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Oil & Gas

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Success Story Collection

Oil & Gas

This is a showcase of success stories
from our customers worldwide.
Many leading companies are using
Yokogawa products to manage their plants and processes.

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Plant Information

- Location: Den Helder, The Netherlands
- Order date: December 2012
- Completion: September 2013

NAM-ONEgas

Gas Plant Shutdown System Migrated Rapidly via Combined Automation and Engineering Package

Executive Summary

Nederlandse Aardolie Maatschappij (NAM) is the Netherlands' largest natural gas producer. In addition to onshore fields, NAM operates manned platforms and four unmanned monotowers in 19 offshore locations. These connect to a pipeline network that comes ashore at Den Helder.

One of the plants at Den Helder is a low calorific gas processing facility that started operating in 1984. As part of a general rejuvenation of the systems and equipment at this facility, NAM decided to upgrade its automatic shutdown (ASD) control system, which relied on obsolete magnetic logic failsafe technology. Once the upgrade decision was taken, time pressure became critical, as ideally, NAM needed the upgrade to coincide with a planned six-yearly maintenance shutdown.

Yokogawa is NAM's preferred main automation contractor (MAC) for its offshore operations. For speed and efficiency, it was decided that Yokogawa would also provide the electrical, mechanical, and civil engineering services required for this automation upgrade – work that would traditionally have been contracted to an engineering, procurement and construction company (EPC). Eliminating the need to hire an EPC sped up project completion by six months.

Project Background

The rejuvenation of the Den Helder gas processing terminal aimed to extend its useful life to beyond 2030. As part of this effort, the company was conducting a progressive upgrade of the terminal's distributed control system (DCS). This upgrade is an element of the ONEgas strategy for the combined assets of NAM and parent company Shell that seeks to lower operating costs in the Southern North Sea by better managing fields that are nearing the end of their operating life.

The final phase of the control and instrumentation upgrades at Den Helder targeted this facility's Yokogawa Maglog 14 ASD system, which relied on magnetic logic technology that was first introduced in the 1960s. Yokogawa stopped selling this system in the late 1980s, and plans to end support for it at the end of 2014. In December 2011, NAM decided to migrate to Yokogawa's latest safety platform, the ProSafe-RS safety instrumented system. A key consideration was its ability to closely integrate via the Vnet/IP control network with the Yokogawa CENTUM VP DCS installed at the Den Helder terminal.

Yokogawa has developed a close relationship with NAM, as for some years it has operated as a MAC for the company. The MAC role provides a single point of responsibility for all the automation equipment at a facility. This partnership-style approach is becoming increasingly popular with larger end users that have complex automation installations, as it can simplify projects both for the user and any EPC involved. Yokogawa has invested in personnel with the skills needed to exercise this higher level of responsibility. In NAM's case, the MAC role involves the provision of automation equipment and services under the terms of an enterprise frame agreement between Yokogawa and Shell.

To fast track this project and ensure that this upgrade coincided with the periodic maintenance shutdown planned for August 2013, NAM decided that Yokogawa should also take on the traditional role of an EPC by providing a complete package and implementation service, including all the mechanical, electrical, and civil engineering work required to install and commission the system. Missing this deadline could potentially have meant requiring the system to operate for a further two years beyond its end of service date.

Several factors led to the decision to ask Yokogawa to operate at this higher level of responsibility. Yokogawa had extensive knowledge of the automation system as it had been associated with the site since it started operations in 1984, and NAM's experience of working closely with Yokogawa as a MAC partner was very positive. The upgrade was a functional replacement for the shutdown system - which was well defined, making it easy to oversee. Another key factor was the importance of this project for NAM, which meant that dedicated NAM engineering resources were available to assist in project planning and implementation.

Services and Equipment

Apart from the elimination of a few control loops that had become redundant over the plant's lifetime, the new safeguard system was a pure functional replacement for the old system.

The initial front-end engineering design (FEED) work was performed by Yokogawa engineering staff under the supervision of an experienced FEED engineer from Shell. This phase of the project started in April 2012 and finished in September. After this initial planning work was completed, Yokogawa presented a solution and execution strategy to NAM in December, and the implementation phase of the project was started in January 2013.

The first element of the execution phase for Yokogawa was the generation of the many detailed drawings, diagrams, and equipment specifications required for implementation. This resulted in a bill of materials that included the core elements of the safety control system, based on Yokogawa ProSafe-RS safety instrumented system with the required I/O interfaces. A range of third-party equipment including new barriers, trip amplifiers and cabinets was also specified to replace old and obsolete I/O technology fitted during the installation of the original ASD system.

The execution phase of the project was performed very rapidly by Yokogawa, with planning, purchasing, and preparation work – plus software development for the ProSafe-RS – completed by the target date of August 2013. Construction, implementation, and testing then took place at Den Helder during the planned shutdown period.

Although the ProSafe-RS platform offers new functional capabilities, it was decided that the safety application would implement the same functionality as the previous Maglog 14 system. That system was based on logic circuits with magnetic cores – a hard-wired system; field communication was made via Modbus links, with data sent as it was requested. In contrast, the new ProSafe-RS safety instrumented system is now directly integrated with the plant's CENTUM VP DCS network. All of the safety-related data – and potentially any other data from the plant's complete DCS – is completely transparent and available to the safety controller. This provides NAM with an advanced safety control platform that can be reprogrammed and modified at will to deal with any proposed future changes to the gas processing terminal.

Key Project Achievements

- Fast-track project completion with on-time start-up
- Implementation during plant shutdown avoided downtime
- Project handled solely by MAC
- Novel approach to project management extends value of plant's MAC strategy
- New software-centric safety platform simplifies future modifications to plant

Customer Satisfaction

"Yokogawa's high level involvement played an important part in helping NAM to implement this automation upgrade project efficiently and cost effectively. With their help we were able to resume normal processing operations on time and without problem after the planned shutdown," says Vincenzo Graziadio, ONEgas Project Engineer with NAM.

Vincenzo Graziadio
NAM ONEgas
project engineer

Plant Information

- Location: Sharjah, UAE
- Order date: July 2007
- Completion: October 2009

BP

Yokogawa Receives Award for Hot Cutover of BP Sharjah Plant DCS

Executive Summary

BP Sharjah was established in the Emirate of Sharjah in 1978 and is one of the UAE's largest private producers and sellers of natural gas, condensate, and LPG. Its main gas production and processing facility about 40 km outside the city of Sharjah provides a key energy lifeline to the people of the UAE.

In 2007, BP initiated a project to replace the existing DCS at the Sharjah plant with a modern, reliable, and expandable system that is compliant with BP's engineering standards and Automation Blueprint and is supportable for at least the next 15 years.

The Challenges and the Solutions

In 2007, Yokogawa was selected by BP as main automation contractor (MAC) for a project to replace the Sharjah plant's existing Rosemount RS3 DCS with a Yokogawa DCS (CENTUM VP). This brownfield upgrade demanded sensitivity to the needs of the customer balanced with an innovative approach and a willingness to leverage the benefits of modern automation technology. The team set out to achieve this from the outset, specifying and designing a system that was in full compliance with BP's Automation Blueprint. It did so while planning to implement this system as a hot cutover - a phased signal-by-signal changeover to the new system with the plant remaining operational throughout.

A comprehensive user requirement specifications (URS) study and a front end engineering design (FEED) study were carried out by BP and Yokogawa in order to ensure that the Yokogawa system's capabilities closely matched the requirements of this complex BP facility. Taking an integrated team approach, Yokogawa Middle East worked closely with BP, ABB Engineering Services, and Maritime Industrial Services Company (MIS) with the shared goal of safely completing the upgrade and minimizing its impact on plant operations.

During the project, the team overcame various challenges and successfully delivered the job safely, on schedule, and on budget. A deep desire within BP and Yokogawa to learn lessons from previous projects was a catalyst in this project's success.

Some of the challenges that the team faced were:

- A lack of up-to-date documentation
- The need to integrate 32 subsystems spanning a variety of communication protocols
- The requirement that the upgrade not interfere with normal operations at the critically important Sharjah plant

To address these challenges, numerous site surveys were conducted to collect and verify data on the existing plant facilities. A team of highly skilled engineers was deployed during the FEED study to examine the existing systems, and this team remained active until the commissioning of the new system was complete. Several unconventional decisions were made that included a decision to pre-test all the serial subsystems during the FEED stage to remove a known project scheduling risk.

Hot cutover

The BP Sharjah facility supplies gas to the power plants operated by the Sharjah Electricity Water Authority and is a critical part of the UAE's infrastructure. The plant is so important that even a one day shutdown was to be avoided. Hence, the commissioning was executed as a loop-by-loop hot cutover, requiring meticulous planning and execution. The cutover was executed successfully with no downtime, and saved an estimated 1,550 MMSCF of LPG and 60,000 barrels of condensate at present production rates.

Award from BP

At a function held at BP's Sharjah facility, four members of the Yokogawa team were commended by BP for outstanding contributions to the success of the project. The function was attended by executives from BP Sharjah and representatives of the Government of Sharjah.

Award from BP

Customer Satisfaction

Comment from Craig Fisher, roject Engineer:

"This was a complex job - minimising disruption to our customers meant replacing the control system while plant was running - not unlike performing a brain transplant while the patient was doing their normal day job. Brownfield upgrades such as this demand sensitivity to the requirements of the existing assets, and matching these with CENTUM VP's extensive capabilities was a fine balance. Yokogawa put a lot of effort into helping us define the scope, and deployed an exceptional team to deliver it. Several of the core team remained dedicated to the project until the last loop was commissioned. This commitment and one-team approach were key to our successful delivery, which has been widely recognised as such within BP."

Craig Fisher Project Engineer BP Sharjah Project

Key Project Achievements

- Excellent health, safety, security, and environment performance
- One-team approach with the client
- Smooth and safe changeover to the new system
- Project installation and start-up to schedule
- High level of system integrity, reliability, and quality management
- High level of customer satisfaction

Central control room

System Details

Integrated control and safety system:	CENTUM VP
Number of hardwired I/O:	1,500
Number of serial I/O:	2,500, 32 subsystems
Number of cabinets:	14 (including 8 extensions to existing cabinets)
Number of graphics:	100
System distributed across two local equipment rooms and a central control room	
System information:	6 x FCS, 1 x ENGS, 4 x HIS, 1 x Exaquantum (server for interface to MIS) 1 x large LCD (52" HD)

Plant Information

- Location: Oyazawa, Niigata Prefecture, Japan
- Order date: March 2012
- Completion: November 2012

INPEX Corporation

Analysis of Operator Expertise Leads to Redesign of Interface that Improves Operations at Gas Plant in Niigata, Japan

Executive Summary

INPEX Corporation (INPEX) is Japan's biggest oil and gas development company and is involved in all aspects of this business, from research to exploration, production, and sales. INPEX is engaged in projects all over the world, in a total of 29 countries, including Japan, where it operates a gas production plant near Oyazawa, a town in Niigata prefecture. This plant receives natural gas from the Minami Nagaoka onshore gas field and treats it using the methyldiethanol amine method to remove corrosive CO_2. Each day, it sends out 1,500,000 Nm^3 of purified gas to its customers via a pipeline network.

To improve safety and efficiency at this plant, INPEX needed to bring the graphical user interface (GUI) on its production control system (PCS) human-machine interface (HMI) stations up to international standards, specifically the ASM Design Guidelines[*1], ISA-5.5[*2], ISO-9241[*3], and API RP 1165[*4]. INPEX turned to Yokogawa for a solution because the company had expertise in developing advanced operator graphics (AOG[*5]) solutions. A team of Yokogawa engineers visited the plant to conduct a detailed analysis, review the tasks carried out by operators, and learn about the plant's operations. In accordance with general principles on industrial design and human engineering, Yokogawa then redesigned the GUIs for the HMI displays to reduce operator errors, make their work easier to perform, and reduce physical stress. Throughout this project, the Yokogawa team followed the Six Sigma DMAIC methodology:

*1 Effective operator display design
*2 Graphic symbols for process displays
*3 Ergonomic requirements for office work with visual display terminals
*4 Recommended practice for pipeline SCADA displays
*5 A PCS graphic design service provided by Yokogawa that is based on human factors engineering and knowledge engineering. AOG emphasizes ergonomic design, and seeks through improved color selection, layout, and so on to improve operators' situational awareness. Based on insights gained from experienced personnel, this ensures operators have ready access to all the information they need to make effective decisions.

Steps	Contents	Period
Define	Design scope, Design team set up	1 week
Measure	Investigation of operation environments	2 weeks
Analyze	Style design, task analysis, proposal	6 months
Improve	Evaluation, consulting to the team	6 months
Control	Final evaluation, final report	1 month

DMAIC overview
As the work periods overlapped, this process took 9 months, from start to finish.

The Challenges and the Solutions

After a careful review of the operation and the design of the GUI, the team identified five issues:

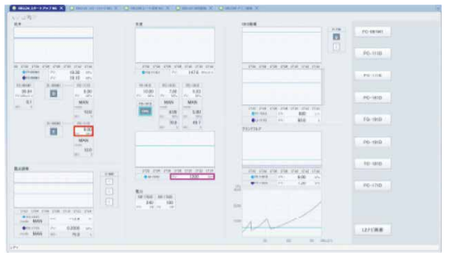
- Plant operators had to quickly scan many different process graphic displays and trend displays to understand what was happening throughout the plant, hampering their ability to take quick and appropriate action.
- The information displayed was not color coded based on priority.
- The layout of text, graphics, etc. was confusing and easy to misread, leading to operator errors.
- The overview displays lacked detailed information and were of limited use to the operators.
- Although the operators had access to multiple monitors at their workstations, they had received no training in their use and the extra monitors were not being used.

Yokogawa's industrial design and ergonomics engineers proposed the following solutions:

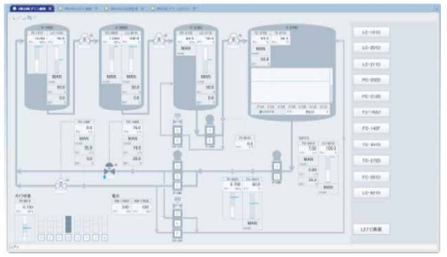
Design of task-based displays

The team reviewed and analyzed how the plant's most experienced operators carry out their monitoring and control tasks, examining the purpose of each task, the data needed, the displays used, how information was used to control an operation, and how information was used to monitor operations.
Based on this, the process data was ranked by level of importance and documented in a task analysis sheet.

