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YOKOGAWA

Success Story Collection

LNG Supply Chain

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Success Story Collection

LNG Supply Chain

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: South Hook, Milford Haven, UK
- Order date: March 2005
- Completion: April 2010

South Hook LNG Terminal Ltd.

Yokogawa Provides CENTUM CS 3000 and ProSafe-RS for the Largest LNG Terminal in Europe

Executive Summary

The demand for natural gas is growing rapidly and at the same time indigenous gas production in European Union is going down. Experts predict that the resulting import requirements in the European Union in 2030 will be between 1.5 and 2 times the import amount of 2007. One of the options to close the resulting supply gap is through LNG imports. As a consequence, liquefied natural gas (LNG) facilities are under pressure to deliver not just now, but well into the future. Consequently, a requirement for LNG terminals is that they have exceptionally reliable field proven process automation solutions that will be supported for at least 15 years, and which in practical terms can be expected to be longer.

The South Hook Terminal provides the UK with a significant proportion of its natural gas requirements. It is an integral part of the Qatargas 2 integrated value chain and is the largest Liquefied Natural Gas re-gasification terminal in Europe.

The South Hook LNG terminal and jetty

The South Hook re-gasification Terminal is the stage in the LNG process which changes it back from the liquid to gaseous state. This is then delivered to the UK's homes and businesses via the UK's national grid network.

The LNG is delivered to South Hook by a state of the art fleet of double-hulled ships which brings the LNG from Qatar's immense North Field, to the safe, deep water in Milford Haven.
The South Hook Terminal also plays a major role in the strengthening of the strategic partnership between the state of Qatar and UK. LNG imports greatly increase the UK's security and diversity of gas supply while helping to ensure that natural gas remains a competitive source of energy.

The Challenges and the Solutions

Yokogawa Europe successfully completed the implementation of the full ICSS automation control system project which includes flagship products of distributed control system (DCS) CENTUM CS 3000, Yokogawa's safety instrumented system ProSafe-RS and Exaquantum - Yokogawa's Plant Information Management System (PIMS). For design and training purposes the Yokogawa scope also included an Operator Training System (OTS) based on the Visual Modeler dynamic simulation software.

The South Hook Terminal facility comprises a ship unloading system, five dual containment 155,000 m^3 LNG storage tanks, and duplicated re-gasification and gas send-out systems.

Plant Safety Operation

Owners of LNG terminals are subject to compliance with many laws, regulations, standards and guidelines which need to be met to ensure that the health and safety and commercial viability of all of its stakeholders are not compromised. These comprehensive requirements influence the design, construction, operation, and maintenance of an LNG facility.
Yokogawa's skills, expertise and experience is not just limited to its product but recognises the importance of understanding the LNG process. In order to be able to implement a successful fully automated solution, Yokogawa utilises its experience and specific knowledge of LNG terminal control system automation. Yokogawa safety consultants are involved at the earliest stages of development and can participate, for example, in HAZOP studies and SIL studies. Yokogawa supported, designed and supplied a full automation control system for this terminal, which incorporated the DCS (distributed control system), emergency shutdown (ESD) system, fire and gas (F&G) system, fire and gas devices, asset management system, data historian system and operator training simulator. The basis of this LNG terminal solution is Yokogawa's CENTUM CS 3000 R3 DCS system and ProSafe-RS safety instrumented system, which are considered the most reliable process automation system on the market.
As LNG EPC projects have increased in size and complexity, owners have increasingly employed Yokogawa during front end engineering design (FEED) activities, utilising Yokogawa's extensive experience in LNG supply chain automation.

Central control room

Data Management by Exaquantum

CENTUM CS 3000 and ProSafe-RS were totally integrated with 17 sub-vendor systems and all process operation data needing to be visualised for efficient terminal operation. The plant management team operates daily KPI reporting that the terminal utilises to monitor and continually improve its efficiency. Yokogawa's Exaquantum plant information management system (PIMS) is the tool that South Hook utilise to manage this important part of their operation. To ensure operators can see their process information clearly, various process information in real time data are always displayed on their large operator screen. This enables the process situation to be known in advance and ensures that the operator can always take any necessary proactive action. Finally, gas nomination and allocation is smoothly executed by having Exaquantum provide the required data to the Terminal Access System that handles .

State-of-the-art Training Facilitation

In managing and operating LNG terminals effectively, terminal owners are frequently faced with the need to train and refresher train staff in order to maintain competitiveness and maximise efficiency, process and safety knowledge. It can be difficult for LNG owners to find experienced operators, and therefore need to train their own. An experienced operator may only require training on the specific system and not always on the plants process. However, inexperienced operators may also need to be trained in process behaviours and specific operator scenarios. In the South Hook LNG terminal's case, Yokogawa's OmegaLand plant operator training simulator (OTS) helps to reduce costs, optimize LNG terminal processes, and improve reliability by training operator staff in trouble-free start-up and load operation, prior to real plant operation. By establishing a network connection between OmegaLand and an actual DCS (the CENTUM CS 3000), it is possible for operators to receive realistic training in a virtual environment.
Training is available for procedures such as plant startup and load change, abnormal conditions such as an instrument or equipment failure, and exceptional emergency situations such as earthquakes, fires and runaway reactions. Because the simulator uses exactly the same algorithms as the actual control system, individuals can be fully trained to respond to emergencies, however rare, that could lead to a plant shutdown. The dynamic model not only facilitates the training of operators, but also allows the designers to check the dynamic aspects of the design. Having such a dynamic simulation environment attached to the actual control and safety systems, additionally supports the validation of process operating procedures.

Operator training simulator

Customer Satisfaction

According to Maurice Khoury the SHLNG Facilities, Control & Instrumentation Lead Engineer, " We are very happy using Yokogawa's DCS and SIS, as well as their software packages. The South Hook LNG Terminal can provide up to 20% of UK gas demand, so the plant runs 24 hours a day, 7 days a week, 365 days a year. Yokogawa's highly reliable systems and products are contributing to this continuous operation." He added, "Yokogawa are a significant partner here and we will continue to work as one seamless team throughout the plant's asset lifecycle."

Plant Information

- Location: Malaysia

MISC Berhad

Integrated Automation System (IAS) for MISC LNG Carrier Tenaga and Seri 'A' Class

Tenaga Class: 5 Ships
Capacity: 130,000 cbm per ship
Start: 2002
Finish: 2006

Seri 'A' Class: 5 ships
Capacity: 145,000 cbm per ship
Start: 2005
Finish: 2007

Project Profile

Yokogawa has been selected to supply the CS3000 for Integrated Automation System (IAS) and Boiler Integration as well selected field instruments for MISC Tenaga and Seri 'A' Class of LNG Carriers.

One of the tasks in the Tenaga Class project is to replace the existing panel instrumentation and obsolete PLCs with the advanced CS 3000 IAS which partly will extend the service life of the ships built in the early 1980's. Whereas in the Seri 'A' Class, the CS 3000 IAS will provide a reliable automation system onboard of all the newly build ships each with capacity of 145,000 cbm. The certification bodies for the Tenaga and Seri 'A' class are from ABS and BV respectively.

The Challenges and the Solutions

There was a requirement for an intensive site survey onboard of the Tenaga ships to ensure that the engineering and design works could be carried out successfully. A dedicated survey team comprises of Yokogawa global team with the assistance from the end-user did the onboard survey to map out all the necessary engineering details.

Part of the scope of work is to convert the existing panel instrumentation made in the early 1980's to accommodate the latest in the DCS technology. These include the previous boiler control which was based on obsolete PLC to be integrated into the new DCS. With the Yokogawa capability in handling major project using the Main Automation Contractor (MAC) approach as well as with existing close cooperation from Marine Boiler Maker and Marine Consultant, the project was able to be successfully completed even with a really tight yard schedule, all within a period of 2 months per ship on the average.

