinets and then sent to a central processor. The system has gateways for SCADA communications

FAST FORWARD
- Facility growth leads to imminent upgrade at Bolivian petroleum plant.
- Strategy is to link all facilities under one DCS system.
- Upgrade divided into three phases for cost efficiency.

Gas plant converts DCS in phases for better efficiency

with the Amine Plant's PLC and the RTU of the wells in the Bulo Bulo field (five total). The instruments connect to the field modules through 4-20 mA point-to-point connections.

Existing problems

The old system had old technology, which required high maintenance costs. It was difficult to obtain spare parts. The hardware and software were saturated, and we could add no more instruments and I/O modules to the system. It was impossible to work with modern instrumentation, such as, Hart, Foundation Fieldbus, Profibus, and Ethernet.

The system was centralized. The whole control system was under a control processor, so when it broke down, the whole plant shut down, with the consequent losses in production and time. The system's software was old, and we could not upgrade without totally changing to a superior version and without losing licenses. It was impossible to obtain reports and historical data on Excel spread sheets.

While we wanted to improve the system and process efficiency, eliminate obsolescence, and reduce operation and maintenance costs, it was not possible to

replace and update the whole control system for production and budgeting reasons. So we decided to partially substitute the present structure and gradually substitute all the components of the system as budget, time, and production allowed. In order to do this, we divided the project into three phases:

Phase 1: The DCS system migration began in the year 2005 with the installation of a new DCS system, which was connected from separators, measurement, gas re-injection system, LPG cargo station, and the SCADA system. The new system would be interconnected with the old system through OLE for process control (OPC).

Phase 2: The new DCS system was to consolidate through connecting the system to electric energy generation, glycol dehydration, the separator's control, and total replacement of the old DCS system in the cryogenic process of the plant.

Phase 3: The implementation process of a new DCS system will end up with the optimization of all the control links of the plant.

Modernizing the DCS

The hope was adding all new facilities to the control system would achieve automation of 100% of the plant. The

addition would also allow us to reduce operational and maintenance costs, improve the quality of the final product (natural gas processing), and extend the benefits of the modernization through the use of more recent versions of software and hardware. Where possible, we could also adopt industry standards to ensure greater system availability and operation, as well as increasing its life cycle. We also wanted the system to be open for new additions of software with the external world (object linking embedding [OLE], OPC, and open database connectivity [ODBC]).

Because we were making a partial conversion of the obsolete DCS system, we needed to segment the plant into its various areas of automation so we could move selected areas and functions to the new DCS system. We have identified these areas of automation as automated (cryogenic, dehydration and fractioning, Bulo Bulo field, Amine plant, separation, and compression) and not automated (generators, Kanata field [8 wells], LGP loading, analytical instrumentation, re-injection, and glycol dehydration). All areas have necessary instrumentation and are operating with local control loops and monitoring.

Proposed solution

- Update the old DCS to a new technology.
- Increase speed, field modules, software capacity, and security.
- Make it possible to manage modern instrumentation.
- Don't lose connection with old instruments.
- Update obsolete equipment.
- Open systems.

The new DCS system is distributed in different areas, in DCS cabinets connected to the control room by means of Ethernet optic fiber. We added two PCs to the control room for graphic information because it has corresponding software for configuring the applications of the new DCS system.

The old system is in charge of three DCS cabinets in which we have added what we call the old plant, or the cryogenic part for which the old DCS system was originally designed. We took special care to follow the appropriate norms and standards of the industry for this case, such as IEC and ISA standards.

HMI training, communication

Communications between the two systems occur through OPC. The new system has the capacity to monitor the old system and present graph screens of the whole plant on its human machine interface (HMI). We used design standards from the old DCS system when designing the new one because operators
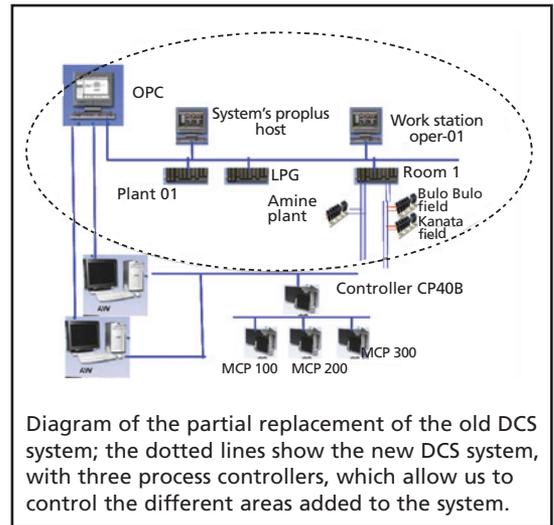

Diagram of the partial replacement of the old DCS system; the dotted lines show the new DCS system, with three process controllers, which allow us to control the different areas added to the system.

Integrating SCADA reduces engineering, maintenance costs

By Xu Jie

Zhejiang Natural Gas Co. is engaged in substantial pipeline construction of its West Gas Eastwards Pipeline, which will include the installation of a new system featuring an industrial server. The new system will enable Zhejiang Natural Gas Co. to meet users' needs by helping them visualize its plant processes, analyze the resulting information, and use that information to optimize the plant as a whole.