In the redesign of the displays, careful consideration was given to factors such as the relationships between information, pop-up window position, and navigation between displays. Some of the redesigned task-based graphic displays are shown below.



Display for monitoring gas well start-up procedure that shows well trend data and related tag faceplates

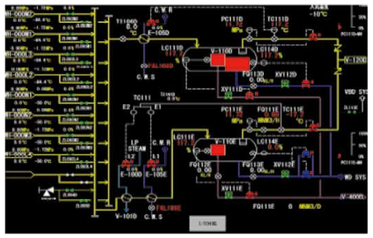


Amine circulation process tanks and related tag numbers. The graphics clearly show the status of each pump.

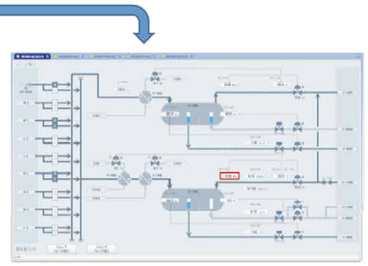
INPEX Corporation

Improved presentation of process data

In a display, the color of the background, text, and graphics can have a significant impact on usability. Based on interviews with this plant's most experienced operators, and in accordance with ergonomic principles, the project team employed the AOG approach to redesign the GUI color scheme and layout and make process data easier to read. This also was done with CAMS for HIS, a standard consolidated alarm management function for Yokogawa's CENTUM VP PCS that was introduced to address the issue of alarm flooding. After a reprioritization of all the system alarms, the alarm color scheme was redesigned based on priority.



Before: A display with a black background fatigues the eyes, if looked at for long periods of time



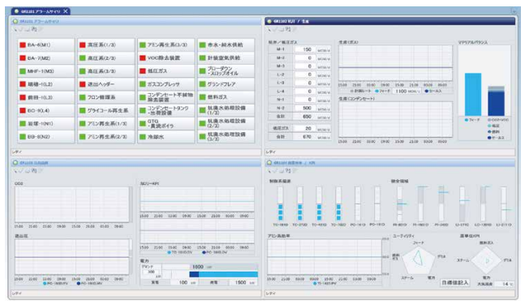
After: A display with a light gray background is easier to read/results in less eye fatigue

Utilization of KPI display

A KPI display provides information on every aspect of a plant's operations that its operators are responsible for, including output, quality, efficiency, and safety. They help motivate operators by showing how their work impacts plant performance. The following display shows four different types of KPIs and can be viewed on a single large screen positioned behind the double-tiered HMI screens.

Plant overview status

Information of mass balance and production data



Efficiency indicators

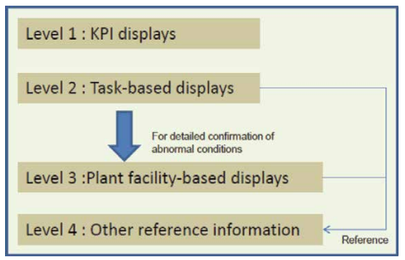
Information related to control and information on utility consumption needed for overall plant management

KPI display example

Define graphic display hierarchy / monitor layout

To make effective use of the double-tiered HMI screens and a single large screen in the control room, a four-level hierarchy was defined for the graphic displays. Since plant operators mainly interact with task- and plant facility-based displays (levels 2 and 3), these were mainly assigned to the lower monitor in the double-tiered HMI. Level 1 displays along with the level 2 loop-watch displays were assigned to the upper monitor in order to navigate into level 3. KPI display is presented on the single large screen to share plant performance information between all control room users. This arrangement allows operators to stay on top of what is happening throughout the plant and quickly identify any abnormal conditions.

Through the AOG service, other package solutions were also proposed to help this plant achieve operational excellence. For example, to make use of a task time estimation program that INPEX developed, Yokogawa proposed the introduction of the Exapilot operation efficiency improvement package to eliminate operational mistake by manual calculation, and to reduce working time for alternative tanks usage.



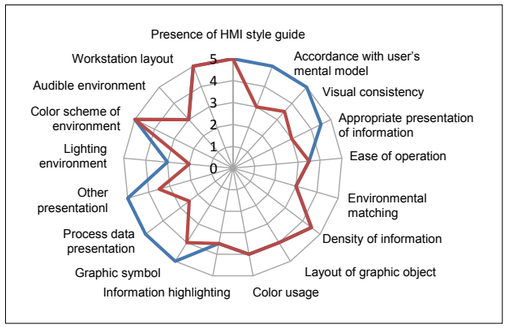
Four-level graphic display hierarchy

Customer Satisfaction

The operators and managers at the INPEX Oyazawa plant initially were not sure how ergonomic design and knowledge-based technology could benefit them, but came to appreciate this approach after seeing how it improved not only alarm design and procedural automation but also the overall operations at their plant. The project team created the radar chart shown on the right, and assigned scores for a range of criteria, before and after this consulting project.

The following points are the major benefits that this project provided to INPEX:

- Shortened operation monitoring cycle
- Timely identification of abnormal conditions
- Fewer operator errors
- Reduced operator workload / eye fatigue
- Improved transfer of skills and expertise
- Increased motivation to improve operations



Red line: before AOG service
Blue line: after AOG service

Plant Information

- Location: Nigeria
- Order date: 2008
- Completion: February 2012

Total E&P Nigeria

Yokogawa's Integrated Solution Contributes to Reliable and Efficient Operation of Usan FPSO

Executive Summary

Total S. A. (Total) is a major oil and gas company with operations in more than 130 countries that span all aspects of the industry, including both upstream (exploration, development. and production) and downstream (refining, marketing, and the trading and shipping of petroleum products) operations. Total has been operating in Nigeria for 50 years and its deep-offshore oil & gas field development projects have been one of the main growth drivers in Africa. In Nigeria, the company operates through Total E&P Nigeria Limited (TEPNG) which carries out all upstream activities, including deep-offshore operations.

The Usan field is situated offshore Nigeria within oil mining lease (OML) 138, some 100 km south of Bonny Island, at a water depth of 750 m. Construction of the Usan FPSO by Hyundai Heavy Industries commenced in 2008 and was overseen by TEPNG. The vessel was launched in April 2011 and arrived at the field in July 2011. The Usan field came onstream in February 2012 and is able to yield 180,000 barrels of oil per day.

Usan FPSO specifications:

- Hull dimensions: 320 m long x 61 m wide x 32 m high
- Oil processing: 180,000 barrels/day
- Seawater injection: 190,000 barrels/day
- Gas compression: 5.2 million standard cubic meters/day
- Hull dry gross weight: 87,000 tons
- Oil storage: 2 million barrels
- Oil-water separation: wash-tank inside the hull
- Produced water treatment: 100,000 barrels/day
- Topside dry gross weight: 25,000 tons
- Living quarters: 130 people during normal operations (180 max.)

As the supplier of the integrated control and safety system (ICSS) for the Usan FPSO, Yokogawa Korea was involved from the early stages of this project. The delivered solutions include the CENTUM CS 3000 process control system (PCS) for the hull / topside control, the subsea control with the interface solution and overall control of wells and risers (OCWR), and the Plant Resource Manager (PRM) package for instrument management. These are integrated with third-party systems and software such as a process safety system, emergency shutdown system, fire and gas system, machine monitoring system, process data server, and operator training and maintenance system. Yokogawa's vortex flowmeters were also installed in the field. From the very start of operations at this field, the entire facility has run safely and smoothly.

The Challenges and the Solutions

Joint team for effective design

The first phase of the project (phase 1) required the development of basic design documents based on Total's general specifications (GS). The GS provide a general description of the overall requirements for the project and specify what must be developed during the detailed design phase. Normally the phase 1 work takes at least eight months, but this had to be accelerated because of a tight project schedule. With a strong commitment from all members of a joint team made up of personnel from Total, an EPC contractor, a third-party vendor, and Yokogawa Korea and France, the phase 1 work was completed in just 5.5 months. Working together with the EPC contractor, the team also achieved satisfactory progress during the detailed engineering phase (phase 2). In both phases of the project, including the offshore commissioning of the ICSS, Yokogawa played a key role on this joint team.

Full integration for reliable and efficient operation

Full integration of all systems was a key to ensuring the reliable and efficient operation of all subsea systems from the central control room (CCR) onboard this FPSOYokogawa provided the third-party SCADA data gateway software as a protocol translator (from OPC to Modbus TCP/IP) using automated operating procedures that were developed on the ICSS platform. The following describes how the full integration of systems was achieved.

• Integration of subsea process data and topside control systems

All the subsea process information is gathered by a master control station (MCS) supplied by a subsea module supplier and transmitted to the ICSS system operator stations in the CCR. The MCS uses approximately 16,000 OPC tags for data exchange with the ICSS through a full redundant OPC gateway, with a scan time of one to two seconds. Since most of these tags are used by the ICSS controller for OCWR control functions, the ICSS controller must interface with the MCS through the Modbus TCP ports. To enable the controller and the MCS to communicate with each other, a Modbus TCP communications link was established via a software converter. Data could thus be collected from OPC servers and slave devices using the IEC 60870-5, DNP3, and Modbus communications protocols. Without having to install additional OPC servers, this data can then be passed on to other control systems that support these protocols. In this way, the control systems for subsea and topside operations can be integrated, allowing easier configuration and maintenance.

The Usan subsea production system is linked to the FPSO topside by flow lines, risers, and umbilicals, and is comprised of 42 wells with vertical Xmas trees, of which 23 are oil producers and 19 are injectors (10 gas and 9 water). There are also 8 off-line manifolds (for the producers).

• OCWR development

The subsea systems are fairly complex and difficult to control, and this places a considerable burden on the operators. As part of the OCWR system, a set of control algorithms was implemented in the PCS that automate certain recurring operational procedures for the subsea production and injection networks that are carried out from the CCR. The OCWR system improves the reliability and efficiency of subsea production and injection operations by taking into account factors such as gas lift availability and separator throughput, well characteristics, and subsea infrastructure, resulting in reduction of the overall workload for the operators in the CCR.

Instrument management for effective maintenance

All the instrument information from hull and topside, including the data from a third-party package, is fully integrated with the instrument management system. From their stations in the computer engineering room, operators and maintenance personnel can monitor device status in a window and analyze problems as they occur. Consequently, maintenance personnel do not have to go out and inspect/troubleshoot devices as frequently.

Control and monitoring of subsea and topside systems from the CCR aboard the Usan FPSO

Customer Satisfaction

Temitope Olapoju, Onshore Maintenance Supervisor at TEPNG, commented, "The Usan FPSO project was a success and I attribute this to the good performance of the Yokogawa Korea personnel and their cooperation with the third-party vendor. Though the overall schedule was tight for items such as engineering, FAT, and integrated FAT, the people from Yokogawa and other members of the integrated team worked closely together to bring the project to a satisfactory conclusion. Now we are operating the whole facility smoothly and effectively from the CCR."

Temitope Olapoju, Onshore Maintenance Supervisor, TEPNG

Plant Information

- Location: Multiple locations, India
- Order date: April 2011
- Completion: July 2012

GAIL (India) Limited

Yokogawa FAST/TOOLS SCADA System Centralizes Monitoring & Control of India's Gas Pipelines

Executive Summary

GAIL (India) Limited (GAIL) is India's flagship natural gas company, integrating all parts of the natural gas value chain including exploration & production, processing, transmission, distribution, marketing, and services. GAIL has built two major liquefied petroleum gas (LPG) distribution networks centering on the Jamnagar Loni LPG pipeline and the Vizag Secundrabad LPG pipeline, which transport gas to bottling plants. GAIL also presently has seven natural gas pipeline networks across the country, with a total length of over 10,700 km. Until recently, each of GAIL's pipeline networks was controlled by its own independent supervisory control and data acquisition (SCADA) system.

Considering the difficulty in managing many different SCADA systems, GAIL decided to implement a single centralized SCADA system for all of its natural gas and LPG pipeline networks, and to integrate this system with all pipelines that are either currently under construction or on the drawing table. Yokogawa was entrusted with the conceptualization and implementation of this state-of-the-art, centralized SCADA system, relying on the FAST/TOOLS SCADA software package and a system architecture that was best suited to GAIL's pipeline networks and its expansion requirements. Yokogawa also signed a long-term contract with GAIL based on which it will endeavor for a 10-year period to integrate all upcoming pipelines with this system in a cost effective and timely manner.

Work by Yokogawa on the replacement of the existing systems with a single SCADA system and the integration of multiple makes of remote terminal units (RTU) was completed in just 15 months. The new SCADA system was installed at the National Gas Management Center (NGMC) in Noida, in a main master station (MMS) that houses all the main SCADA servers. The system was also installed at a hot backup master station (BMS) in Jaipur.

Today all pipeline networks can be monitored and controlled centrally from the NGMC using the reliable FAST/TOOLS data communication package. The FAST/TOOLS system at the MMS has also been integrated with a gas management system (GMS) so that all operation data can be directly utilized for gas allocation and billing. Email and short message service (SMS) notification of critical alarms is supported, and authorized persons have access to this SCADA system anywhere an Internet connection is available.

National Gas Management Center

The Challenges and the Solutions

Achieving efficient operation with higher system availability

Previously, GAIL personnel used telephones to manually collect the operation data for each of the regional pipelines. To improve overall operation and management of the gas pipelines, GAIL decided to put in place a single centralized control room and, as a disaster preparedness measure, have the backup and main master stations in separate locations.

For the central control room, Yokogawa provided the FAST/TOOLS package and a high availability computing (HAC) solution that utilizes a history server, client server, and zonal server in a triple redundant configuration. From their terminals in the central control room, operators can view the operational data for all the regional pipelines, and access to this data is assured 24/7 throughout the year. For each regional gas management center (RGMC), Yokogawa also implemented a FAST/TOOLS-based HAC solution that relies on dual redundant front-end processor (FEP) servers, for uninterrupted monitoring and control.