In the Seri 'A' Class ships, the challenge was in different nature as these are newly build. With the knowledge gained and the same dedicated team all the engineering, installation, testing and commissioning as well as during sea trial, the Seri 'A' projects have been successfully delivered to the satisfaction of customers. This including the DCS integration of with Terasaki Power Management System as well as integration of ship's boiler system.

Benefits Realized

With the completion of the retrofitting of the new CS 3000 IAS in Tenaga and new installation on Seri 'A' Class LNG Carriers, MISC could be ensured of better information visibility, performance foresight, and operational agility to deliver overall operations excellence, reliability, safety and on-time cargo deliveries to the confidence of their charterers.

MISC operation team could also benefit from the global Yokogawa support around the world in all the destinations during the Tenaga and Seri 'A' Class voyage.

To ensure the adherence to the highest safety standards, for all periodic vessels' inspection and audit conducted at the Malaysian dry docks, MISC will be guaranteed of Yokogawa support and expertise from the Malaysian office. Because of similar operating system the Tenaga and Seri 'A' Class ships' crew could be interchangeable and hence optimise the cross-fleet integration and operations.

MISC will also benefit from the training and process simulation at Yokogawa DCS Training Simulator Centre located at their world class Malaysian Maritime Academy to train sea personnel.

Customer Satisfaction

One of the MISC engineer commented, "We want an idiot proof, user friendly and reliable IAS system to ensure safe operations for our LNG carriers. Yokogawa CS 3000 system has proven in both the Tenaga and the Seri Class LNG carriers that their hardware is very reliable with very less problem. This means that we have fewer spare parts to purchase and hence a reduced maintenance cost and a faster turn-around for the vessels."

He further added, "Yokogawa CS 3000 software and operating system proven to be most user friendly as almost any ship engineer can familiarise with the system in a very short time. The system is also very easy for our trouble shooting works."

Customer Profile

MISC Berhad (MISC), a subsidiary of the PETRONAS Group of Companies, is a renowned leading international shipping and logistics company with a formidable presence in energy transportation and marine engineering. With a fleet of 27 LNG tankers, which is expected to expand to 29 by April 2009, MISC is the world's single largest owner operator of LNG Carriers.

System Details

System: CENTUM CS 3000

Plant Information

- Location: Incheon, South Korea
- First Installation: 1998
- Current Migration: 2011 (plant 1)

Korea Gas Corporation

World's Largest LNG Terminal Relies on CENTUM to Maximize Safety and Reliability

Executive Summary

Established by the Korean government in 1983, Korea Gas Corporation (KOGAS) is the world's largest importer of LNG, and the country's sole importer of this important resource. KOGAS is fully committed to providing clean, safe, and convenient energy to the people of Korea. The company currently operates LNG receiving terminals in Incheon, Pyeongtaek, and Tongyeong, and distributes natural gas and gas by-products via a 2,739 km pipeline network to power plants, gas utility companies, and city gas companies throughout the country.

The Incheon LNG terminal is the world's largest LNG receiving complex, and it supplies natural gas to the Incheon and Seoul metropolitan areas, which account for 40% of the country's natural gas demand. Built on a 990,000 m^2 plot of reclaimed land 8.7 km off the coast, the terminal has two plants with a jetty capable of accommodating two ultra-large LNG carriers of up to 100,000 tons in size and a total of ten 100,000 m^3 above-ground storage tanks, two 140,000 m^3 underground tanks, and eight 200,000 m^3 underground tanks, giving it a total storage capacity of 2,880,000 m^3 (Kl). The total gas send out capacity of the Incheon terminal is 4,350 tons per hour.

In 1996, Yokogawa Korea installed a CENTUM CS production control system at plant 1 of the Incheon terminal, and migrated this system to CENTUM VP in 2011. With the construction by KOGAS of plant 2 in 2004, Yokogawa Korea installed a CENTUM CS system, and subsequently installed another CENTUM CS 3000 system in 2009. Engineering work is now underway at plant 2 for migration to CENTUM VP. The Incheon terminal utilizes Yokogawa's CENTUM systems for the control and monitoring of facilities throughout both plants, including unloading arms, storage tanks, recondensors, open rack vaporizers (ORV), submerged combustion vaporizers (SMV), and trunk lines with metering stations.

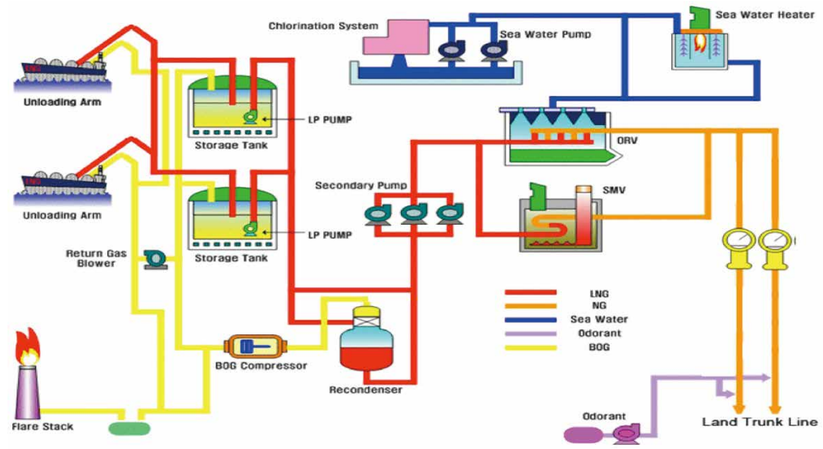
The Challenges and the Solutions

Safe operation

At LNG receiving terminals, safety is a paramount concern with the transfer and storage of LNG from carriers. It is very important to maintain a constant pressure inside the storage tanks, which requires careful control of the operation of boil-off gas (BOG) compressors, recondensors, and pumps. By means of sequence functions, CENTUM operators can easily control the process from a remote location, starting and stopping the BOG compressors depending on BOG temperature, gas composition, and volume. In addition, KOGAS has a disaster protection system for dealing with critical situations, and personnel in the central control room can share information in real time with operators in plants 1 and 2, ensuring a timely and well coordinated response if fire or a gas leak is detected.

Steady gas supply

It is very important for KOGAS to be able to adjust flexibly to shifts in demand in the gas that it supplies to power plants, industrial companies, and residences. While seawater in an ORV is normally used to cool and vaporize the LNG, in periods of peak demand operation can be automatically switched over to an SMV that relies on the combustion of BOG to vaporize the LNG. Every aspect of these vaporization processes, from the switching on and off of pumps to the control of vaporization temperature and gas pressure, is carefully configured in the CENTUM system. The adjustment to shifts in demand is fully automated at this terminal, ensuring uninterrupted supply.



KOGAS Incheon LNG terminal

Proactive maintenance for asset excellence

Systems from other vendors that control the plant's offloading, tank gauging, pipe line monitoring, metering, and other processes are all integrated via a Modbus interface with each plant's CENTUM production control system. The data from these processes is used to make production reports, calculate plant efficiency, and analyze performance. For example, operators use an accumulated running time report to track how long each LNG pump, air compressor, and other rotating equipment throughout the terminal has been operating. This enables a proactive approach to the scheduling of inspections to determine when repair or replacement will be necessary. This puts the right information at the right time into the hands of the right operators and managers, so they can make timely and correct decisions. The system can also generate the following types of reports used by plant specialists to analyze overall performance of the LNG terminal as well as individual processes:

1. LNG cost analysis
2. Electric power consumption
3. Fuel gas consumption
4. Unit operation cost
5. Daily cost analysis
6. LNG unloading
7. BOG treatment
8. Odorant treatment
9. Running time accumulation
10. Yield accounting

Customer Satisfaction

People at the KOGAS Incheon LNG terminal, says, "With CENTUM and other systems, we have built an enterprise-wide operating information system. The visualization of all process data allows us to maintain a clear picture of the execution of our business plans, create optimal LNG supply chain scenarios, and make quick decisions and timely adjustments. With the CENTUM system, operability and safety are enhanced, and operators as well as managers can maximize the effectiveness of their activities." They went on to say, "We appreciate the continual support and the solutions that Yokogawa Korea has provided us. Yokogawa is one of our best partners."

