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The clear path to operational excellence

VigilantPlant is Yokogawa's automation concept for safe, reliable, and profitable plant operations. VigilantPlant aims to enable an ongoing state of Operational Excellence where plant personnel are watchful and attentive, well-informed, and ready to take actions that optimize plant and business performance.

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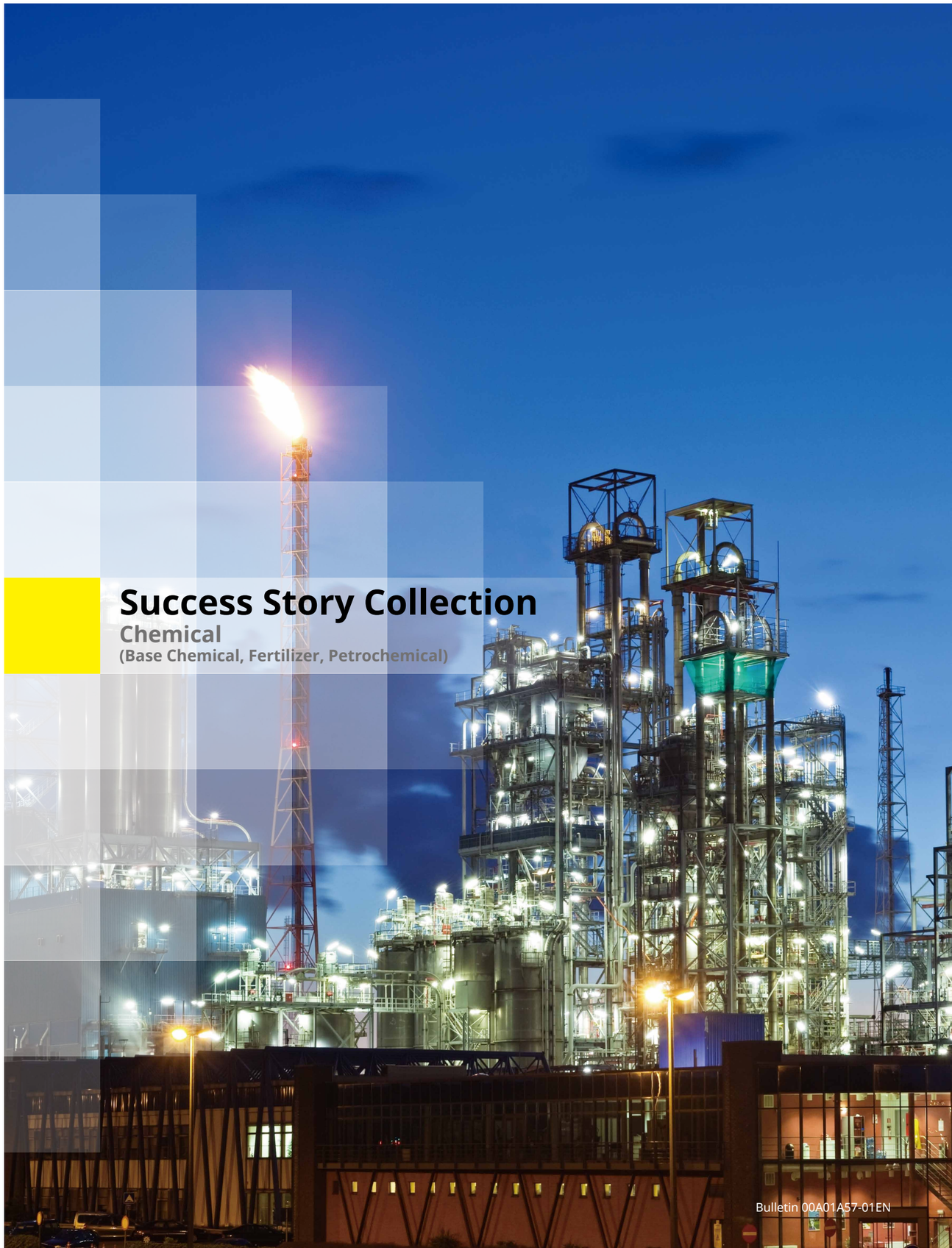
YOKOGAWA

Co-innovating tomorrow™

YOKOGAWA



Success Story Collection

Chemical

(Base Chemical, Fertilizer, Petrochemical)

Bulletin 00A01A57-01EN

Success Story Collection

Chemical

(Base Chemical, Fertilizer, Petrochemical)

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

The clear path to operational excellence

Envision a plant where people are watchful and attentive while your business responds to change quickly and efficiently. Now picture an operation that delivers non-stop production while confidently expanding your capabilities into the future. Imagine no further. This is the vision and promise behind VigilantPlant, the clear path to operational excellence.