Thanks to this redundant configuration, the flow of operation and maintenance (O&M) data from the field is ensured. As a result, operators, production engineers, and analysts at the NGMC have the real-time visual access at all times to the data needed to efficiently operate this nationwide pipeline network. System availability for the entire GAIL pipeline network has been increased to 99.5%, ensuring a steady supply of gas across the nation.

Summary of Customer Benefits

Steady gas supply

- Uninterrupted monitoring and control thanks to an architecture that significantly improves system availability

Improved operation & maintenance

- Visualization of all pipeline operation data
- Total system integration with a single interface

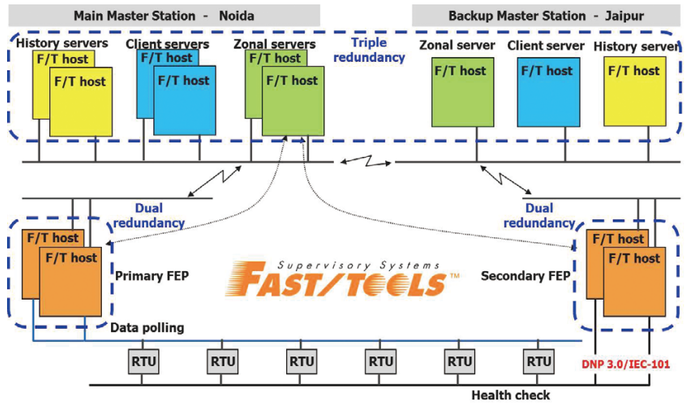
Minimized TCO

- High system availability thanks to double and triple redundancy
- Centralized system support for engineering, operation, and maintenance
- More efficient training for a single SCADA system

Customer Satisfaction

S. K. Agrawal, a Deputy General Manager for GAIL, commented, "This is the largest ever SCADA system commissioned by GAIL. Yokogawa has really done a commendable job by completing this centralized SCADA system within the contracted completion period of 15 months. This work included the integration of approximately 400 RTUs of eight different makes. They demonstrated excellent global teamwork in dealing with several real challenges and providing solutions for the new modular system architecture. In addition to improving O&M, the centralized SCADA has substantially reduced CAPEX and OPEX. All new pipelines coming up in the next 10 years will be integrated with the centralized SCADA system in a cost effective and timely manner."

S. K. Agrawal
Deputy General Manager



Overview of system architecture

Note:
F/T: FAST/TOOLS
RTU: Remote terminal unit
FEP: Front-end processor
Zonal server: Selects which FEP will poll data from RTUs
DNP 3.0 / IEC-101: Remote communication protocol

Plant Information

- Location: Qatar
- Order date: November 2006
- Completion: March 2009

Qater Petroleum

EPIC Upgrade of Instruments & Control Systems at PS-2 & PS-3 Offshore Platforms

Executive Summary

Qatar Petroleum (QP), a government-owned company responsible for all oil and gas industry activities in Qatar, initiated this project to upgrade and enhance the control systems on the PS-2 and PS-3 offshore production platforms in the Maydan Mahzam and Bul Hanine fields. The scope of work encompassed the upgrade and replacement of existing instruments and systems with a FOUNDATION™ Fieldbus (FF) -enabled distributed control system (DCS). The existing control system was partly electronic (Honeywell DCS and GE Fanuc PLC) and partly pneumatic (single loop controllers from various vendors).
All of the subsystems such as the emergency shutdown (ESD) and fire & gas safety systems (FGS) (Triconex and Wonderware), well head monitoring system (DATAC), and power management system (ABB) had independent human machine interfaces (HMI).

Amidst stiff competition from engineering companies, Yokogawa Middle East was awarded the engineering, procurement, installation, and commissioning (EPIC) contract for the control system upgrade at the PS-2 & PS-3 offshore platforms. It is believed that QP is the first company in the Gulf region to adapt the FF technology on its offshore platforms.

Central control room (before)

Central control room (after)

The Challenges and the Solutions

Yokogawa Middle East faced a wide scope of challenging tasks in this EPIC project, conducting extensive site surveys, carrying out detailed engineering of field instruments and control systems, preparing design specifications, interfacing with existing third party systems, and eliminating barriers for QP's documentation practices. The Yokogawa Middle East engineering team and their project partners made full use of the best engineering practices and their experience to realize QP's project vision for utilizing all the features of the latest technology. Regular team meetings, knowledge sharing sessions, and methodical validation of output data during the engineering process paved way for the delivery of quality products. One hundred percent FAT checks of the hardware and application software as well as tests verifying communications with sub-systems ensured that the plant could start up and be fully operational in a minimum amount of time.

Yokogawa worked very closely with QP Project Execution Team consisting of Sathar Vadooth, Sathesh Kamath, Subbiah Shivaji, Abdullah Al-Marri and Shahed Halim from project commencement to project handover guiding Yokogawa Team-This was a major contribution factor in the success of the project
Much to the appreciation of the client, the entire cutover to the new systems was achieved well within the 30 day shutdown timeframe, and this was accomplished in spite of the typical offshore operational hurdles of weather, logistics, and limited accommodations. The QP, Yokogawa Middle East, and project business partners worked as one team to bring this project to a successful completion.

Aplying the new FF technology was one of the challenges in this project. Nearly 1,000 FF-enabled devices were connected to the CENTUM CS 3000 DCS and this configuration brought the following major benefits to QP's operations:

- Space is very limited on offshore platforms and must be put to optimum use. The FF-based design enabled drastic reductions in the size and number of marshalling cabinets and in the amount of trunk cable that had to be laid.
- With Yokogawa's Plant Resource Manager (PRM) asset management system, commissioning tasks such as valve tuning, loop checking, device configuration, and troubleshooting could all be done online from a central location, yielding a drastic improvement in efficiency.
- For those valves that had been retrofitted with new positioners, valve signatures could be derived using the PRM ValveNavi plug-in application.
- PRM also provides a single window interface to all FF and HART devices on the platform and this gives maintenance personnel quick access to all related device documents such as loop drawings, manuals, and hook-up drawings that have been registered with the system.

Customer Satisfaction

"We are now very comfortable with our current operations and we very much appreciate Yokogawa's support. The PS-2 & PS-3 offshore platforms are equipped with Yokogawa's VigilantPlant product solutions that clearly deliver value at each stage of our processes. These include the Tharp multivariable transmitter, YTA temperature transmitter, CENTUM CS 3000, Exaquantum/SER, PRM, and the FIELDEYE CCTV system.", said by Mr. Ahmed Abbad Nasser Hussain Al-Aji, Manager Production (Offshore Fields), Mr. Mohd Ali Mohd Humaid, Asst. Manager, Operations-PS2, Mr. Darwish Ghloom Hussein Bahzad, Asst. Manager, Operations-PS3.

A Great Achievement

Yokogawa Middle East announces with pride the successful start-up of the PS-2 & PS-3 offshore platforms after a seamless upgrade from existing Honeywell DCS, GE FANUC ICS, and pneumatic systems to a FF-based CS 3000 DCS. The system has interfaces with the ESD/FGS, power monitoring, wellhead monitoring, and heating/ventilation/air conditioning systems, thereby achieving the project objective of having a single HMI window for monitoring and control of an entire platform.

"Talent wins games, but team work and intelligence win championships"
– Yokogawa Middle East project team

Plant Information

- Location: Nakron Srithummarat, Thailand
- Order date: January 2008
- Completion: June 2010

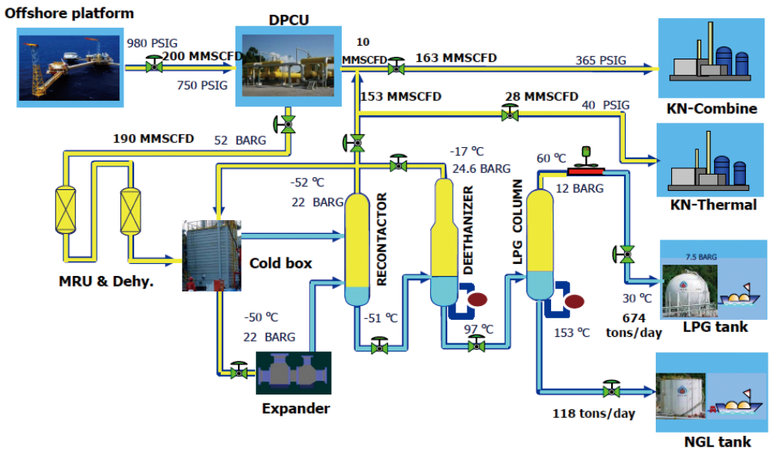
PTT Public Company Limited

Exapilot Improves Operations and Reduces Energy Use at PTT Khanom Gas Separation Plant #4

Executive Summary

In 1997, PTT Public Company Limited built the Khanom gas separation plant (GSP #4). Located in Nakron Srithummarat, 700 km south of Bangkok, GSP #4 receives gas via a 24 inch undersea pipeline from an offshore platform operated by PTT Exploration & Production. The plant produces 246,000 t/y of liquefied propane gas (LPG) and 43,000 t/y of natural gasoline (NGL). The LPG is supplied to homes throughout southern Thailand and to a local power station, which generates electricity for the entire region.

This plant has operated since 1997 with a CENTUM CS production control system (PCS) that was installed by Yokogawa Thailand. It has proven to be highly reliable, operating continuously without any major problems for this entire period.



The Challenges and the Solutions

The customer was seeking to improve safety and have operations run more smoothly not only during plant shutdown/start-up but also during normal operations. Yokogawa Thailand demonstrated that Exapilot was easy to configure and use, and showed how it could be used to fully automate and speed up the start-up and shutdown procedures. This reduced the operator workload around 40% and protected pumps by eliminating unnecessary speed increases that cause them to heat up.

The customer confirmed Exapilot's capabilities in the above application and gradually extended its use to the following applications over a one year period:

- **Oil heater combustion control**

  Exapilot improves control of a non-linear air damper to optimize the fuel air ratio, based on O_2 measurements performed by a Yokogawa zirconium type oxygen analyzer. This reduces the consumption of fuel gas by two oil heaters, and each year saves the company $30,000 in fuel costs and reduces CO_2 emissions by 210 tons.

- **Cooling fan control**

  Previously, eleven cooling fans ran non-stop. Based on ambient temperature readings, Exapilot is able to reduce electricity bills by switching the fans on and off.

- **Feed gas and bypass gas flow control**

  Exasmoc APC software is normally used to control the feed flow in response to changes in the power plant load. To accelerate response times, feed and bypass gas flow control is now also performed by Exapilot. By switching between these programs, it has been possible to reduce propane costs by $450,000 per year.

- **CO_2 composition monitoring**

  The power plant uses gas from an offshore platform that is approximately 22.5% CO_2. If this rises above 25%, plant efficiency goes down. Exapilot maintains CO_2 within agreed levels, keeping the power plant customer happy and increasing LPG yield by $450,000 per year.

- **Ship loading**

  Exapilot controls the venting of the loading pumps and controls product flow during LPG/NGL ship loading, reducing electricity consumption and preventing LPG product loss.

Customer Satisfaction

Kanit Pattarakup, process control and DCS board man at PTT Khanom Gas Separation Plant #4, said, "We are very much happy with Yokogawa's CENTUM CS, Exaquantum, Exasmoc, and Exapilot. Exapilot is really easy to use and has improved production very much, and it has been applied to three main procedures (start up, shut down, normal operation : 24 sub procedures) to achieve real production excellence. We have confirmed the high reliability and solid functionality of Exapilot in various applications. This is a real solution package and a good tool for the plan-do-check-act (PDCA) cycle to achieve operational excellence in the plant."

"This year we successfully replaced the existing CENTUM CS with the Yokogawa's most current CENTUM VP. We are always challenging to be a VigilantPlant"

Kanit Pattarakup with CENTUM CS and Exapilot (before)

Kanit Pattarakup with CENTUM VP and Exapilot (after)

Plant Information

- Location: Hui Zhou, China
- Order date: March 2004
- Completion: April 2006

CACT Operators Group

CACT Offshore Platform Reduces Unplanned Downtime by Migrating from Legacy PLC System to Reliable CENTUM CS 3000

Executive Summary

The Hui Zhou 21-1A (HZ21-1A) offshore gas production platform has been operational since 1990. It is in the South China Sea, 130 km south of Shenzhen, China, and the water depth at this location is approximately 115 meters. The HZ21-1 gas field is operated by CACT Operators Group (CACT), a joint venture between CNOOC Ltd., Eni China BV, and Chevron Corporation. Four wells in this field produce 54 million cubic feet of natural gas per day. After processing, this gas is piped to a natural gas terminal in Zhuhai through subsea pipelines.

In 2004 CACT began construction of the HZ21-1B platform to house facilities for the compression and dehydration of gas. Now completed, this platform is positioned near HZ21-1A, and a bridge has been built to link the two platforms.

As part of its ongoing activities to develop the HZ21-1 gas field, CACT has also made modifications to HZ21-1A. This included the migration from a legacy PLC control system – for which spare parts were no longer available – to Yokogawa's CENTUM CS 3000. CACT's principle aim in this was to improve efficiency and productivity by acquiring the ability to monitor and control production data in real time. A further benefit of this migration was that the new production control system could be integrated with the control system on the new HZ21-1B platform, allowing HZ21-1A to convert to unmanned operations.

Yokogawa Engineering Asia and the CACT project team worked closely with Aker Kvaerner in Singapore and the China Offshore Oil Engineering Corporation (COOEC) to ensure smooth execution of this project. All systems and products were delivered to the COOEC construction yard in Tongu, China ahead of schedule.

Factory Acceptance Test

The Challenges and the Solutions

Challenge 1

Maintenance is a big issue on all offshore platforms. Maintaining equipment which is located hundreds of kilometers from shore can be costly and time consuming. Unanticipated equipment failures can quickly lead to platform shutdowns costing millions of dollars in lost production. The various Yokogawa systems and products including the CENTUM CS 3000 have proven to be highly reliable and have caused no unplanned shutdowns, providing major cost savings for CACT. This has also eliminated various safety and environmental risks.