CENTUM VP operator in central control room

Plant Information

- Location: Qalhat, Sultanate of Oman
- Order date: September 2012
- Completion: December 2013

Oman Liquefied Natural Gas LLC

Upgrade of PCS Brings Higher Operation Efficiency and Productivity at Gas Liquefaction Plant in Oman

Executive Summary

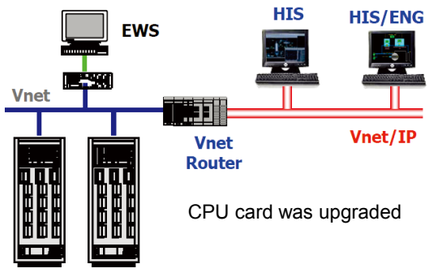
Oman Liquefied Natural Gas LLC (OLNG) is a limited liability incorporated joint venture company established by a Royal Decree and operated under the laws of the Sultanate of Oman. It engages in the business of producing and selling liquefied natural gas (LNG) and byproduct natural gas liquids (NGLs).

The Company undertakes, directly or indirectly, project operations and activities necessary to liquefy, store, transport and market Oman's natural gas and to deliver LNG to customers in the global markets. The Company operates three liquefaction trains at its site in Qalhat near Sur with a capacity of 10.4 million tonnes per annum.

The produced gas at the Barik, Saih Nihayda and Saih Rawl gas fields are gathered at the Saih Rawl Plant – a gas field complex operated on behalf of the Government of Oman by Petroleum Development Oman (PDO) - in Oman's interior. From there, a gas pipeline approximately 360 kilometres long and 48 inches in diameter with a gas capacity of 34 million cubic meters a day, is delivered to OLNG where the gas is liquefied.

The LNG production trains 1 and 2 located at the OLNG plant have been using Yokogawa CENTUM CS production control system (PCS) since 2000, and train 3 has been controlled by CENTUM CS since 2005. There have been no major issues in the process control systems over the course of these years.

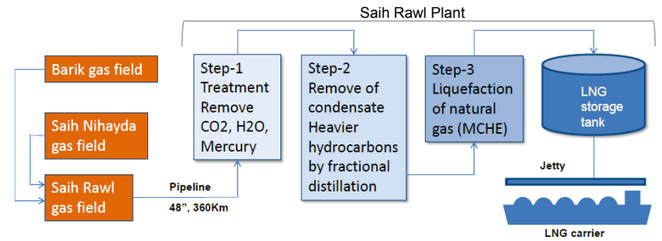
With the discontinuation of the UNIX OS system, OLNG decided to take a phased approach to upgrade its systems from CENTUM CS to CENTUM VP for all liquefaction trains, a common facility upgrade involving other systems like Exaopc stations used for PI, APC (Exasmoc, Exarqe), and metering. Yokogawa's eLogBook, an electronic logbook, is now an integral part of the OLNG day-to-day operations. Operator logging and handover applications are easily handled by this eLogBook. In addition, the central control room (CCR) renovation has been completed.



CENTUM VP configuration upgraded

Process	Completion
Train-1	October, 2013
Train-2	May, 2013
Train-3	November, 2013
FAR-5	November, 2013
FAR-6	December, 2013
FAR-7	December, 2013
Utility	April, 2014
CCR Beautification	April, 2014

Phase-wise upgrade completion



The Challenges and the Solutions

Efficient upgrade from CENTUM CS to CENTUM VP

Yokogawa Oman office has been offering resident engineer support to OLNG, since the plant has been operational. This has helped to plan the system modifications, upgrades and life cycle support.

One of the criteria put forth by OLNG was to ensure minimum downtime for the upgrade work due to tight LNG carriers schedules. A phased upgrade approach was adopted for the three trains and the common utility operation. The human machine interface (HMI) upgrade was successfully completed without any plant shutdown and the main CPU units of field control station (FCS) were flawlessly upgraded. Various kind of information related to the HMI such as graphic displays, tag list, control group displays were migrated from CENTUM CS to CENTUM VP using the Yokogawa conversion tool.
The upgrade work is completed on schedule. This online upgrade work was a considerable benefit to OLNG with no production loss.

Enhanced operator work flow

The operator logging and handover application had issues and caused issues to maintain and upgrade the application to continue to meet OLNG's latest operating requirements as well as its compatibility with the latest Microsoft operating system. Database corruption was the other issue. OLNG needed a rapid replacement that could meet the needs of the plant while maintaining the company's high standards.
Yokogawa delivered an enhanced release of eLogBook product, meeting the specific OLNG's needs. Yokogawa's eLogBook is now an integral part of OLNG's day-to-day operations. The eLogBook is configured to support specific customer tasks - a minimum of 15 separate tasks and four instructions.
Each group of OLNG operators can be assigned read / write access to a specific list of tasks. This enables operators to view, review and analyze complete activities at any time and at any location in the plant, which in turn enhances the total operator workflow.

- Shift operation tasks
- Shift instruction tasks
- Shift cycle hand over
- Plant-field (process common facility/storage and loading) tasks

Optimization of gas liquefaction operation

Acid gas (mainly carbon dioxide), water, and mercury are removed from the gas delivered to OLNG. This cleaning is a necessary step to enable liquefaction of the natural gas and a safe production for OLNG. Condensate which is a natural gas liquid is made up mainly of pentane and hexane that are removed by fractional distillation of the feed gas after treatment.

After the removal of condensates, the gas (mainly methane) is sent to the main cryogenic heat exchanger (MCHE). The selected liquefaction process is the propane-pre-cooled mixed refrigerant (C3-MR) process.

The liquefaction step is driven by two large turbine-driven compressors, which through a series of compression and adiabatic and non-adiabatic cooling steps, cools the gas to minus 162 degrees Celsius, where the gas turns into liquid. The LNG is sent to special storage tanks awaiting shipment by LNG vessels to customers in Asia and Europe.
Yokogawa CENTUM VP is fully used as PCS for both plant-wide operations and specific control strategy and monitoring such as compressor anti-surge control and start-up/shut-down control. Exasmoc multi-variable optimizing controller and Exarqe robust quality estimator packages are applied to maximize the liquefaction. The collaboration usage of PCS and APC provides OLNG a smooth and efficient operation.

Customer Satisfaction

Mr. Fahad Al Kaabi, Instrument Engineering Manager of OLNG mentioned, "We are very happy to complete this upgrade. All our operators reap the benefits of the latest CENTUM VP system and with the change of the new operating system obsolescence issue also has been resolved."

Double tiered console type HMI (CENTUM CS)

Double tiered high density LCD HMI (CENTUM VP)

Plant Information

- Location: Porto Viro, Italy
- Order: 2008
- Operation: November 2009

Terminale GNL Adriatico Srl

World's First Offshore Regasification Terminal Relies on Yokogawa ICSS (CENTUM CS 3000, ProSafe-RS)

Executive Summary

Terminale GNL Adriatico Srl, commonly known as Adriatic LNG, was established in 2005 by Qatar Petroleum, ExxonMobil, and Edison for the purpose of designing, building, and operating the world's first offshore regasification plant. Located in the northern Adriatic Sea, approximately 15 km off the coast from Porto Levante, Italy, the Adriatic LNG Terminal (ALT) is a huge state-of-the-art gravity based structure* (GBS) with facilities for the mooring and unloading of liquid natural gas (LNG) vessels, two 125,000 m^3 LNG storage tanks, and an LNG regasification plant. Gas from this facility is shipped to the mainland via a newly built pipeline that connects to the national gas distribution network.