Goal: Centralize monitoring, control

The main goal in the new construction is to centralize the monitoring of station equipment, processes, and pipelines. A new SCADA system offers plant staff increased system access. With the ability to visualize production processes, they can make real-time adjustments and analyze the resulting data, using an industrial real-time plant historian. The staff also benefits from independent PLC access. Easy maintenance and centralized control simplifies system growth and optimizes ongoing pipeline construction. In addition, the platform architecture is expected to generate great engineering and maintenance cost savings.

An integrated solution

System integrator HollySys helped implement the new control system, which includes an industrial application server, visualization software, a server historian, and reporting and analysis clients. The software monitors and controls the operation of the entire pipeline system and monitors the plant's equipment processes (including pressure, temperature, flow transmitters, motor-driven valves, modulating valves and special equipment) via the Modbus protocol. The system also performs gas-flow and supply calculations. Personnel can thus decipher the plant's complex operations contracts and how they affect downstream and upstream costs. Furthermore, they can evaluate gas quality based on process and capacity calculations and create statistical models based on the server historian's database structure.

Simple, secure application replication

The application server, built on an industrial automation and information software architecture, centralizes the company's pipeline system using simple drag-and drop methods to create application objects that model equipment, such as pumps or valves, connectivity devices, or an entire plant. Operators can replicate objects multiple times and include operational attributes such as performance history, I/O characteristics, and other requirements when replicated. The application server security model provides security at the data-element level, which is valuable for protecting the system.

The industrial application server enables efficient system deployment across the company's control system, which stretches across a wide area, but uses identical equipment per each control station. A portal software facilitates secure access to statistical reports, alarm information, and data stored within the server historian.

So far, plant personnel appreciate the application server's plant model, which helps them organize each station in a consistent manner using application templates. Because the new architecture is built on a Microsoft.NET framework, the plant's programmers can use .NET scripts to easily add more functionality to the system at a low cost.

The expansion of its natural gas pipeline has given the company new business opportunities. To build on this success, plant staff can now visualize their plant processes, analyze the resulting real-time plant information, and use it to optimize the plant as a whole. Even more importantly, the new architecture is expected to save the company time and money by providing highly distributed applications for the entire pipeline.

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were familiar with the graphics, and we believed there was no advantage for introducing different standards. The OPC system provides the possibility of getting plant reports and historic variables on Excel spread sheets.

The operators were trained in the handling of the system, alarms, screens, setpoints, and changes. We prepared maintenance personnel, such as DCS and instrumentation engineers, with training in the configuration of the system, control loops, and equipment calibration. We made sure the supplier provided technical support in planning, implementing, maintaining availability of spare parts, and advice for personnel in all the project's stages. This way, we can maintain the system with new versions of software and firmware available on the market.

Implementing phases

To implement the first phase, we planned the work jointly with operations and supplier. We tested instruments and the database in supplier office and installed the cabinets one day before the migration. Maintenance prepared a report of signals and power supply (100VAC and 24VDC) before the migration. The day of the migration, operations planned the work in such a way they only passed to local control (in field) the affected areas of the old DCS, allowing the work without plant shutdown, and completing in the shortest time period (approximately six hours).

All connections followed the appropriate standards for Zone 2, Division 1. The control room was air-conditioned to allow more comfort and facilitate the operator's job. While developing this phase, we did not have any unforeseen plant shutdowns, and the whole implementation process occurred without any great inconvenience.

Second, third phases

The objective of Phase 2 is to completely replace the old DCS system, for which we will have the following control processors:

- Room II: Control processor in charge of the generating and compression areas
- Plant II: Control processor in charge of the fractioning and turbo-expansion areas
- Plant III: Control processor in charge of the dehydration and hot environment areas

Phase 2 is underway, and the database for the old DCS system is transferring to the new one. For this phase, where we will replace the entire old system, we have programmed a plant shutdown, allowing us to safely carry out the main work. The objective of Phase 3 is to optimize the control loops and the production parameters so we can fulfill the proposed objectives. The hardware and software substitution of control systems should be carefully planned, following the ISA Certified Automation Professional (CAP), model for an automation project, and limiting the project's scope to any needed operational improvements, as this is linked to budget and time. We should responsibly select a supplier, bearing in mind local technical support, such as maintenance and supply infrastructure.

With joint work between maintenance and operational personnel, it is vital to remember their needs and thus ensure the project has a high life cycle. It is also important to develop an operator training course before or during the project's implementation, thus getting the operator to participate in the project. We should also take special care when selecting the hardware and software, since this must permit its easy integration with future phases and technologies. The OPC's structure allowed us to open the control system to other systems, enabling us to interconnect the different control systems of other fields Empresa Petrolera CHACO owns or operates.

Project update

Today, the DCS implementation has achieved 100% automation of the plant's gas treatment. We wrote new startup and shutdown sequences, and we are now adding new instrumentation to the new DCS system (SCADA). We put new automation areas into the system as well.

As a third phase of the project, we are changing instruments with 4-20 mA or proprietary protocol to HART-type instruments. Our objective is to have the whole plant instrumentation (transmitters and control valves) changed to the HART protocol. At the same time, we are managing instrumentation, with inspection, calibration, qualification, and preventive maintenance plans, throughout the entire plant. We hope to finish this phase during the first trimester of 2008. As a fourth phase, we plan to install a safety instrumented system (SIS) throughout the plant.

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