Challenge 2

The HZ21-1A platform operations management team required the collection of key process and production data for transmission to the Zhuhai gas terminal via a satellite communications system. Accurate real-time measurement of production data is essential for the management of gas distribution. The data gathered by the monitoring and control system can also be used to detect gas leaks in the pipeline.

Challenge 3

CACT's process control and instrument engineers are responsible for keeping down the cost of configuration changes to the control system. With the CENTUM CS 3000, it is possible for CACT engineers to modify the system configuration, download software updates, and hot-swap I/O cards while the process control system is online.

Challenge 4

CACT places a high priority on protecting the environment. For example, after removing water that has been produced by a separator, the company treats it to bring it up to government standards before discharging it. The pH and conductivity levels are accurately measured by Yokogawa's analytical instruments, which are linked with the control system so that alarms can be issued and the water treatment system shut down if set limits are exceeded.

Customer Satisfaction

"Yokogawa's reliable, proactive, and responsible approach made a significant contribution to the project's success. The positive and cooperative approach of your team facilitated teamwork and good relationships. We commend your project team for this great effort and look forward to working with you in the future."
David Godard, HZ21 Gas Project Manager

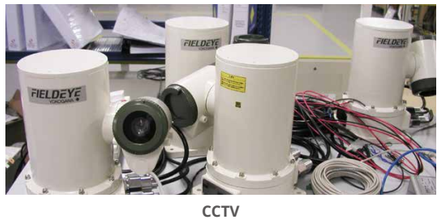
HZ21 Project – System Configuration

The new control system designed and built by Yokogawa for CACT's HZ21 gas field project consists of the following sub-systems and components:

CENTUM CS 3000 platform process control system
ProSafe PLC safety shutdown system and fire & gas system
FieldEye CCTV system
Local area network
Satellite communications system consisting of a satellite dish, ODU, VAST modem & router, PABX telephone system, and PAGA system

Factory Acceptance Test

CENTUM CS 3000



CCTV

ESD console

Plant Information

- Location: Escravos, Nigeria
- Order date: April 2006
- Completion: September 2008

Chevron Nigeria Limited

Escravos Gas Plant Control System Online Migration (Hot Cutover)

About Chevron Nigeria Limited

Chevron Nigeria Limited (CNL) is Chevron's principal subsidiary in Nigeria, one of Africa's most prolific oil-producing countries. CNL and its related companies have done business in Nigeria for more than 90 years and CNL's workforce totals more than 2,000 employees, of which 90 percent is Nigerian. CNL operates and holds a 40 percent interest in 13 concessions covering 2.2 million acres (8,900 km^2), predominantly in the onshore and near-offshore regions of the Niger Delta. In 2007, total daily production averaged more than 350,000 barrels of crude oil, 14 million cubic feet of natural gas, and 4,000 barrels of liquefied petroleum gas. The company's net oil-equivalent production in 2007 was 129,000 barrels per day.

Background of This Project

The Escravos Gas Plant is located in the vicinity of the Escravos River, adjacent to the Chevron Nigeria Oil Terminal, on the Bight of Benin. The site is approximately 100 miles southeast of Lagos and 37 miles west of Warri.

The existing Escravos gas plants (hereinafter EGP1&2) process 285 million standard cubic feet of natural gas per day (scfd). This will be increased to 680 million scfd with the completion of a new gas plant (hereinafter EGP3) by 2009.

Yokogawa Electric Korea received an order from Hyundai Heavy Industries (HHI), the project EPC contractor, to replace EGP1&2's existing Honeywell TDC3000 system with the CENTUM CS 3000 system and to install an integrated control system (DCS, SIS, CMS, and FGDS) at EGP3.

The main objective in the EGP1&2 phase of this project was to do an online hot cutover from the legacy Honeywell TDC3000 to the Yokogawa CENTUM CS 3000. The hot cutover involved the Train-1 operating plant and the processes at EGP1&2. This included migration of the existing fire and gas monitoring signals and migration of the existing serial communication interfaces for the existing PLC controlled ESD system and the master surge CCC compressor control system. The contracted work was scheduled to be completed in 90 days.

Summary of Online Hot Cutover Migration Project

- The key business driver for this online system migration: estimated savings of US$2.3 million by not shutting down gas plant operations for 90 days.
- Secondary business consideration: by doing the system migration in the second quarter of 2008, operators would have time to familiarize themselves with the new CENTUM CS 3000 control system before the main EGP3 control system is introduced in 2009.
- Migration scope: migration of all EGP1&2 control system signals/functions from the legacy Honeywell TDC3000 DCS to the new Yokogawa CENTUM CS 3000 and the migration of 279 digital input signals, 127 digital output signals, 322 analog input signals, 59 analog output signals, 480 WORKPACKs, and 787 loops. WORKPACK means that whole procedure and concerned data in order to HCO work of each loop.
- Replacement of existing Honeywell field termination assemblies (FTAs) in marshalling cabinets with new Yokogawa terminal boards.
- Project execution period: from the middle of July to the middle of October 2008 (90 days, no days off)

The Challenges and the Results

The greatest challenge in this project lay in carrying out the migration from the existing Honeywell TDC3000 to the new Yokogawa CENTUM CS 3000 without disrupting gas production. This online hot cutover required both systems to be manned by operators during the migration process.

Although this presented a high risk for disruption to ongoing gas processing operations, the work was successfully completed 48 days ahead of schedule and without disruption to operations thanks to detailed planning, risk/mitigation analysis, and a robust execution strategy with a coordinated team approach between CNL/HHI and Yokogawa Korea.

Through the successful execution of this project in just 42 days, CNL was able to avoid a costly shutdown of operations and generated additional savings in labor costs. And by working together on this project, CNL, HHI, and Yokogawa Korea were able to build a strong relationship. Thanks to their efforts, the CENTUM CS 3000 is running smoothly at EGP1&2.

The key success factors were as follows:

- Mutual trust and effective cooperation by all stakeholders (CNL/HHI/Yokogawa Korea) for the smooth execution and accelerated completion of the project
- An effective team approach that resulted in the project being driven to a successful conclusion in a highly expeditious manner
- The preparation of enormous WORKPACKs containing key reference data documents, which eased the cross-checking of process system functionality across both systems before the signal migration was commenced
- Meticulous planning that ensured a safe and disruption-free changeover
- Yokogawa Korea's technical leadership and expertise in performing online hot cutovers

Customer Satisfaction

The following quotes are from the DCS-HCO-Lessons Learned Meeting of September 26, 2008:

"The new CENTUM CS 3000 DCS equipment has exhibited excellent performance thus far."

"The DCS vendor provided effective technical leadership throughout the hot cutover and demonstrated a good command of English, avoiding potential communication problems. Technical challenges were encountered throughout the execution phase but these were resolved in an expeditious manner."

"The DCS vendor's sub-contractor panel technicians kept to a demanding work schedule for an extended time period. They contributed significantly to the success of this project. Their work has been critically important and it required extensive concentration and dedication from them while working in cramped conditions. Not a single isolation or installation mistake occurred! – Congratulations."

- **Receipt of Recognition & Achievement Certificate from CNL**

  "The EGP3 project leadership team recognizes your efforts for being part of the team that successfully executed the DCS – Hot Cutover without LTI and unnecessary / prolong shut down of the Gas Plant. Thank you for a job well done on behalf of Engineering, Construction & Operation Teams."

- **Receipt of Excellent Performance Certificate from HHI**

  "This is to certify that Yokogawa Korea has supplied the CENTUM CS 3000 FIO R3 system to EGP-3 onshore project in Chevron Nigeria Limited (CNL) via Hyundai Heavy Industries (HHI) and HOT CUTOVER (HCO) work between the existing HONEYWELL TDC3000 system and new YOKOGAWA CENTUM CS 3000 system has been successfully completed in accordance with HCO procedure."

System Details

For hot cutover	
DCS:	CENTUM CS 3000 R3 with Vnet/IP
Total I/O:	787
For EGP3	
DCS:	CENTUM CS 3000 R3 with Vnet/IP
SIS:	ProSafe-RS Safety Instrumented System
FGDS:	Autrosafe fire and gas detection system
CMS:	3500 condition and monitoring system
Total I/O:	4,610

Plant Information

- Location: Navamindra, Thailand
- Order date: May 2005
- Completion: March 2006

PTT Exploration and Production Plc

Highly Reliable Production Solution Using Yokogawa Automation and Safety Systems with FOUNDATION™ Fieldbus (FF) Technology

Background of This Project

With the Arthit project, PTT Exploration and Production Plc. (PTTEP) has for the first time engaged in every stage of developing a new gas field, from exploration to production. For this project, PTTEP built the Arthit Central Processing Platform, one of the largest of its type in Asia and the first ever in Thailand to be moved into position using the floatover method. It is located in the Navamindra Petroleum Area, which is in the Gulf of Thailand about 230 km off the coast of Songkhla Province. At this location, the water depth is approximately 80 meters. In the first project phase, six wellhead platforms have been connected to the central processing platform. Ultimately, 50 wellhead platforms will be constructed.

Production Overview

- Natural gas exported to PTT Riser Platform via a 42 inch, 200 km subsea pipeline
- Daily contractual quantity of 330 MMSCFD
- Maximum daily quantity of 363 MMSCFD
- Stabilized condensate exported to Bongkot FSO2 via an 8 inch, 30 km subsea pipeline
- Production rate: 15,000 to 20,000 BPD

About PTTEP

PTTEP is the first and only Thai-operated petroleum exploration and production (E&P) company. In line with a cabinet resolution calling for a flexible E&P entity that would provide maximum benefit to Thailand, it was established on June 20 in 1985 by the Petroleum Authority of Thailand (PTT). Its mission is to explore for, develop, and produce petroleum from onshore and offshore sources in Thailand and other countries.

The Challenges and the Benefits

With an automation system comprised of the Yokogawa CENTUM CS 3000 Production Control System (DCS) and the ProSafe-RS Safety Instrumented System (SIS), this is the first offshore platform in Thailand that is designed to make full use of FF technology.

A key challenge in this project was the tight schedule during the detail engineering and procurement stage. Yokogawa succeeded in delivering its systems on time and without compromise in quality.

During the pre-commissioning work for the FF instruments, the challenge was integrating the CENTUM CS 3000 system with instruments from other vendors. With the great vendor support provided by the Yokogawa service team, all devices were successfully connected and full integration was achieved.

This platform also had many new operators who required training on an operator training system (OTS). An OmegaLand simulator provided by Yokogawa helped control room operators quickly come up to speed in running platform processes.

Thanks to Yokogawa's highly reliable systems and products, a safe working environment has been achieved for the 120 operators, engineers, maintenance staff, and other personnel stationed on this platform.

Central control room

Central processing platform

Customer Satisfaction

"A lot of modification and fine tuning of the automation system occurred during startup, but this was not difficult for Yokogawa. The system has a lot of capability and flexibility. With great support from Yokogawa Thailand, the DCS and SIS on the Arthit platform have met our requirements. During startup and commissioning of the platform, we never had problems caused by the Yokogawa system." Theeraporn Kongwilai, Instrument Engineer

System Details

System:	CENTUM CS 3000 R3 (DCS) ProSafe-RS (SIS) OmegaLand (OTS) Plant Resource Manager (PRM)
System Configuration:	HIS x 5, ENG x 2 (DCS), SENG x 2 (SIS), PRM x 1, FCS x 4
Conventional type I/O:	1,104 (HART I/O: 368) 50 FF segments

Plant Information

- Location: Kauther, Oman
- Order date: November 2005
- Completion: December 2007

Petroleum Development Oman

Yokogawa Commissions FOUNDATION™ Fieldbus (FF) based Control System and Safety System for PDO's Kauther Gas Plant and Gas Wellheads in Oman

Executive Summary

The Kauther Gas Plant is located 300 km from Muscat and 100 km south of Nizwa, the old capital of Oman. The Kauther plant is designed to process 20 million cubic meters of wet gas per day. Petrofac of Sharjah, UAE was appointed as EPC contractor for the project, which faced considerable challenges, the most significant being the demanding schedule. The barren desert in a totally remote location was transformed into a fully operational gas plant in 107 weeks. This was the first control/safety system project which Yokogawa executed with Petrofac as EPC contractor.

Central control room

FCSs at FAT

The project was won by the Yokogawa Middle East Sales Division based in UAE and Bahrain. It was executed by Yokogawa Engineering Middle East FZE based in the Jebel Ali Free Zone, Dubai, UAE.

Through this project, PDO and Petrofac achieved the following with Yokogawa's support:

Project schedule

- The plant became operational in October 2007, two months ahead of schedule.

Local, Middle East based project execution

- The EPC Contractor, PDO Project Team, and Yokogawa Engineering Facility were all UAE based for the duration of the project, resulting in a "one team" approach, in one location, with common goals.

Remote operation and device diagnostics

- The plant was designed to be unmanned, except for some first-line maintenance personnel who are stationed at the plant.
- Through the use of the latest control system and FF technology supplied by Yokogawa, process control and the diagnostic monitoring of field instrumentation is done from remote locations.

Customer Satisfaction

The project was successfully commissioned well ahead of schedule, thus satisfying all stakeholders. The following was stated in PDO's press release dated November 19, 2007:

"Petroleum Development Oman announces that its Kauther Gas Plant began operating at the end of October, a full two months ahead of schedule. The plant, located in northern Oman, is now delivering in excess of 4 million cubic meters of natural gas a day to the Government Gas System as well as over 25,000 barrels of condensate (a liquid hydrocarbon by-product of gas processing that commands a premium price)."

Ammar Ishaq, Project Manager for Petrofac, stated: "Excellent support during the pre-commissioning and commissioning of the project, including start-up and troubleshooting. The site team performance was great in all aspects."

About Petroleum Development Oman (PDO)

Petroleum Development Oman (PDO) is the major exploration and production company in the Sultanate of Oman. It accounts for more than 80% of the country's crude oil production and nearly all of its natural gas supply. The Company is owned by the Government of Oman (which has a 60% interest), the Shell Group (which has a 34% interest), Total (which has a 4% interest) and Partex (which has a 2% interest). Gas fields are operated by PDO exclusively on behalf of the Omani Government.