Sitting in waters that are 29 meters deep, the ALT is 375 meters long and 115 meters wide, with a main deck that rises 18 meters above sea level and a flare tower that tops out at 87 meters above sea level. With its nominal 8 billion m^3 per year regasification capacity (equivalent to 775 million cubic feet per day), approximately equal to 10% of the country's gas consumption, the ALT is making a significant contribution to the diversification of Italy's energy sources, and is thus contributing to the country's energy security.

The LNG for this plant comes mainly from Qatar but also from Egypt, Trinidad & Tobago, Equatorial Guinea and Norway. Edison has a 25 year contract for 80% of the gas from the ALT, and the remaining 20% is open to third parties. Of this latter amount, 12% is allocated according to the procedures defined by the Italian Ministry of Economic Development and the Regulatory Authority for Electricity and Gas.

Acting from the early stages of this project as main instrumentation and control contractor (MICC), Yokogawa Europe installed an integrated control and safety system (ICSS). The individual components of this system are the CENTUM CS 3000 distributed control system (DCS) and the ProSafe-RS safety instrumented system (SIS) for IPS/F&G, and it is supplemented by the STARDOM network-based control system for pipeline monitoring & leak detection at block valve and metering stations and an operator training system (OTS) from Omega Simulation.

* A structure that sits on the ocean floor and is held in place by gravity

Central control room

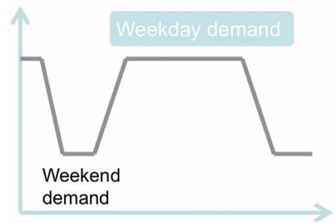
The Challenges and the Solutions

Safe operation

At the ALT, safety is the top priority. A robust and reliable ICSS made up of the CENTUM CS 3000 DCS and the ProSafe-RS SIS, together with a leakage detection system powered by the STARDOM network-based control system, provide non-stop disaster protection. Operation of the ICSS from the CENTUM human machine interface is convenient and user friendly. The SIS and DCS faceplates have the same look & feel, and security measures are in place that restrict SIS faceplate access to authorized individuals. In an emergency, operators have all the information they need to take immediate and effective measures including the operation of safety valves.

Steady supply

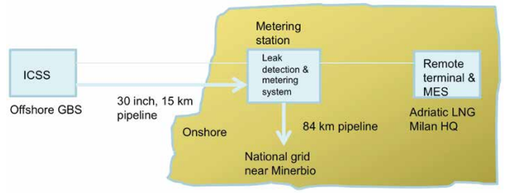
Providing a steady supply to the national grid is another important role of the ALT. The terminal has two tanks that can store up to 250,000 m^3 of LNG, an amount sufficient for meeting four days of demand, so punctual LNG carrier scheduling and efficient LNG unloading and vaporization are required. The gas quality is sampled by a GC1000 gas chromatograph and controlled to meet the specifications of the national grid. Thanks in good part to the robust reliability of the integrated CENTUM CS 3000 and ProSafe-RS systems, the terminal has continued to operate 24 hours a day, 7 days a week, with an availability approaching 99.5%.



Weekly demand pattern

Visualization of terminal operations

Systems from other vendors such as the LNG unloading system, tank gauging system, pipeline monitoring system, metering system, and gas turbine system are all integrated through a Modbus interface with the ALT's main CENTUM control system. The resulting ability to visualize process data from throughout the terminal allows the preparation of production reports, calculation of plant efficiency, and analysis of the performance of individual processes. Reports on the accumulated running time of rotating equipment such as LNG pumps and compressors are compiled, allowing operators to determine the optimum timing for equipment maintenance and replacement. The visualization of data from throughout the terminal puts the right data in from of the right person, enabling the right decision to be made at the right time.



Asset Optimization

The ALT is located offshore, so maintenance of the facilities and the control system, instrumentation and equipment is essential. To maintain a stable operation, unexpected field device failures must be prevented. The ALT uses the Plant Resource Management package (PRM). Field digital technology allows an operator to clearly see the status of field devices at any time. Operators and maintenance crews continuously monitor field devices from the Control Room using the PRM. Maintenance activity is scheduled before predicted device failure. Yokogawa continuously supports the PRM in order to ensure optimized management of the asset.

Customer Satisfaction

Russell Golson, Operations Manager at the ALT, said, "We are confident in our ability to provide a steady supply of gas to the national grid because our integrated control and safety system is reliable. LNG carrier scheduling, unloading, tank storage, and vaporizing are all procedure based operations and are carried out flawlessly. The terminal's availability is about 99.5%. We strive to automate terminal operations as much as possible. All process data is clearly visualized for optimum operation, maintaining a clear gas business plan and creating optimal LNG supply chain scenarios."

Plant Information

- Location: Bontang, East Kalimantan, Indonesia
- Order date: December 1999
- Completion: September 2002

PT Badak

Trains A-D DCS Retrofit & Instrumentation Upgrade at Natural Gas Liquefaction Plant

Background

PT Badak (a subsidiary of Indonesia's National Oil & Gas Company, PERTAMINA) operates one of the largest LNG production complex in the world, having eight LNG process trains, associated utility plants and offsite facilities. The first four trains including the utility plant and offsite facilities (i.e. Module I), were commissioned in 1977 and 1983 respectively. They were being monitored and controlled by panel mounted single loop controllers. In order to enhance the reliability and due to obsolescence of equipment of the Module I plant facilities, an entire revamp / upgrade of the control, safety and the electrical system took place, with Chiyoda Corporation being the prime EPC contractor.

The remaining four trains including the associated utilities and offsite facilities (i.e. Module II) were commissioned in 1989, 1993, 1997 and 1999 and are being monitored and controlled by a Yokogawa control system, the CENTUM. During the past 15 years of operation, the CENTUM system proved to operate without a single shut-down and this high reliability was a key criteria to be selected for this upgrade project.

Another criteria for the selection of Yokogawa as the control system supplier for this project was the capability and experience of cutover work – moving from the existing panel mounted single loop controllers to the new distributed control system (DCS) with no interruptions to the LNG production and minimal disturbance to plant operation. The cutover work consists of both cold cutover during a maintenance shut-down and hot cutover while the plant and the control system were under normal operation. In both cases, expertise that can only be obtained through actual work experience is mandatory to minimize risks and to achieve smooth and successful project completion.
Yokogawa's experiences and capability gained through successfully conducting such cutover type of projects around the world, was well recognized by the customer.

Project Schedule

Although the project schedule was very tight, the project was completed ahead of schedule without any trouble. This greatly owes to the way of working where PT Badak, Chiyoda and Yokogawa carried out the cutover work as one integrated team.

- The design, engineering and manufacturing were conducted in a very short time - seven months from kick-off meeting.
- The factory acceptance test including the system integration test with the sub systems was carefully conducted in four months.
- It took only 13 months after the kick-off meeting for the start of the initial cutover work.
- The cold and hot cutover work of 14,810 I/O points was completed in 13 months with no impact to normal plant operation.

Conventional analog control panel board (before)

Project Scope & Results

On this project, Yokogawa's scope was not limited to just the supply of the control system and the cutover work, but also included responsibility for all of the major safety and electrical systems, playing an important role as a system integrator.

Now, all eight trains including the associated utilities and offsite facilities are controlled by the Yokogawa CENTUM, which are integrated into one system consisting of approximately 100 man-machine interfaces and 100 field control stations. As a result of the change from panel mounted single loop controllers to a DCS on Module I, there was an increase in both productivity and efficiency of plant operations.

The results and benefits include:
- An increase of steam production from 6%-12% from original max load (total of 11 boilers rated 295t/h per boiler)
- Improvement of boiler response time of 6.7 to 7.9 seconds for 1 ton of steam flow rate change
- A decrease of production down time since the first two trains' cutover in September 2001
- Allowed a supervisory computer system that enabled process data from all eight trains, utilities and offsite facilities of Module I & II to be acquired and monitored at a single location

"We are very proud to have participated in this prestigious project, and are appreciative of PT Badak, the LNG operators and Chiyoda - the EPC contractor - for giving us this opportunity and their strong support throughout this project."

Central control room (after)

System Details

System:	DCS (CENTUM), Supervisory Computer System, Anti Surge Control, Vibration & Temperature Monitoring, Hazard Monitoring & Control, SER (Sequence of event recorder), Field Instruments, Analyzer System, ESD/EDP Valves, ESD (Emergency Shutdown System)/ EDP (Emergency Depressure System), Electrical Control, UPS, CCTV, Telecommunication, Public Announcement, Fire Suppression System
Total I/O:	14,810
System Configuration:	Man-machine Interface x 47, Field Control Station x 49 (Four LNG Process Trains, Associated Utilities, Offsite)
Scope:	System integration and cutover (hot & cold) work

Plant Information

- Location: Nagasaki, Japan
- Order date: December 2001
- Completion: March 2003

Saibu Gas Co., Ltd.

Compact, Well-designed LNG Terminal Ensures Stable Supply of Utility Gas

Executive Summary

Saibu Gas Co., Ltd. built an LNG receiving terminal at its Nagasaki Works to ensure a stable supply of clean-burning utility gas to its customers in Nagasaki Prefecture. In a project that will serve as a model for future terminals, Saibu Gas achieved a superb design that fit all plant functions into a limited area. Yokogawa's 30 years of experience in providing control systems for LNG receiving terminals was instrumental in ensuring a successful outcome for this project.

- Scalable, flexible configuration with functions distributed to multiple controllers on a facility basis
- Redundant architecture optimally designed for requirements of entire plant
- General-purpose communications network used for control bus
- Integrated operation environment through web-based human machine interface (HMI)

"We are very satisfied with the STARDOM system as it has exactly the kind of ultra-distributed configuration that we had in mind. The plant started up smoothly, and our operators are comfortable working with this system."

Mr. Hayakawa, Manager, Nagasaki Works, Saibu Gas

Mr. Yamanaka Manager Nagasaki Works

Mr. Murashima Leader Nagasaki Works

Mr. Masumoto Leader Nagasaki Works

The Challenges and the Solutions

- **Scalable, flexible configuration with functions distributed to multiple controllers on a facility basis**

  The Nagasaki Works employs many cutting-edge technologies at its LNG receiving terminal facilities, which include a berth for arriving LNG tankers, an LNG regasification plant, and a terminal where LNG is reloaded onto tank lorries for shipping. STARDOM controllers are assigned to the monitoring and control of the individual facilities, each of which carries out a different function.

- **Redundant architecture optimally designed for requirements of entire plant**

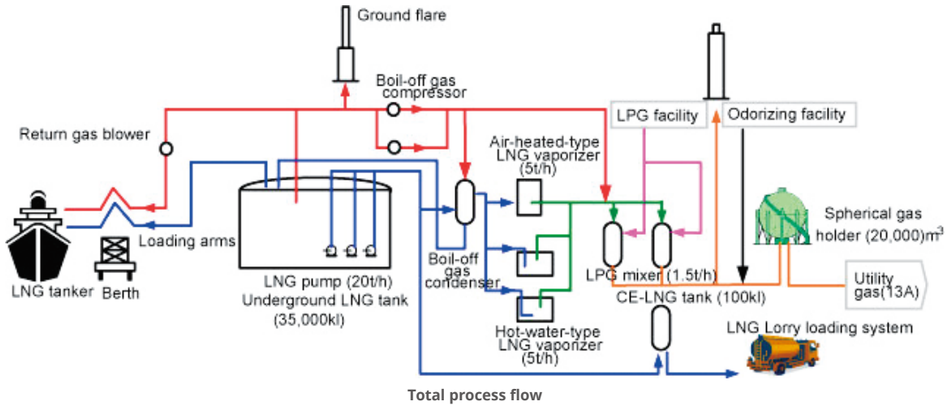
  Assigning controllers on a facility basis ensures each facility's independence, improving the reliability of the entire LNG terminal. For greater safety, high priority facilities have redundant controllers. Facilities with a redundant configuration employ a single CPU, eliminating extra investment for higher cost performance.

- **General-purpose communications network used for control bus**

  Controllers installed over a wide area spanning from the central control room (CCR) to the berth and shipping terminal communicate with each other through Ethernet and fiber-optic cables. The cost of the new system is reduced by using general-purpose network cables and equipment, and reliability is improved through the use of redundant control buses and repeaters.

- **Integrated operation environment through web-based HMI**

  A SCADA system with a web-based HMI enables the same operation to be performed at the CCR and the berth control room, which are 1 km away from each other and are connected by fiber-optic cables.



Total process flow

Saibu Gas Co., Ltd.

About Saibu Gas Co., Ltd.

Founded in 1930, Saibu Gas stably supplies gas to 16 cities and 16 towns (as of June 2007) in three prefectures of the Kyushu region. Its business operations can be categorized into:

- Production, supply, and sales of utility gas
- Heat supply
- LNG sales and cold energy utilization
- Production, sales, and installation of gas appliances, and related construction work

System Details

Controller: STARDOM FCN Autonomous Controller

HMI: STARDOM SCADA VDS

About the Nagasaki Works

The LNG receiving terminal at the Nagasaki Works was built in 2003 to facilitate the supply of gas to Nagasaki Prefecture. In this rugged and confined coastal area, Saibu Gas succeeded in designing and constructing a berth, regasification plant, shipping terminal, and other facilities that enable the stable supply of gas to 120,000 households in the Nagasaki area.

The Site Configuration

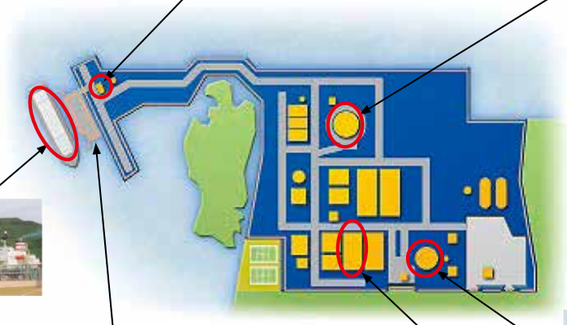
Berth control room (FCN autonomous controller)

Displays are mounted next to the controller in the berth control room to enable monitoring of the overall site status. A web browser displays the same information here and at the CCR, which is 1 km away.

As the HMI information is transmitted via the control bus, there was no need to install a separate network.

Underground LNG tank

The tank was built underground for aesthetic reasons. It has an internal diameter of 37 m and can hold up to 35,000 kl. As LNG is cooled to -162°C, the inside of the tank is lined with thermal insulation and a cold-resistant stainless membrane.



Berth

In late September 2003, the Nagasaki Works received its first shipment aboard the tanker Aman Hakata, which arrived from Malaysia with 18,800 m³ of LNG. This was the ship's first visit to Japan.

Gas holder

CCR

All LNG terminal functions including gas production and storage, maintenance, and disaster prevention are centrally controlled from the CCR. The two large displays give an integrated overview of operating status, making it possible to deal with abnormal incidents quickly and operate the terminal safely.

Loading arm

LNG is received through the on-shore piping, which is connected through these loading arms to the tanker moored at the berth.