About Petrofac

Through its Engineering & Construction, Operations Services, and Energy Development divisions, Petrofac designs and builds oil & gas facilities, operates or manages facilities, and trains personnel worldwide. A major center for Engineering & Construction in the Oil & Gas field is based at Sharjah in the UAE.

About the Kauther Gas Plant project

For Yokogawa, the project scope included supply of the DCS (CS3000, FF based), IPS, FGS (ProSafe-RS), field instruments for the gas plant and wellhead sites, dynamic process simulator, training system, alarm management system, and large plasma screens.

At the wellheads, Yokogawa supplied remote nodes connected to an FCS through fiber optic cables, using Hirschmann's Hyper-Ring technology. This helped PDO reduce the number of fibers without compromising network availability. Housings built from stainless steel IP66 panels were supplied for the remote nodes and networking accessories at the remote wellheads.

This plant is unique in that it is unmanned and remotely operated. Only a limited number of maintenance personnel stay on site. Yokogawa supplied its Server for Remote Operation and Monitoring software, which has five clients connected over the PDO WAN at the Saih Rawl, Qarn Alam, and Mina Al Fahal control rooms. To enable remote plant startup, specialized start up sequences were developed that integrate the DCS and IPS with the highly user-friendly HMI.

A control desk console with a modern "minimalist" design was custom made to PDO's requirements. The console has a marmoleum work surface and solid oak buffering to protect the front, side, and rear edges.

PDO selected FF instrumentation for the gas plant and the wellheads. At the plant, there are about 300 such devices connected in 46 segments. At each wellhead there are 10 devices in 2 segments.

The complex calculation of the wet gas algorithm is done by the FCS for each wellhead. Other salient features include customized pump logic, integration of CCTV and access control in the DCS, and alarm management.

At the start of the project, the IPS and FGS systems were to be based on the ProSafe PLC, but later this was changed to a ProSafe-RS system. This was one of the first ProSafe-RS systems to be commissioned by Yokogawa in the Middle East.

System Details

Control Systems:	CENTUM CS 3000-Vnet/IP (for DCS) and ProSafe-RS (for ESD and FGS)
Number of DCS I/O's :	6,000
Number of ESD I/O's :	1,000
Number of Sub-Systems connected :	21
System Information :	
<DCS>	12 x FCS, 23 x Remote Nodes, 1 x ENGS, 3 x HIS, 1 x PRM, 1 x ExaOPC Server for interface to GMIS, 1 x RMS (Remote Server) 5 x Remote Clients, 1 x Firewall, 2 x Plasma Screens (65" HD)
<ESD / FGS>	3 x SCS, 1 x SENG
<Field Instruments>	361 x EJA, 103 x YTA, 36 x YVP

Plant Information

- Location: Saudi Arabia (Abqaiq, Shedgum, Aindar, Uthmaniyah)
- Order date: June 1998
- Completion: December 2007

Saudi Aramco

Saudi Aramco Southern Area Gas Oil Separation Plant Control System Upgrade Project

About Saudi Aramco and Southern Area

Saudi Aramco's operations span the globe and the energy industry. The world leader in crude oil production, Saudi Aramco also owns and operates an extensive network of refining and distribution facilities, and is responsible for gas processing and transportation installations that fuel Saudi Arabia's industrial sector. An array of international subsidiaries and joint ventures deliver crude oil and refined products to customers worldwide.

The key production region for Saudi Aramco is the Southern Area, which is divided into North Ghawar and South Ghawar. Throughout this region are numerous gas oil separation plants (GOSPs), which provide the initial separation of water and gas from the oil prior to shipment to Abqaiq for further processing.

Background of This Project

In 1997, Saudi Aramco embarked on a program to address the obsolescence of control systems and instrumentation in these Southern Area GOSPs. The program consisted of seven individual projects, which eventually covered 16 GOSPs. In the initial phase of the program, Saudi Aramco invited all approved distributed control system (DCS) vendors to bid on the supply of integrated process control systems for four GOSPs, with an option for five additional systems. Yokogawa Middle East was selected and awarded a blanket purchase agreement for provision of four process control systems, each consisting of a DCS (CENTUM CS 3000), emergency shutdown system (Triconex), vibration monitoring system (Bently Nevada), and field instrumentation.

The first project proved so successful that the option for the five additional systems was exercised, and Saudi Aramco and Yokogawa even extended the purchase agreement to cover the balance of the GOSPs in the program. In addition to the provision of these 16 integrated process control systems, Yokogawa has also supplied a maintenance training system and an operator training system.

Good Guidance and Team Effort

One of the major factors in the successful execution of the GOSP modernization program was the continuous support of Saudi Aramco during all stages of project execution. From the beginning, Saudi Aramco has assigned dedicated senior staff, at times stationed at Yokogawa Middle East, to work as part of the team to ensure the systems provided meet the requirements of Saudi Aramco and the needs of the end users. This team effort extends beyond just Yokogawa and Saudi Aramco. The sub-vendors, most notably Triconex, have also contributed greatly to the success of the program by fully supporting demanding schedules and working with Yokogawa to provide the best in products and services. Yokogawa partnering with Saudi Aramco began under this program, and over the years has culminated in a WIN – WIN scenario for both companies.

What This Project Contributed

Under this program, Yokogawa has been able to:

- Establish a high quality engineering center in the region.
- Develop the in-house management expertise necessary to execute Saudi Aramco projects.
- Develop the in-house engineering core conversant with Saudi Aramco standards and requirements.
- Gain the reputation and credibility necessary to execute larger projects for Saudi Aramco, with continuous projects from Saudi Aramco.
- Dramatically increase its installed base in Saudi Aramco facilities.

What's Next ?

Having successfully completed the various GOSPs in the Southern Area for Saudi Aramco, Yokogawa recently has been awarded a contract to engineer and supply the entire process control system (PCS) for the main Khurais Central Processing Facility (KhCPF). This is part of the Khurais Crude Increment Program, which is the largest crude increment undertaken in the history of Saudi Aramco and one of the largest industrial projects being executed in the world today. This project is divided into three lump sum turn-keys (LSTKs), Snamprogetti – utility, Hyundai – gas, and Snamprogetti – oil.

With its two newly opened offices in Saudi Arabia, Yokogawa is committed, as usual, to providing a state-of-the art and quality PCS for the KhCPF project, and is looking to strengthen and maintain its long association with Saudi Aramco.

System Details

System: FOUNDATION™ Fieldbus (FF) Control System

Typical System Configuration of one project among total 20 projects:

CENTUM CS 3000 R3 DCS with field interface I/O (FIO) for FF and HART
2 x large full redundant control station (FFCS-L)
4 x human interface station (HIS)
1 x DCS engineering station
1 x Plant Resource Manager
(Real-time device maintenance management & advanced diagnosis package)
- PRM Server
- PRM Client
- PRM Field Communication Server

1 x ExaOPC station for interface to PI
1 x PI station
1 x ESD/CCS engineering station
1 x CCS Trilogger station
- ESD & CCS System by Invensys
- VMS system by GE

Plant Information

- Location: Lacq, France
- Order date: November 2004
- Completion: End 2007

TOTAL E&P

TOTAL E&P Renovates Integrated Control & Safety Systems (ICSS) at Gas Processing Plant in France to Maximize Availability and Safety

Executive Summary

The integrated control safety system (ICSS) at the Lacq Gas Processing Plant required an extensive renovation as it was based on Contrôle Bailey Alspa-ZS systems dating back to the mid eighties.

Through this project, Total E&P France achieved:
- The construction of a brand new control room, remote from process units
- The deployment of a redundant Vnet/IP fiber optic network
- The replacement of the old process control equipment with new Yokogawa CS 3000 controllers
- The integration of new ProSafe-RS safety instrumented system

Central control room

The Challenges and the Results

The old control room was located in the middle of the plant, amongst the process units. In order to enhance the safety of operations personnel, Total E&P France erected a new, blast-proof operations building on the outskirts of the process areas to host the hub and operator stations of the new Yokogawa CENTUM CS 3000 system.

The installation of the Yokogawa CENTUM CS 3000 involved the deployment of a set of redundant Vnet/IP ethernet networks with fiber optic cables linking the various technical facilities scattered all over the gas plant.

All the controllers of the outmoded Alspa-ZS systems were replaced with the brand-new Yokogawa CENTUM CS 3000 control system. This overhaul was done process unit by process unit without interruption to plant production operations. In order to reach this objective, some units underwent a hot-change over, meaning they were migrated from the Alspa-ZS over to the CS 3000 while still in operation. This required extreme care and accurate coordination between the project group and the operations team.

The latest generation of TUV-certified SIL-3 ProSafe-RS safety instrumented system was selected to handle the fire and gas detection functions
and the high-level safety trips. This allowed for a seamless integration of the safety controls with the ICSS, which was an improvement over the previous setup where the safety systems required their own dedicated operator stations.

Customer Satisfaction

"Our decision to use Yokogawa's new safety instrumented system ProSafe-RS for the revamping of our existing safety system was mainly based on the improvement of the long term maintainability, and the better integration of the ProSafe-RS into our new CENTUM CS 3000 control system network. After in-depth clarifications, we understand that due to its architecture based upon Pair & Spare technology, the ProSafe-RS reaches high levels of availability and robustness, and is certified by TUV Rheinland for SIL3 safety levels. The initial risk of using a brand new product in our case was compensated by Yokogawa's commitment to providing adequate service capability to guarantee the success of our project."

Christophe Aubin, Project Manager, Total E&P France

Rack room

ProSafe-RS Safety system

About TOTAL

Total E&P France (TEPF) is a subsidiary of France's Total Group and handles all its production activities in France. The two main production assets of TEPF are an oil reservoir complex south of Paris that feeds into the Grandpuits refinery and a reservoir complex that stores gas and condensate produced at the Lacq gas plant in southwestern France.
The Lacq gas field was discovered in 1949 and consists of several production layers, the most important of which being a high pressure sour-gas reservoir containing 15% H2S. A large gas processing plant was built here in several stages, pioneering complex gas sweetening process techniques.

About the Lacq project

The old control systems of the Lacq natural gas plant (Contrôle-Bailey-µZ and Alspa-ZS) dated from the mid eighties and were showing signs of ageing: increasing failure rates (the sour atmosphere is a rather aggressive environment), scarcity of spare parts, and decreasing availability of competent maintenance personnel capable of supporting / maintaining these old systems. A new gas processing unit was to be put in service in 2005, requiring a new process control system and safety controllers. It was then decided to use this opportunity to launch a major renewal of the complete ICSS covering the entire plant.
The overall ICSS revamping strategy covers a total of 10,000 hardwired points and 10,000 soft tags from package PLCs. The ICSS overhaul is being done in phases over a three year period and is currently 50% complete. The first phase commenced with the raw gas compression, condensate stabilization, and export section of the plant, which has satisfactorily been migrated to the Yokogawa CS 3000 control systems without loss of production. We are in the middle of the second phase revamping for the gas sweetening and sulfur section. The third and last phase, boilers and power generation, will be initiated in early 2007.

System Details

DCS: CENTUM CS 3000 R3 with Vnet/IP
Safety System: ProSafe-RS safety instrumented system

Plant Information

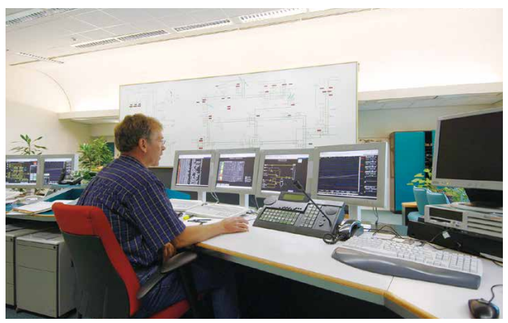
- Location: The Netherlands
- Order date: 1996
- Completion: 2006

Nederlandse Aardolie Maatschappij BV

Remote Production Operations are Fully Automated in Groningen Long Term (GLT) project

About the Customer

Cost of ownership is critical for Nederlandse Aardolie Maatschappij's (NAM) ongoing upgrade of one of the world's largest gas fields in Groningen, The Netherlands. Yokogawa's reliable field instrumentation, and a network of control systems linked to a central, field-wide control system - probably the largest in the world - are providing a pioneering level of automation to support NAM's minimum intervention operating philosophy.



Central control room

Compression Depletion

NAM's Groningen gas field has been in production since 1959. Various 'minor' upgrade measures have successfully postponed the need for a largescale renovation. However, free-flow production is expected to cease sometime before 2010. To ensure access to remaining reserves and continue its role of swing producer, NAM's Groningen Long Term (GLT) project is implementing depletion compression. The first wellhead cluster was equipped with a compressor in 1998 as part of a first-phase contract covering 11 clusters. Ultimately, all of the field's 29 production clusters will be upgraded - securing gproduction for another 40 years. NAM produced its own detailed functional specifications for GLT, and invited firms to qualify for specific parts of the job: engineering, construction, supply of centrifugal compressors, compressor drives (both electricalmotors and gas turbines) and instrumentation/automation.

Qualified suppliers were asked to form consortia. The short-listed consortia engaged in a design competition. NAM's judging decision weighed total cost of ownership against robustness of design and the use of state-of-the-art technology. Stork GLT was the winning consortium, forming a legal entity and establishing an office in the Groningen province. Within Stork GLT, Yokogawa is the Main Instrument Vendor (MIV) - supplying the required instrumentation and automation including field instruments, and monitoring systems, ultrasonic metering systems, safety systems, distributed control systems (DCSs) and plant information management systems (PIMS).

Stork GLT is responsible for project execution of the renovation and maintenance of the clusters. Yokogawa's scope of work includes the commissioning, start-up and maintenance of all instrument systems.