Plant Information

- Location: Shanghai, China
- Order date: February 2008
- Completion: December 2009

Shanghai LNG Company Limited

Yokogawa Provides CENTUM CS 3000 and ProSafe-RS for China's Third LNG Terminal

Executive Summary

China is rapidly developing into a major global economic power. To succeed in its drive to be the center of manufacturing for just about everything, China has an ever growing need for energy. One of the big challenges is securing sufficient gas supplies for the next 25-30 years. Like the country as a whole, Shanghai is undergoing a transformation into a major global economic center. In January 2007 it was announced that CNOOC Gas and Power Limited, a subsidiary of China National Offshore Oil Corporation, had signed an agreement with Shenergy Group Limited for the development of the Shanghai LNG terminal by Shanghai LNG Company Limited (SHLNG). The LNG is transported from Malaysia to Shanghai, the economic hub of east China. This is the third LNG terminal in China, with the others being in Guangdong and Fujian. Its current gas production capacity is 3 million tons per year, and a second construction phase starting in 2011 will double that.
The Shanghai LNG terminal is comprised of an LNG dock, three 160,500 m^3 receiving tanks, regasification facilities, and a 40 km subsea gas trunk line to Shanghai.

Central control room

For this project, Yokogawa China successfully installed and commissioned Yokogawa's CENTUM CS 3000 distributed control system (DCS), ProSafe-RS safety instrumented system (SIS), STARDOM network-based control system, OmegaLand operator training system (OTS), Exaquantum PIMS, and PRM asset management system as well as systems from other vendors.

The Challenges and the Solutions

Safety

Safety is an absolute requirement for this LNG terminal. The ProSafe-RS SIS is fully integrated with the CENTUM CS 3000 DCS, providing operators a unified operating environment in which they can monitor all DCS and SIS loops from the same human machine interface (HMI).

The layout of the central control room is designed with safety in mind. The mimic panel consoles for the fire and gas system and the emergency shutdown system follow the same design. A large screen displays graphics of plant facilities as well as video from CCTV cameras, so operators can easily spot problems and take quick action. All systems throughout the terminal are integrated with the CS 3000 DCS, allowing the Exaquantum PIMS to gather and process data from nearly 1,500 processes and display this in 30 different management level screens that provide information on plant performance, gas demand scheduling, gas production, gas specification, and nomination & allocation.

For added safety, Yokogawa installed its OmegaLand OTS. This simulator is used by both new and veteran operators to acquire and brush up on essential plant operation skills.

Steady gas supply

Shanghai relies on this LNG terminal for 40% of its natural gas, with the remainder coming from the West-East Gas Pipeline and a coal gasification plant. The CS 3000 DCS is the terminal's main control system and its field control stations (FCS) are highly reliable, with an availability of more than 99.99999% (seven 9s). The pipeline delivering gas to Shanghai is accurately monitored and controlled using Yokogawa's STARDOM network-based control system and the FAST/TOOLS SCADA monitoring package. The terminal operates reliably around the clock, 365 days a year.

Maximum automation

A room with engineering workstations is located right next to the central control room to facilitate the efforts of SHLNG's engineers to automate the terminal's control loops. Currently more than 90% of the control loops have been automated, bringing tremendous benefits. SHLNG is now considering certain procedural changes that will yield additional improvements in this area, and is using the OmegaLand simulator to optimize each loop's control strategy.

Effective use of asset management system (PRM)

Before plant start-up, each loop was checked to make sure that wiring had been done correctly, signals were being correctly transmitted, field devices were healthy, and valves were responding accurately to controller output signals. By helping to accurately check all these functions, PRM made it possible to complete the plant start-up ahead of schedule. And by monitoring the status of all field devices and issuing an alarm to maintenance engineers when preset conditions are reached, PRM makes possible a proactive maintenance approach that significantly reduces total cost of ownership.

Engineering room (DCS/ESD/FGS displays)

Rack room (CENTUM FCS cabinets)

ProSafe-RS SIS

Customer Satisfaction

Li Wen, Director of SHLNG's Facility Equipment Department, said, "We completed the first phase of this project and are supplying gas to Shanghai every day without any problems. We supply nearly 40% of the gas used by Shanghai. It follows that this role of providing a stable gas supply is a very important one. We very much appreciate Yokogawa's highly reliable systems and products. We will continue to improve our operations and will work to make more effective use of the OmegaLand OTS, PRM, and Exaquantum. We plan on working with Yokogawa for a long time to come."

System Details

DCS:	CENTUM CS 3000 (I/O: 1,600 points)
ESD:	ProSafe-RS (I/O: 700 points)
Pipeline SCADA:	STARDOM (I/O: 600 points)
OTS:	Exatif & OmegaLand
PIMS:	Exaquantum (1,500 points of data on 30 pages)
Asset management system:	PRM
Fire & gas system:	GE-GMR (I/O: 1,200 points)
Fire & gas detector:	CCTV flame, gas detector, beacon, MAC, etc/
Large screen:	Planar

Plant Information

- Location: Stavanger, Norway
- Order date: 2009
- Completion: 2010

Skangass AS

Yokogawa's Integrated Solutions Contribute to Safe and Steady Production at Gas Liquefaction Plant in Norway

Executive Summary

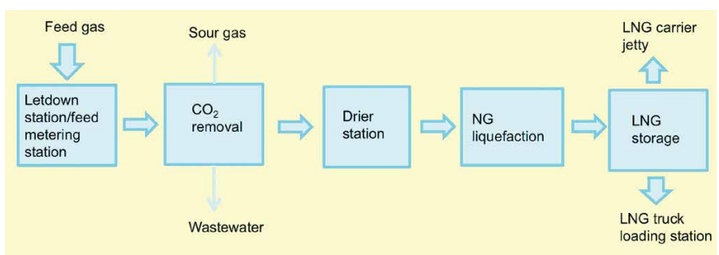
Skangass AS, a joint venture of Lyse AS and Celcius Invest AS, was established in 2007 with the aim of building and operating medium-sized low carbon emission energy plants. The company recently completed construction of a natural gas liquefaction plant at Risavika in Sola municipality that produces 300,000 tons of LNG per annum. The plant receives natural gas from a field in the North Sea via a 50 km high pressure pipeline from Kårstø that was built by Lyse.

This plant has all the facilities necessary for every phase of the natural gas liquefaction process, including CO_2 removal systems, a 30,000 m^3 storage tank, a coil wound heat exchanger is used as main cryogenic heat exchanger, a Linde multi-refrigerant cascade process, and utilities for the generation of electricity and steam. To ensure safe and efficient operations at this new plant, Yokogawa Europe successfully installed an integrated plant process control system consisting of a CENTUM VP distributed control system (DCS), FAST/TOOLS supervisory control and data acquisition system (SCADA), ProSafe-RS safety instrumented system (SIS), and Omegaland operator training simulator (OTS). The plant has been running smoothly since becoming fully operational in 2010.

The Challenges and the Solutions

OTS for familiarization of liquefaction processes and operator training

Skangass needed to avoid any delays in getting this new plant fully operational, and key to that was having all plant personnel fully trained right from the start of operations. For the first time ever, and in a team effort with Skangass, Yokogawa configured a full stimulation type operator training simulator for a gas liquefaction plant, employing the same safety and automation system (SAS) as the actual plant, with fully identical operational functions. This high fidelity model of the natural gas liquefaction process behaves exactly like the actual plant and allows plant upsets and equipment malfunctions to be simulated in a stimulative training environment. This makes it possible for operators at Skangass to undergo repeat training for a full range of situations.



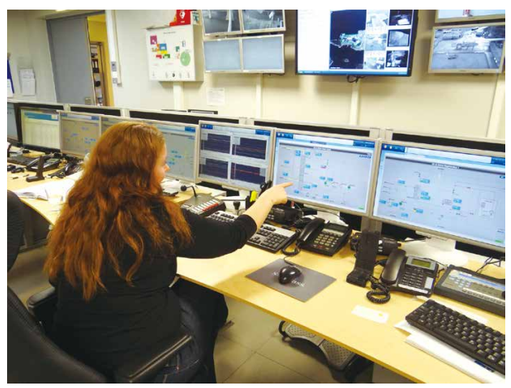
Plant process overview

System integration optimizes total plant operation

Key to maintaining safe operations is for the operators to know in real time what is happening throughout the plant. This has been made possible through the complete integration by Yokogawa of the plant's CENTUM VP DCS, FAST/TOOLS SCADA system, and ProSafe-RS SIS with other systems such as the tank gauging system. At their control stations, operators can easily call up and view trend chart, plant overview, alarm summary, and operation guide graphics, giving them the right information at the right time on processes throughout the plant.

For example, operators can confirm on screen the status and operating sequence for the plant's two drier absorbers, which alternate on a 24 hour schedule, with one unit operating and the other regenerating. To guard against thermal shocks during startup or shutdown, they also are able to monitor temperatures in the coil-wound heat exchanger, whose operation is key to the natural gas liquefaction process and which has been carefully configured in the CENTUM VP system. In real time, operators can monitor at their terminals remote terminal data that has been transferred via a general packet radio system link to the Yokogawa FAST/TOOLS SCADA system in the main office, contributing to the overall efficiency of the Skangass facility and ensuring increased safety and stable production.

With this integrated system, a single operator per shift can control the entire plant from the central control room.



One operator per shift in the central control room

GC1000 for LNG analysis

Yokogawa GC1000 gas chromatographs sample the LNG components and transfer their readings to the CENTUM DCS. With this data, operators are able to adjust production specifications to meet the requirements of the company's LNG storage terminal customers throughout Scandinavia.

ROTAMASS for coolant flow measurement

A Yokogawa ROTAMASS Coriolis mass flowmeter is used to measure flow in the lines that supply coolant to the plant's refrigeration facility. Operators have come to depend on its high accuracy and stability for determining whether sufficient coolant is being provided.

Customer Satisfaction

Roy Kenneth Skar, Operation Team Leader, said, "Yokogawa has strong experience in LNG processes, and their engineers understand our process. The project execution was done by engineers from Skangass and Yokogawa. The OTS really helped us to know the process. We are very satisfied with Yokogawa's systems for our liquefaction plant. Though our liquefaction rate is still a small portion of total gas supply from the North Sea gas field, we are expanding this LNG business continuously to meet market demand. A constant and steady operation and plant availability are mandatory to expand our business."

Mr. Skar

Plant Information

- Location: Rayong, Thailand
- Order: 2010
- Completion: 2011

PTT LNG Company Limited

DCS, SIS, PRM, FOUNDATION™ Fieldbus instruments, and OTS Installed at Thailand's First LNG Terminal

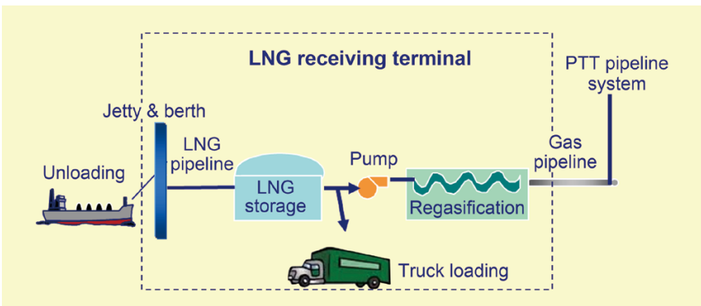
Executive Summary

Natural gas is Thailand's primary fuel source and is absolutely essential to the country's industries, particularly the power sector: two third's of the country's electricity is generated at gas-fired power plants. Much of Thailand's natural gas comes from gas fields in the Gulf of Thailand. It is transported throughout the country via a network of offshore and onshore pipelines built by the national gas and oil company, PTT Public Company Limited (PTT PCL). In 2005, due to economic growth and the resulting shortfall in the supply of natural gas, the country's National Energy Policy Board resolved to begin importing LNG.

In anticipation of this policy shift, PTT PCL established PTT LNG Company Limited (PTTLNG) in 2004 and tasked it with building and operating the country's first LNG import terminal at Map Ta Phut, a deepwater port 220 km southeast of Bangkok. They send out gas to the adjacent Map Ta Phut industrial estate, which is one of Thailand's most important industrial areas and home to a number of petrochemical, oil refining, steel, and fertilizer plants. Gas also be transported via the PTT pipeline system to power companies and other important industrial customers throughout the country.

Construction of the first terminal commenced in early 2008 and was completed in 2011, and the terminal began commercial operation later that year when it received its first shipment of LNG from Qatar. This terminal includes a jetty capable of receiving LNG carriers with capacities up to 264,000 m^3, two 160,000 m^3 full containment LNG tanks, a 5 million ton/year regasification (vaporizer) train, a boil-off gas recondensor, a sendout station, and an LNG pump.

To control key terminal facilities, PTTLNG went with a Yokogawa solution consisting of the CENTUM VP production control system, ProSafe-RS safety instrumented system, OmegaLand operator training system (OTS), asset management package - Plant Resource Manager (PRM), and FOUNDATION™ Fieldbus field digital technology. Work on this project was executed by Yokogawa, which functioned as main automation contractor (MAC).



PTT LNG terminal overview

The Challenges and the Solutions

Safe, uninterrupted operations

Customers all over the country rely on receiving a regular supply of gas from this LNG import terminal, which operates 24/7. It is thus absolutely essential to prevent any shutdowns or other problems that would interrupt this supply. A key asset that makes this possible is the OmegaLand OTS. In preparation for the arrival of each LNG carrier, operators in the central control room (CCR) run simulations of all key terminal processes such as offloading and regasification on the OTS. This reduces the likelihood of any mistakes and ensures smooth and safe terminal operations.

While configuring this fully integrated control system solution for PTTLNG, Yokogawa strictly followed the following safety standards:

- NFPA59A (National Fire Protection Association) standard on production, storage, and handling of LNG
- EN1473 (European Norm) standard on onshore installation and equipment design for LNG
- SIGTTO (Society of International Gas Tanker and Terminal Operations Limited) operating standard and best practices for gas tanker and terminal operations

Once all personnel are all fully trained and gain sufficient experience in operating this terminal, the plan is for it to operate with just six personnel on each 12 hour shift: one supervisor, one board operator, and four field operators.

Asset maximization

The transmitters, flowmeters, and control valves throughout this terminal are all FOUNDATION™ Fieldbus enabled and can be continually monitored using the PRM solution. Alarms are issued before any device fails completely, enabling predictive maintenance that reduces maintenance costs throughout the facility lifecycle. The complete integration of all systems including those at the jetty substation, laboratory, fire station, and truck loading administration room as well as 10 other subsystems via Modbus communications allows operators at the CENTUM human interface stations (HIS) in the CCR complete real-time access to information on operations throughout the terminal. This ensures that they have all the information needed to make the right decisions at the right time. PTTLNG is thus able to make maximum use of all of this terminal's assets.

Effective operator training

As this LNG import terminal is the first of its type in Thailand, it is absolutely essential from the safety and efficiency standpoints for its operators and engineers to always be fully trained on all system operations and procedures. By using the OmegaLand OTS for its operation familiarization training programs, PTTLNG is able to give its personnel repeated training for a full range of operational procedures as well as all situations that they can expect to encounter while operating and maintaining this terminal.

Quality control

Quality control is also essential at this terminal. The results of gas quality analysis and all associated data are entered into the laboratory instrument management system (LIMS) server in the laboratory room and all data are transferred to the CENTUM system, which generates a laboratory report allowing each operator to confirm their operating procedures and make any required adjustments to maintain high quality production.

Truck loading

A portion of the LNG arriving at this terminal is transported in trucks to local LNG terminals. A terminal automation system (TAS) keeps track of all essential custody transfer data such as the truck number, destination, LNG amount, date and time, and customer name, and this data is all recorded and fed back to the production control system. So operators can recognize the total LNG amount versus gasification amount and they can easily visualize the total efficiency of this plant.