Minimum Intervention

The operational concept of NAM is based on minimum intervention - which means Eyes On, Hands Off. from cold NAM operates on day shifts only, and so remote production operations are fully automated - up to and including alarm-free start-up of clusters from cold stand-by status within 60 minutes. Under normal operating conditions of changing throughput, operations have to be stable, and alarm free. Routine operator and maintenance tasks also have to be fully automated, to minimise visits to clusters.The compression facilities also have to have a high turndown capability, with online monitoring of performance as well as remote diagnostics. If a production issue occurs during the night for example, the relevant operator is alerted at home. Using a PC and ISDN line, he or she simply logs onto the site's control network to fix the problem remotely.

Distributed Network

Each of the 29 Groningen clusters (with an average of around 10 wellheads) has approximately 25,000 tag numbers. The total field is estimated to require 640,000 tag numbers, controlled by some 460 stations in 25 domains. In order to satisfy this immense system size, Yokogawa had to increase the capacity of its CENTUM, integrated control system. (This feature will be reflected in CENTUM as standard from early 2004, which will be capable of handling one million tags, 512 stations and 31 domains!) The project concept is based on using modern but field-proven technologies. This means that technology shifts must be accommodated during the project's lifetime, while maintaining a common system architecture. Local control systems at the production clusters are based on the modular CENTUM, together with Yokogawa ProSafe-RS safety systems, Exaquantum, Plant Information Management System (PIMS), and instrumentation. Secure data communications links then network these systems using TCP/IP to a field-wide supervisory CENTUM and field-wide PIMS located at the continuously-manned central control station - allowing clusters to function unmanned.

For system economy and efficiency, NAM selects per cluster on a fit-for-purpose basis to use the local or the remote I/O architectural capabilities of the CENTUM. Most clusters are controlled by a CENTUM system using the local I/O system while the remote clusters that are up to 5 km away will use the intelligent remote I/O units that communicate to the CENTUM on another cluster using CENTUM's Ethernet-based FIO bus. From the central location, any cluster may be started, stopped and controlled without the presence of a local operator - up to and including 100% production. The central control room additionally runs Exaquantum PIMS that continuously monitors the performance of the entire production operation over the long term.

The sheer scale of the Groningen field dictates that the upgrade is happening over an extended duration. One of the first technology shifts to be seamlessly accommodated is the communications links with field instrumentation. The first clusters to be upgraded utilised conventional communications; instrumentation on later clusters will be equipped with FOUNDATION™ Fieldbus (FF) interfaces. This feature will also allow NAM to implement a Plant Resource Manager (PRM) system, adding condition-based maintenance, problem analysis and long term analysis.

Wide-area Interest

In addition to implementing probably the largest network of DCSs in the world, NAM is exploiting the control system to create a closer bond and sense of purpose between enterprise staff. At GLT headquarters, NAM has installed several Human Interface Stations (HISs) alongside coffee machines - programmed to display the production status of the GLT field. The HISs have become binding factors for the organisation: office expertise is available to field operations, and administration staff get direct feedback from the field. The experience has been very positive for NAM, and Ruurd Hoekstra, Head of Control & Automation at NAM, recommends the idea to all such plants because it closes the loop between the office and the field.

System Details

System:	CENTUM CS/CS 3000, Field instruments, Sand monitoring, Ultrasonic metering, Safety, Data archiving
Total I/O:	25,000 per cluster (11 clusters in first phase)
Scope:	Main Instrument Vendor (MIV) and DCS automaiton

Plant Information

- Location: East Coast, Malaysia
- Order date: April 2006
- Completion: December 2007

Malaysian Gas Processing and Transmission Company

Malaysian Gas Processing Complex Reaps the Benefits of a Yokogawa APC Solution

About the Customer

A Malaysian Gas Processing and Transmission Company a subsidiary of the national oil & gas major, plays a prominent role in the gas business value chain. The company operates as a throughput service company providing the services of processing and transmission of gas to the power generation sectors and various customers.

The company operates six gas processing plants (GPP) in East Coast Penisular, Malaysia and is the country's single largest producer and supplier of sales gas through a nationwide transmission and delivery network. In addition to sales gas, other products (ethane, propane, butane) are sold as feed stocks to downstream petrochemical plants.

Background of This Project

The company was looking for a partner with the right advanced process control (APC) technology for its gas processing complex. Yokogawa conducted a feasibility study that would identity suitable technology, determine the areas that could be optimized, and estimate the potential benefits. Completed in 2005, this study found that GPP's No. 2 gas processing plant (GPP 2) was a good candidate for a Yokogawa APC solution.

The Reasons for Selecting Yokogawa

Through this feasibility study, Yokogawa concluded that its APC technology had good potential to bring the company an excellent return on its investment, generating considerable interest among this company's management. After a competitive bidding process, Yokogawa ultimately succeeded in receiving the contract for this prestigious project, and its selection as a preferred vendor was due in good part to its strong expertise in implementing optimization solutions for gas plants.

The Challenges and the Solutions

Continually fluctuating feed gas composition

Efforts to optimize the operations of the gas processing complex were complicated by continual fluctuations in the composition of the feed gas, which came from an offshore field. The resulting changes in the liquid load at the downstream units caused inconsistent product recovery, and this was difficult to manage at the DCS level. However, the multivariable controller is able to sense the changes in composition at an early stage and adjust the parameters to maintain a constant liquid load.

Feed maximization

Constant changes in multiple constraints make it difficult for operators to maximize plant throughput. While respecting safety limits, the APC controller continuously predicts the constraints so that plant throughput can be maximized.

System integration with Honeywell TDC3000 and EPKS systems

OPC data exchange between the APC server and the legacy Windows based application processing platform (APP) node link to the TDC3000 LCN and EPKS required configurations for optimum performance. This problem was tackled by optimizing data scanning and setting the priority for data processing in the APP node.

The Results

Rapid return on investment (eight times the CAPEX)

GPP 2, 3, and 4 APC economic benefits exceeded the expected return on investment and annual APC benefits exceeded eight times of CAPEX. This is equivalent to ROI in 1.5 months.

Big jump in product yield

A 4-6% increase in the production of sales gas, ethane, propane, and butane was registered during the successful test run of the APC application due to increase in recovery factor and plant load. This increase in production rate was attributed mainly due to:

- Maximization C2 and C3 Recovery factor
- Maximization of Gas Load
- Maximization of Liquid Load
- Maximization of C4 Recovery from Condensate
- Component shifting to maximize the more valuable product

Major improvement in energy efficiency

A unique energy minimization strategy led to a 2-5% improvement in energy efficiency by optimization of column operating conditions and utilization of recycle stream to recover energy from recycle streams in various plant units.

Operators paradigm shift to Operational Excellence

By constantly adjusting plant parameters that previously had to be manually adjusted by plant operators, the APC controller allows operators to spend more of their time focusing on improving plant efficiency and performance.

Customer Satisfaction

To the immense satisfaction of the APC team and customer's management, Yokogawa successfully implemented the APC at all three plants despite working on a tight schedule. This successful initiative has boosted the morale of all engineers and operation technicians at this complex and has spurred new initiatives to implement improvements. Continuing on the success GPP 2, 3, and 4 APC projects, The company has decided to award Yokogawa the contract to implement the APC at GPP 5 and 6.

System Details

DCS:	Honeywell TDC 3000/ Honeywell EPKS
OPC:	APP node
APC suite:	Yokogawa Exasmoc Online Multivariable, Model Predictive and Optimizing Controller Yokogawa Exarqe Robust Quality Estimator Exarqe

Plant Information

- Location: Banagas, Bahrain
- Order date: 2016
- Completion: 2018

Bahrain National Gas Company

Yokogawa Delivers N-IO based Integrated Control and Safety System (ICSS) for Banagas Gas Processing Plant

Executive Summary

About Banagas

Bahrain National Gas Company (Banagas) operates state of the art LPG plant facilities for the recovery of propane, butane, naphtha, and other marketable products from associated gas and refinery off gas (ROG). The associated gas comes from Tatweer oil wells and the off gas from the Bapco refinery.

The Third Central Gas Plant

The construction of the Third Central Gas Plant (CGP-III) was carried out as part of Bahrain's Economic Vision 2030 initiative. A major step forward for Bahrain's oil and gas sector, this has been hailed as a strategically important project that will ensure sustainable economic growth for the Kingdom of Bahrain.

CGP-III is a 350 MMSCFD gas processing plant with inlet gas treatment, mercury removal, gas sweetening, dehydration, NGL recovery, liquid fractionation, LPG treating, and acid and residue gas compression units as well as auxiliary systems and storage tanks and pipelines for product export. The NGL recovery unit utilizes a cryogenic turbo-expander, and residue gas produced by the plant is re-injected into the Tatweer network.

The Challenges and the Solutions

Construction of CGP-III was overseen by Bahrain National Gas Expansion Company (BNGEC), a separate Banagas entity under the umbrella of the National Oil and Gas Authority (NOGA). In the project early stages, BNGEC intended to have independent control and safety systems for this greenfield plant. Yokogawa advocated the use of an integrated control and safety system (ICSS) with ESD functionality and Yokogawa's proprietary network I/O (N-IO) technology.

One factor that worked in Yokogawa’s favor was that Banagas was very satisfied with the performance of a N-IO based control system at its CGP-I plant. By carefully evaluating Banagas’ requirements and working closely with different departments within this company, Yokogawa was able to convince them of the benefits offered by N-IO based systems at all three of their gas plants. Yokogawa also made a strong case for the reductions in maintenance and other operating expenses (OPEX) that could be achieved with an N-IO based solution for ESD and other applications.

This project used IO-list engineering for the ProSafe-RS system, a first for Yokogawa in the Middle East. The system was delivered ahead of schedule, creating customer delight points for both JGC Corporation (the customer) and Banagas (the end user).

The project was also unique in that remote engineering was employed and this involved closely coordinated teamwork between JGC (Japan), Yokogawa Middle East & Africa- Bahrain, and Yokogawa India’s Global Delivery Center using the yi-Cloud platform and the TeamViewer software for the HMI and control loop prototype design. Complex sequences for drier, treater, and STB (stabilizer) process units were implemented to the complete satisfaction of JGC and Banagas.

The CGP-III project involved approximately 4,200 hardwired IOs and 5,000 soft IOs. Yokogawa offered CENTUM VP and ProSafe-RS with the N-IO hardware for the DCS, ESD, burner management system (BMS), and fire & gas system (FGS) applications. N-IO technology empowered optimization of the system configuration and ensured flexibility through universal IO assignment. In addition to drastically reducing the footprint of the instrument technical room (ITR) buildings and reducing power consumption, all HVAC requirements were met.

Customer Satisfaction

“It was a pleasure working with Yokogawa Middle East & Africa (YMA) for the CGP-III project of The Bahrain National Gas Expansion Company. The project was successfully commissioned in October 2018.
N-IO concept was chosen for DCS and SIS (safety instrumented systems). It was a challenging decision to accord approval of N-IO for SIS, because at that time the product was just launched and there was no installed base for SIS globally. However, all the technical and safety concerns of N-IO were clarified, and this solution was successfully implemented by the competent team of YMA engineers.

Yokogawa supports us with just a phone-call away for any technical issues on the system. I consider Yokogawa not only as a reliable brand, but also as a partner to achieve the company’s goal.”

Mr. Sanjib Changkakati
Acting Head Engineer-Instrument
Bahrain National Gas Company

Plant Information

- Location: Germany
- Order date: 2015
- Completion: 2016

Wintershall Dea Deutschland

Turnkey Process Analytics Technology Monitors Corrosiveness

For more than 30 years, oil has been produced on the Mittelplate at the southern edge of the Schleswig-Holstein Wadden Sea National Park.
It was initially transported to the coast on specially built ships, but since 2005 this has been done via a ten-kilometer stainless steel field pipeline. The location of the production platform on a sand bank in a national park means that the strictest environmental protection and safety regulations apply. Strict compliance with these regulations has been part of everyday life on the Mittelplate since its very beginnings.

The analysis container being delivered on the Mittelplate

Analysis container and reserve hydrogen supply (left in attached container) at the final location

Virtually continuous monitoring to protect against stress corrosion

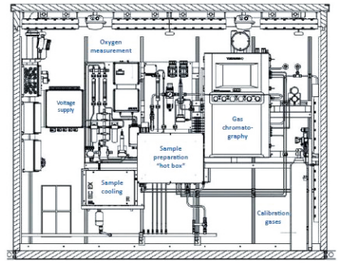
The mix of oil and water that is produced is divided in separators on the production platform itself. The gas that is not used to drive the platform's gas turbines is compressed and injected into the field pipeline to the land station, where it is separated again and transferred on. It contains over 60% methane, around 25% light hydrocarbons (C2-C4) and around 6% nitrogen as well as small amounts of corrosive gases such as carbon dioxide, oxygen and sulphurous gases. At higher concentrations, these can cause stress corrosion in stainless steel. Any leakages involving oil and gas could endanger safety and the environment. That's why monitoring the pipelines is the top priority.

According to official requirements, the corrosiveness of the carrier gas must be checked on a regular basis. Until the analysis container was constructed, this took place every six months by taking a manual measurement. The operator Wintershall Dea Deutschland found this to be inadequate. "The composition of the carrier gas may change in the short term, depending on the production schedule and the separation conditions. So we wanted to establish a frequent monitoring process", explains Fabian Ehlers, electrical engineer at the Holstein oil production unit of Wintershall Dea Deutschland. "Construction of an analytical measuring system to detect components responsible for stainless steel corrosion" was the somewhat unwieldy name of the project.

A gas analysis system for this purpose was ordered in 2012 and installed on the Mittelplate. However, this UV-photometric solution was never able to meet expectations in terms of functionality and reliability. So in 2015, the operator made a second attempt. A combination of gas chromatography and electro-chemical oxygen measurement was intended as a reliable solution to this analysis task. "It was important to us to obtain a complete solution from a single source that covered all the requirements", says Ehlers, describing the goal.