LNG import terminal

Central control room

Plant Information

- Location: Hazira, Gujarat, India
- Order date: September 2012
- Completion: March 2013

Hazira LNG Private Limited

Legacy ProSafe-PLC SIS Replaced with ProSafe-RS to Improve Sustainable Lifecycle Support at LNG Terminal

Executive Summary

Hazira LNG Private Limited (HLPL), a joint venture between Shell Gas B.V. and Total Gaz Electricite Holdings, operates an LNG receiving terminal in Hazira, which is a major port and industrial hub in India's Gujarat state. Commissioned in 2005, the terminal has two 160,000 m^3 storage tanks along with re-gasification and auxiliary facilities that are capable of handling 3.6 million tons of LNG per year. This is the first LNG terminal in India to be built by global energy companies.

A 22 km pipeline connects the Hazira terminal to the national gas grid at Mora Station. The pipeline has sectionalizing valve (SV) and LNG custody transfer metering (CTM) stations that are located 4 km and 14 km from the terminal, respectively.

The control systems for the Hazira terminal are installed in its main control room (MCR), which handles all re-gasification processes and utilities, and at the jetty facility, where arriving LNG carriers are unloaded.

Original configuration

The Hazira terminal's process, utility, jetty, and pipeline operations were all originally automated with a Yokogawa CENTUM CS 3000 process control system (PCS), a ProSafe-PLC safety instrumented system (SIS) with emergency shutdown (ESD) and fire and gas detection (F&G) functionality. The ProSafe-PLC was connected to the PCS via a MULCOM multiple protocol communication interface unit, an M-net bus (SIS control bus), and a V net bus (PCS control bus), with all these systems sharing the same human machine interface (HMI).

New configuration

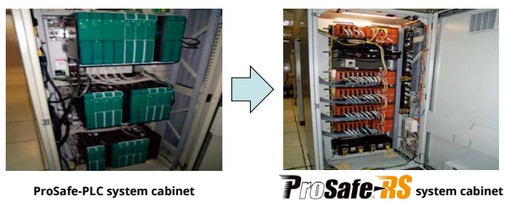
As the legacy ProSafe-PLC system was costly to maintain and was reaching its end of support date, Yokogawa India proposed that HLPL upgrade to Yokogawa's latest SIS offering, ProSafe-RS. After considering the merits of adopting the latest hardware and software, which included the use of a single control bus for all terminal facilities, the seamless use of the same HMI for both PCS and SIS, and improved safety and integrity, HLPL opted to go with Yokogawa India's migration proposal.

The Challenges and the Solutions

Migrating application logic while keeping existing engineering philosophy

HLPL was specific in its requirement that the ProSafe-RS system had to retain the same engineering philosophy used with the ProSafe-PLC system. HLPL also insisted that the migration project should leverage the latest advances achieved in the ProSafe-RS system software blocks.

Yokogawa's PLC2RS tool for converting from ProSafe-PLC to ProSafe-RS applications proved to be extremely effective in fulfilling the client's requirement to retain the essential engineering features of the terminal's existing systems. The base application output by the conversion tool implemented all the latest features of the ProSafe-RS software. The engineering output was a perfect blend of the original engineering philosophy and the latest software features, and engineering time was drastically reduced.



ProSafe-PLC system cabinet

ProSafe-RS system cabinet

Network migration and integration with existing components

The key point was the need to replace just the SIS (ESD & F&G) while keeping the existing PCS and F&G mimic panel as is. This involved the removal of the MULCOM interface unit and ProSafe-PLC components and their replacement with ProSafe-RS components on a Vnet/IP control bus. To enable the use of the existing PCS network (V net), Yokogawa India installed an AVR10D V net router.

The most challenging aspect of this migration was the software, which included special logic on the PCS for controlling the MULCOM interface unit. To reduce network load, Yokogawa India conducted a thorough investigation and was able to remove this logic without impacting the PCS logic.

In addition, the MULCOM interface unit had ISA-F3A alarm indication logic for the F&G mimic panel.
All of this functionality was successfully embedded in the ProSafe-RS system, and HLPL continues to use the mimic panel as an operation interface.

Continued operation of BOG and MSO compressors during migration

For the project execution phase, HLPL inquired whether it would be possible for safety reasons to continue operating two boil off gas (BOG) compressors and a minimum send out (MSO) compressor. Yokogawa India took up this challenge in spite of the fact that the running/trip logic for this equipment resided on the existing ProSafe-PLC system, which needed to be disconnected as part of the migration. The company offered an innovative workaround by implementing this logic on a stand-in ProSafe-RS system that was temporarily hooked up to the existing PCS for the duration of the migration process. Following the completion of all migration activities, the data on the stand-in system was merged with that on the main ProSafe-RS system.

Exhaustive planning coupled with clinically perfect execution helped Yokogawa India meet this client's demanding requirements with a minimum of disruption to terminal operations. As a result, both the BOG and MSO compressors were able to continue operating throughout the migration process.

Maintaining the same hardware footprint

Given the limited amount of space available in the control and rack room, HLPL stipulated that the ProSafe-RS system must have the same footprint as the system that it replaced. It was indeed a challenge to fit the ProSafe-RS terminal boards into this space without compromising Yokogawa's high engineering standards.

Customer Satisfaction

Yet another primary criterion for this migration project was the need to complete the entire migration during a planned eight day shutdown. This was not an easy task considering the fact that Yokogawa India had to migrate the entire SIS at the main control room and jetty, and hook this up with the original PCS.

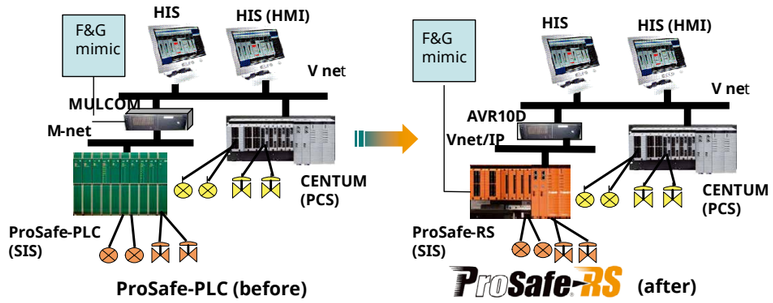
Thanks to the integration of the PCS and SIS, HLPL personnel are now able to use the same HMI for the PCS and SIS to operate the entire terminal. All the faceplates and other operation displays have the same design. This helps to eliminate operator errors and allows HLPL's engineering team to use the same engineering environment to make configuration changes to the PCS and SIS, reducing both engineering workload and maintenance costs.

A key factor in the success of this project was the micro level planning for the site erection and commissioning activities and the clear definition of roles and responsibilities for each member of multilevel teams that worked round the clock.

As a testimony to Yokogawa India's success in this endeavor, HLPL offered the following generous praise:

"The Yokogawa team performed the engineering, design, pre-FAT, and FAT so well that the site installation and commissioning were flawlessly completed. This was an important aspect in ensuring that the installation and commissioning were completed by the targeted completion date. The team's excellent knowledge and commitment were also visible in pre-shutdown activities, where many activities had risks of manual errors that could cause a process shutdown; however all these activities were completed impeccably."

"The project was very challenging as it had to be completed in eight days and had to be integrated well with other HLPL shutdown activities. The Yokogawa team's meticulous planning and flexibility in making necessary schedule changes helped a lot in preventing conflicts with other concurrent shutdown activities. Yokogawa India's customer focused approach is highly appreciated."



OpreX™ Yokogawa achieves operational excellence by providing products, services, and solutions based on the OpreX comprehensive brand that cover everything from business management to operations.

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