Custom solution required

"We came under consideration as one of several possible suppliers for the analysis solution", recalls Werner Worringen, Marketing Manager for Analytical Solutions at Yokogawa. Following initial discussions, an on-site meeting was quickly arranged on the Mittelplate in summer 2015. His colleague Sascha Gölz, Service Engineer for Analytical Solutions, was initially impressed by the tight spatial conditions. "It quickly became clear to me that we needed a custom container that was as compact as possible and could also withstand the rugged environmental conditions", he says. Just a few weeks later, when a detailed overall quotation was submitted that was also attractive from a cost perspective, Ehlers was initially surprised: "Yokogawa developed a custom solution and incorporated its own ideas – a supplier that listens and thinks proactively. That's what ultimately convinced us." As Gölz



Schematic diagram of the analysis container inventory

emphasizes: "It was obviously a team effort that our partner companies also made crucial contributions to."

In that same year, a contract was awarded to build an analysis container with a surface area of just six square meters. In May 2016, this container was transported by ship to the production platform and set up. Its analytical core is formed by a gas chromatograph from the Japanese company, together with the oxygen measuring device and the upstream compressor measuring gas cooler.

"The fact that we had the container made out of glass- fiber-reinforced plastic rather than special corrosion- resistant steel – contrary to the original tender offer – was fundamental to our success", explains Gölz. This removed the need for any complex and expensive welding work on the Mittelplate when attaching the container roof, which had to be removed before installation for space reasons. "We had only a few centimeters of leeway in height", recalls Ehlers. The container was lighter than the steel variant and did not require a complex coating. Plate heat exchangers integrated into the roof of the container, which were connected to a cooling circuit that is also used for the central control room of the production platform, make an electrical climate-control system unnecessary. "This results in further cost benefits in terms of procurement and operation and saves on investment in explosion protection", explains Worringen. A heating element and air supply ducts for overpressure ventilation are also integrated into this roof.

Preliminary discussions regarding maintenance work on the Mittelplate: Sascha Gölz, Fabian Ehlers, and Werner Worringen (left to right).

Precise measured values in four-minute cycles

An isokinetic measuring gas sampling probe ensures continuous and representative sampling in the carrier gas pipeline. The gas is supplied to the container via a heated pipeline. The analysis system was commissioned in October 2016 and is connected to the CENTUM VP control system, which also has a safety instrumented ProSafe-RS controller to support it. It supplies precise measured values roughly every four minutes. The analysis unit has also proven its worth in multi-year operation in the offshore environment. It undergoes routine maintenance twice a year, which primarily relates to the filter elements for sample preparation and the electrolytic hydrogen production for the flame photometric detector (FPD). As the latter has a non-redundant design, there are two 50-l compressed gas cylinders as a backup solution in a cabinet attached to the container. These cylinders enable continued operation for approximately three weeks. "This was another suggestion from Yokogawa. We were initially critical because of the associated logistical requirements. But it has proven to be useful if the hydrogen generator actually fails", explains Ehlers. During the maintenance work, the GC measurement is also recalibrated with standard gas mixtures. The packed columns used are very robust and have been in service for more than three years. Aside from on-premise work, Gölz can access the analytical unit via VPN following authorization. "That means we can resolve smaller problems quickly and easily together with the operating personnel – without making an expensive trip to the site", he explains.

Continuous improvement and expansion

"Even when a system is functional, there are still things about it that can be improved", adds Gölz. For example, pneumatic Teflon control lines were initially installed in the sample preparation area, which causes no problems at the normal operating temperature of 85°C. However, these connections have since been replaced by metal pipelines to provide higher temperature resistance without any damage and with more reliable protection against leakages. The temperature control system has also been further improved.

The noise level caused by the overpressure ventilation in the container – which was required for occupational safety and system protection reasons – was rather disruptive. "Even though hardly anyone needed to work in the container for long periods – except for me during maintenance – we found a solution", says Gölz. An additional pressure reducer installed in the air supply duct will soon be correcting this problem.

A combined compressor was also recently put into operation on the Mittelplate. It can provide carrier gas pressure levels both for turbine operation and for pure injection into the field pipeline. In future, the separate gas supply for this line will also be monitored by the tried-and-tested analytical system. A second sampling device has already been installed for this purpose. Depending on the operating status, this can be activated and controlled by the control system. "We have been convinced by the analytical system from the design right through continuous operation, which has been running for several years. It's impressive how robust such a sensitive measuring setup of this kind can be", says Ehlers, summing up his experiences.

Key facts

- Oil carrier gas contains corrosive gases. At higher concentrations, these can cause stress corrosion in stainless steel.
- On the Mittelplate drilling and production platform, this is monitored using a custom process analysis solution.
- An isokinetic measuring gas sampling probe ensures continuous and representative sampling in the carrier gas pipeline.

Plant Information

- Location: Den Helder, The Netherlands
- Order date: January 2006
- Completion: March 2009

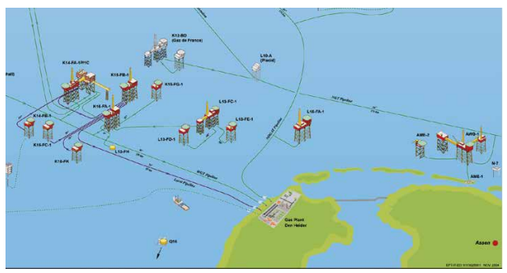
Nederlandse Aardolie Maatschappij BV

FAST/TOOLS SCADA System as the Basis for Lower Operational Costs in NAM

Executive Summary

With an annual production of around 50 billion m^3 of gas, Nederlandse Aardolie Maatschappij BV (NAM) is the largest producer of gas in the Netherlands. Just over half of this quantity originates from the Groningen gas field, with the remainder from various smaller fields at other locations across the country (12.5 billion m^3) and from the North Sea fields (11 billion m^3). What began as a single platform quickly grew to form a collection of production platforms spread throughout the North Sea. Thirty years ago, the first steps were taken towards an automation process that would allow all of the platforms in the North Sea to be operated from a central control room in Den Helder. However, the processes taking place at the various platforms are so diverse in nature that a uniform solution proved to be a difficult task, and it was for this reason that the decision was taken to install a telemonitoring system, allowing the individual platforms to be monitored.

In the following years, a great deal changed. Not only did the technology develop, but the number of platforms also increased. As a result, the amount of data from the field continuously increased and the telemetry system that had been chosen at the beginning could no longer be maintained effectively.



NAM's production platforms at North Sea

A solution was found in the form of a local data concentrator. By installing this onto the existing system, the ever greater data streams became easier to manage. Ultimately, this solution was superseded by other technological developments on the market. The operational personnel and maintenance costs became too high and the risk of injury became too great, and so consequently, a new system became necessary to reduce the operational costs and to further optimize the process. Martin Dantuma of NAM's SCADA Operation Liaisons, explains: "One condition was that the operation and management of all platforms should be centralized within the NAM office in Den Helder and that better use should be made of the data coming from the field. That would make maintenance work in the field much more efficient."

The solution was found in the Yokogawa FAST/TOOLS supervisory control and data acquisition (SCADA) system.

Field Wide PAS* Project

The actual introduction of the SCADA system, given the name Field Wide PAS, was preceded by a lengthy process. The project is somewhat distinct from other similar projects in that the majority of production platforms differ from one another. The North Sea platforms can be roughly divided into two types: locations at which operation is fully pneumatic, and locations that are equipped with a distributed control system (DCS). In addition, these systems have been produced by different manufacturers and are from different generations. The uniform interfacing of these systems to the SCADA system was one of the most critical conditions that was set within the Field Wide PAS project. In order to make this form of interfacing possible for pneumatically operated platforms, these were equipped with a PLC-based system with limited functionality. This system ensures that signals can be transmitted from the platforms to the shore and guarantees the possibility of expansion in the future.

* PAS: process automation system

"At all locations where a DCS had been fitted, assessment was made to determine whether or not the relevant version offered the possibility of interfacing with FAST/TOOLS. In the absence of an interfacing option, the DCS was upgraded or migrated. In total, upgrades or migrations were carried out on six Yokogawa systems and various systems from other manufacturers. The cabling already in place in the field could be preserved in the case of Yokogawa systems as only new hardware blocks needed to be connected. Commissioning in this case could therefore be carried out quickly," explains Mr. Dantuma. What was noticeable about the project was the excellent collaboration that took place. He adds: "The Field Wide PAS system is distributed across a number of locations with many suppliers involved. Despite the large number of parties that were involved in the project, everything ran smoothly. All parties worked well together, especially the technical experts from the different suppliers. The technical solutions that were developed exceeded expectations in a large number of cases."

Information Used More Widely across the Organization

The arrival of the SCADA system increased the resolution of data and consequently, the flow of information to the shore was improved. The number of tags from DCS and SCADA increased from 200 to at least 100,000 for each location, which suggests that a greater amount of data is being used and that this data is of a more accurate nature. In addition, all connections between the onshore and offshore platforms are monitored continuously using the new system. "This not only simplifies infrastructure monitoring, but also ensures that it can be used more efficiently," explains Mr. Dantuma.

The presentation of information is performed in Den Helder using FAST/TOOLS. "All graphics from the various DCSs are copied and simplified. By doing so, we can guarantee a uniform presentation of the information despite the high degree of variety across the DCS systems. The risk of errors has also decreased thanks to straightforward presentation," explains Mr. Dantuma. An identical system has been installed at the NAM office in Assen, alongside the system in Den Helder. This redundant installation not only provides an additional level of security, but also enables the platforms to be operated from two different locations.

The signals transmitted from the various fields to the Field Wide PAS system are not used solely for operation of the platforms. As Mr. Dantuma explains: "Alongside the interface to the SCADA system, an interface to the data historian has also been installed at all locations so that the same data can be read. Coordination of both systems has taken some time to achieve, but the result is that everyone who is authorized to do so can now view the DCS system." The data is also used to the organization's advantage, for example by the Sales Department and by well and reservoir engineers.

Smooth Commissioning

Commissioning work taking place in the middle of the North Sea is no easy task, especially when it involves more than 20 platforms. Mr. Dantuma explains: "The commissioning was dependent on the platform shutdown periods, as other activities would be taking place at this time. In order for everything to run smoothly, detailed plans were put together many months in advance. Even the SAT tests were carried out on the platform several months before commissioning took place." By making such thorough preparations, and thanks to the excellent collaboration between the different suppliers, the commissioning process ran smoothly. One part of the commissioning process is checking the tags. "You can view the DCS as an oil drum with tags," explains Mr. Dantuma. "The tags are divided into categories, to each of which we have assigned a priority. All tags with priority 1 and 2 are related to safety, the environment, and production loss, and were 100% tested. Tags with priority 3 (operational assistance) were 80% tested. Of the tags with priority 4 (no immediate action by the operator necessary), 5 (situation reports), and 6 (analog values), only the most crucial were checked."

Seeing the First Savings

Are concrete savings being seen yet? Mr. Dantuma continues: "When it comes to maintenance, we are already seeing savings. These savings are the result of being able to monitor all platforms, in combination with the associated infrastructure. We no longer have to travel offshore for every minor event, something that was clearly not cost effective. However, there are still returns to be achieved by optimizing the process. Live checks are still carried out in this way, but it is expected that these will be transferred to a fully automated process within the near future. What is more, this project has laid the foundations for achieving savings on operational costs."

Automation will be further introduced in the field. According to Mr. Dantuma: "The logic that is required in order to determine which valves are open on a platform, and which are not, will now be optimized. On top of that, we will be looking at if we are able to operate more frequently and over longer periods on an unmanned basis. A greater amount of data is available, allowing the operator on the platform to perform his/her work onshore in Den Helder, too. We can take the next step by introducing further automation to the equipment and, as a result, full control of the platforms from the shore will be within our grasp. In principle, all of the components are now in place. To add to all of this, Yokogawa now performs all of its maintenance activities from the office in Amersfoort, resulting in a much simpler maintenance process. In addition, the system itself is much more straightforward to maintain. It's simply a question of removing one card and inserting another."

Central control room at Den Helder

Plant Information

- Location: Den Helder, The Netherlands
- Order date: December 2009
- Completion: August 2010

Nederlandse Aardolie Maatschappij BV Den Helder

Yokogawa Revamp of Control Systems at NAM Den Helder Plant Ensures Stable Gas Supply in The Netherlands

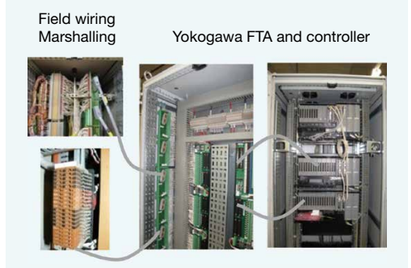
Executive Summary

Nederlandse Aardolie Maatschappij B.V. (NAM) is the largest natural gas producer in The Netherlands, accounting for three quarters of the country's natural gas production.

The gas treatment plants in Den Helder receive gas from NAM's offshore production platforms and carry out various processes to ensure that the gas meets the delivery requirements of Gasunie, a Dutch company that is responsible for transportation via the gas pipeline network in The Netherlands and Germany. One of these plants is a low calorific (LoCal) facility that started operating in 1984 with a Honeywell TDC 2000 system. As NAM was having a difficult time maintaining this legacy control system due to the scarcity of spare parts and the vendor's declaration of end of support (EOS), the decision was made to modernize the control system. In so doing, NAM anticipated improvements in production performance, system reliability, and maintainability.

NAM awarded Yokogawa Europe the contract for this plant's control system upgrade in December 2009, and the replacement of the Honeywell TDC system with Yokogawa CENTUM VP was successfully completed in August 2010. This included the very time consuming replacement of obsolete field terminal assemblies (FTA) with Yokogawa hardware.

Field wiring of Honeywell TDC 2000 system



Field wiring of Yokogawa CENTUM system

The Challenges and the Solutions

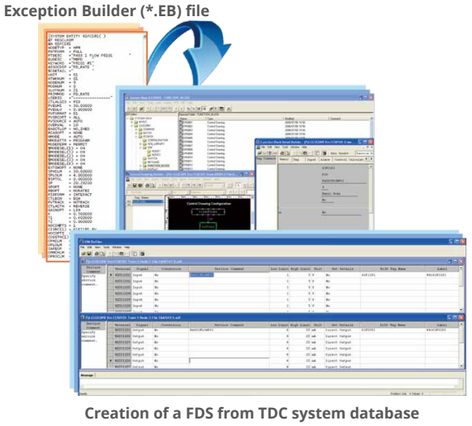
Yokogawa Europe faced a wide range of challenging tasks during project execution, which included a site survey, creation of a function design specification (FDS) from the existing TDC system database, documentation verification, and the development of interfaces with existing third-party systems. The Yokogawa Europe engineering team worked very closely with the NAM project execution team throughout the project execution period and utilized Yokogawa's global expertise in Honeywell migration to resolve all issues. These factors all contributed significantly to the success of this DCS revamp project.

Creation of FDS from TDC system database

As NAM wished to retain all the functions running on the TDC 2000 system, Yokogawa Europe had to generate an FDS from a system database prior to making the detailed design. Yokogawa's dedicated database analysis/conversion tools and rich experience in Honeywell migration projects proved invaluable during the FDS generation phase.

A database analysis tool generated a visual representation of the control loops and a logic chart. An engineering tool converted the TDC 2000 database into an Excel-format file containing tag lists that could be used to generate the CENTUM database. And a TDC graphic conversion tool facilitated visual comprehension of the information embedded in the graphics. Based on their discussions with the members of the NAM project team, and with the assistance of these tools, Yokogawa's engineering team was able to finalize the FDS for the replacement of functions, and this was approved by NAM.

Exception Builder (*.EB) file



Creation of a FDS from TDC system database

Factory acceptance test (FAT)

Already during the FDS generation phase, Yokogawa Europe discussed with NAM how the FAT would be executed. The major challenges were identifying how to carry out the test and what to test against as a reference. The FAT was executed by experienced operators from NAM who knew their plant very well and were able to perform extensive testing and verification. During the FAT all I/O points and sequences were tested.

The OPC interfaces to the plant information (PI) system were also tested during the FAT; however, the serial interfaces to third-party equipment were not tested because the sub-systems were in operation on site and not available for in-house testing at Yokogawa.

Site acceptance test (SAT)

Prior to the actual shutdown of the plant, panels were brought into position and cables were pulled. At the start of the shutdown and after the change in cabling the Yokogawa CENTUM VP system was started. The serial interfaces were first checked in close cooperation with the vendors of the third-party equipment. Secondly, all I/Os were checked from the field terminals to the CENTUM VP system; this was to ensure that all cables and connectors were attached correctly. In order to speed-up commissioning, special commissioning graphics were generated. After the I/O check individual sequences were checked with the actual field equipment connected. All the site activities were finished well ahead of schedule, allowing NAM to seamlessly start their plant on time and without any trouble.

Customer Satisfaction

Steffen Mueller, the NAM project engineer responsible for the Den Helder EPE-P-OP, had the following to say on August 30, 2010: "Once again I can report good news. We have been back in operation for one week after the LoCal shutdown. We successfully replaced our Honeywell TDC 2000 system with a new Yokogawa CENTUM VP system. This challenging project has significantly contributed to the reliability and the integration of the Den Helder gas treatment plant 's operations. I want to thank the whole project team for the motivation and competence that they have demonstrated over the past few months. Although a lot remains to be done and fine tuning activities will follow over the next weeks..... the puzzle is finished! It was a pleasure working together with you!"

In short, NAM expressed complete satisfaction with Yokogawa Europe's perfect completion of the DCS replacement project at Den Helder.

Steffen Mueller NAM project engineer for Den Helder EPE-P-OP

Key Project Achievements

- Replacement of all TDC 2000 system functions
- Close "One Team" cooperation between NAM and Yokogawa Europe
- Smooth and safe cutover to new system
- On-time system installation and start-up
- 100% production performance
- High level of system integrity, reliability, and quality management
- High level of customer satisfaction

Plant Information

- Location: Chennai, India
- Order date: July 2008
- Completion: October 2010

HMI with FAST/TOOLS

Pump facility

STARDOM units

Indian Oil Corporation Ltd.

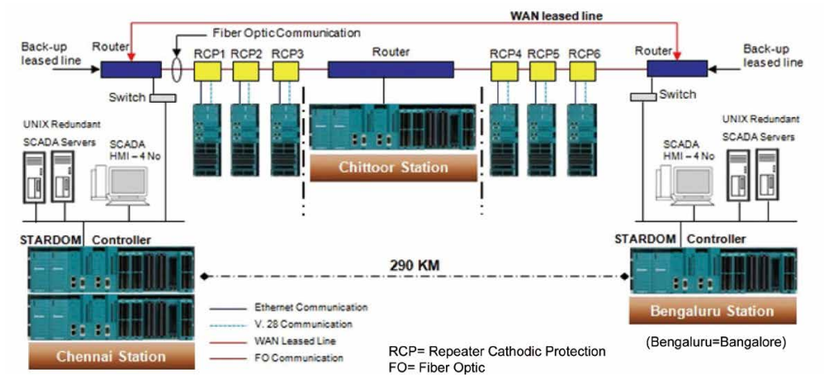
STARDOM and FAST/TOOLS Integrated SCADA Solution for Indian Oil Corporation's Multiproduct Oil Pipeline

Executive Summary

The Chennai-Bangalore Pipeline (CBPL) has been constructed by the Indian Oil Corporation Ltd. (IOCL) to ensure uninterrupted, reliable, and economical transportation of petroleum products to meet the growing demand in and around the city of Bangalore, India.

The pipeline originates at Chennai Petroleum Corporation's Manali refinery near Chennai, passes through Chittoor in Andhra Pradesh, and terminates at IOCL's Devanagonthi terminal on the outskirts of Bangalore. Completed three months ahead of schedule, this 290-km underground pipeline has one booster pump and three main line pumps, and can transport 1.45 million tons of products per year.

IOCL selected Yokogawa's FAST/TOOLS SCADA system to provide integrated and centralized monitoring and control of pipeline operations from the Chennai station. The principal elements in this solution are STARDOM intelligent remote terminal units (RTUs), the FAST/TOOLS SCADA package, and a fiber optic telemetry system. As a backup for monitoring and control communications, a redundant leased line links the Chennai and Bangalore stations. A pipeline leak detection system (LDS) was also installed and commissioned.



The Challenges and the Solutions

Centralized control and monitoring

To achieve a centralized control and monitoring function, servers located in the Chennai and Bangalore stations are linked with each other. Chennai is the master station and is able to control the Bangalore station remotely with the authorization of the Bangalore terminal operator. SCADA operator stations at the Bangalore terminal are capable of displaying status information from the Chennai station.

Integration with LDS

The SCADA servers at the Chennai station are linked to the LDS for real-time display of information on leaks detected in the pipeline. High-priority alerts and other data are exchanged in real time between the LDS and the SCADA servers when leaks are detected.

Integration with IOCL intranet for pipeline monitoring

IOCL offices all over India are able to monitor the pipeline on the company intranet. Once per minute, the SCADA servers at Chennai populate the IOCL intranet server database and a web application displays this real-time pipeline status information. This gives IOCL personnel a clear view of pipeline operations. In this way, STARDOM facilitates the total visualization of data needed for safe and reliable pipeline operations.

Customer Satisfaction

One of manager in the pipelines division- Chennai said, "At all the main stations and RCPs, Yokogawa India completed the turnkey package of supply, installation, testing, and commissioning of the Yokogawa STARDOM RTUs and FAST/TOOLS SCADA, measuring and testing equipment, a field instruments package that included a UPS and energy solution pipeline application software (PAS) and an LDS package, and the interface to the IOCL intranet. The entire project including detailed design, manufacturing, integration testing at the factory, installation, and commissioning was completed ahead of schedule. Yokogawa completed the CBPL project on time and achieved excellent customer satisfaction, and application development."

Functions of SCADA

- Centralized monitoring and control
- Gathers data from unmanned stations (RCPs) via fiber optic communications link
- Integration of RCPs / block valve stations (BVS) with V.28 link
- Chennai and Bangalore link via leased line (WAN)
- Integration with LDS for real-time display of leak status information
- Integration with IOCL intranet for real-time display of data in an IOCL web application
- Authorization to control Bangalore station from Chennai station
- Complex report generation on a shift, daily, and monthly basis

Supplied Hardware & Software

- 4 SCADA servers - Unix (redundant) & 10 client stations (Windows)
- 10 STARDOM RTUs with cabinets & panel mount displays
- Large video screen
- Routers / switches / terminal servers / RS232-485 converters
- Field instruments, test and measuring equipment
- FAST/TOOLS SCADA R9 (Windows & AIX5.3)

System Details

- 1,500 conventional I/Os
- Modbus communications with UPS, flowmeters, flow computer, VFD, tank farm
- Integration of Solatron 7835 densitometer with Lobos 600 flow computer
- Large video screen
- Leak detection system
- Routers / switches / terminal servers

Plant Information

- Location: Groningen, The Netherlands

Nederlandse Aardolie Maatschappij BV GLT-PLUS

True Value in Instrument Diagnostics and Preventative Maintenance with Powerful Software Tools like DTM

Executive Summary

As with most European countries, natural gas is a critical source of energy for the Netherlands. And most conveniently for the 16 million Dutch people, an abundant annual supply, 32 billion cubic meters, is located in Groningen province, in the far northeastern corner of the country. This rich gas field began producing in the 1960s. Since then, the inevitable depletion of resources and aging of equipment as well as stricter environmental regulations have required a massive upgrading of facilities. Nederlandse Aardolie Maatschappij BV (NAM), the Dutch petroleum company (a joint venture of Shell and Exxon) that oversees the project, began working on the upgrade in 1997. NAM realized that the days of "free flow" were gone, and like most other oil and gas companies around the world, a great deal of additional effort would be required to continue production.

The most urgent need has been to boost the gas pressure. Nearly 40 years of production have depleted the source by half, reducing the wellhead pressure to 90 bar. About 30 bar is lost through dehydration and the removal of impurities, which leaves 60 for transmission. Since this is the threshold value for gas distribution, NAM engineers know that if they are going to be supplying in the year 2040 and beyond, it will have to be done with gas compression equipment.

Another great need is to stabilize gas supply for customers' varying needs. During the warm summer months, the Dutch demand a modest 50 million cubic meters from Groningen. But on a cold winter day, they may ask for 250! On any given day, the demand may swing by as much as 3:1. To handle these wide changes in demand, NAM is planning to reconstruct huge underground storage facilities, one kilometer below the surface, to act as a buffer for the gas supply.

One of the 20 gas well clusters in Groningen province

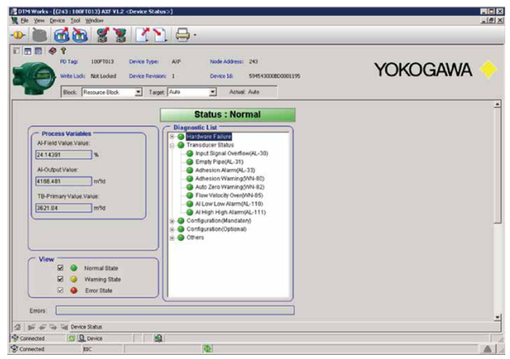
The Challenges and the Solutions

As one would expect, an engineering project of this scale cannot be handled by a single company, no matter how large. Stork GLT, a five-company consortium that included Yokogawa Europe as instrumentation and control system provider, was formed in 1997 and spent the next 12 years renovating the clusters. With that work now done, NAM has signed up for about another 15 years with the consortium, which is now called GLT-PLUS, for additional renovations and plant maintenance.

The gas wells are organized into 20 clusters, each consisting of wells and a treatment plant. Each cluster has a control room that normally operates unmanned, automatically, under the supervision of the central control room. Many types of field instruments are utilized in each cluster, and NAM needs to remotely monitor these devices and organize their maintenance schedule. NAM always uses the latest technology to improve operations and productivity.

Yokogawa's Plant Resource Manager (PRM) software is the backbone for all maintenance operations. The combination of FOUNDATION™ Fieldbus networking technology, combined with the use of DTMs and the PRM software make it possible for the engineers to keep track of thousands of valves and instruments. In many cases, when problems arise, the maintenance engineers can use DTMs to get a quick picture of what is happening with the equipment.

Central control room



DTM device status window

Work orders are prepared each day, and maintenance engineers meet the next morning with operations personnel to discuss needs and priorities. The close collaboration means there are few, if any, surprises. And so, the maintenance department, thanks to powerful tools like DTMs, is beginning to change from "corrective" mode to "proactive" mode. The intelligent instruments and the database infrastructure make this happen. There is still a learning curve, but the engineers are starting to work through it.

DTMs can collect and organize hundreds of instrument parameters and diagnostics and make them available in comprehensible form for maintenance engineers. With thousands of instruments spread over a very wide area, this plays a crucial role in making sure that everything runs smoothly in the gas field.

Customer Satisfaction

Ron Schoemaker, Yokogawa's representative within the GLT-PLUS consortium, said, "The complete field is controlled by a Yokogawa CENTUM VP system, the largest field-wide DCS in the world. It presently supervises about 800,000 tags, and when the underground storage facilities are connected to the field-wide DCS, the tag count will be close to one million. The gas field is automated to the degree that, theoretically, one man could run the entire operation. In practice, NAM keeps two men in the control room."

Mr. Schoemaker went on to say, "When we started, fieldbus was too new for us to consider using it, but the concept of predictive maintenance appealed to the team, and so the first 13 clusters were done with standard HART instruments, in a "quasi fieldbus" of sorts. Yokogawa's field controllers are connected to the central control system by using a dedicated fiber optic network."

Robin de Vries, a Yokogawa plant asset expert, said, "It was the first one equipped with FOUNDATION™ Fieldbus technology on a pilot basis, in 2004, and has 25 FOUNDATION™ Fieldbus devices in four segments. Now there are 2,500 intelligent instruments connected with FOUNDATION™ Fieldbus and 8,000 with HART. Most of them are Yokogawa instruments for pressure, mass flow, temperature, and conductivity. But standardized instrumentation buses make it easy to connect other manufacturer's devices, and so there is a scattering of Magnetrol and Endress+Hauser level instrumentation and Emerson valve positioners."

Ron Schoemaker
Yokogawa Europe representative within the GLT-PLUS consortium

Robin de Vries
Plant Asset Expert for Yokogawa Europe