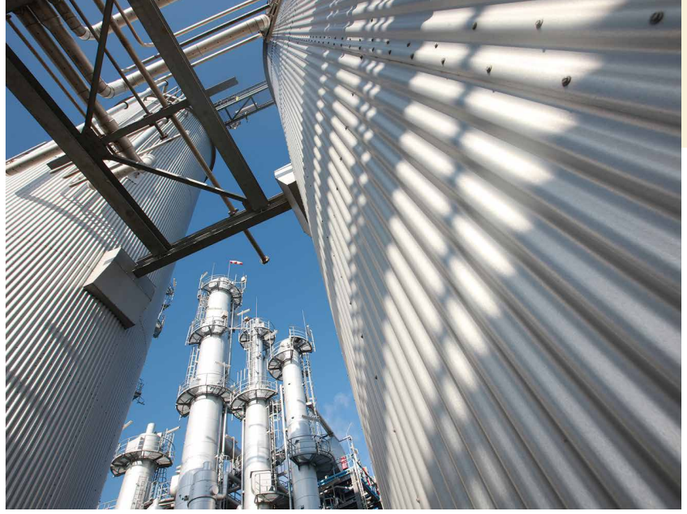
Making critical plant information fully visible is just the beginning of the vigilant cycle.

Seeing clearly gives you the knowledge necessary to anticipate the changes required in your process. Knowing in advance brings you the speed and flexibility to optimize your plant in real time. And by acting with agility, you are able to adapt to the ups and downs of your business environment.

VigilantPlant excels at bringing out the best in your plant and your people - keeping them fully aware, well informed, and ready to face the next challenge.

Contents

Chemical
(Base Chemical, Fertilizer, Petrochemical)



Plant Information

- Location: Marl, Germany
- Order date: October 2011
- Completion: November 2012

Evonik Industries

Carefully Planned Modernization of Control Systems Makes Chemical Shipping Terminal Fit for the Future

Executive Summary

The Marl Chemical Park is a fully integrated site that is one of the largest of its kind in Europe. Operated as part of the ChemSite Initiative through a partnership between the public and private sectors, this 650 hectare (6.5 km²) site is home to 30 major chemical companies such as Evonik Industries, Sasol, Rohm and Haas, and Vestolit that operate approximately 100 chemical plants here. Pipelines and rail, road, and water transportation links are used to bring in basic feedstocks such as ethylene and propylene, and a newly upgraded Vestolit chlor-alkali facility produces feedstock for the company's own vinyl production chain as well as chlorine that is supplied to other users at the site. Altogether, more than 4,000 different types of chemicals are produced at the Marl Chemical Park, ranging from high volume materials such as styrene, polystyrene, 1-buten, acrylic acid, ETBE, and PVC to speciality products like polyamides and polyesters, plasticizers, surfactants, elastomers, and latices.

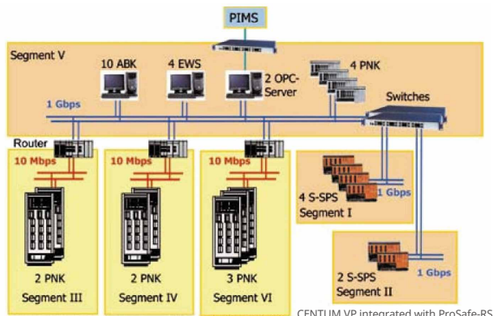
Each year, a total of 4 million tons of chemicals produced at the site are shipped to customers all over the world, with approximately 400,000 tons going out by rail, 2.4 million tons by road, 900,000 tons by water, and 300,000 tons by pipeline. Overseeing all of these operations is Evonik Site Services, the site operator and service provider. The company employs some 3,400 people who tend to the site's railway, port, pipeline, storage, and other logistics facilities as well as such mission critical infrastructure as power stations, water treatment facilities, and incinerators.

The company continues to improve and add to these facilities, and recently completed the construction of a major multi-story warehouse that will serve all of the companies with operations at the site. It is also currently improving the site's harbor facilities by adding an extra barge berth and upgrading the automation systems that control operations throughout this facility. This has been necessitated by the rising use of automation in the facility's operations and the increase in volume of information that must be handled. Widespread vertical integration of the control and manufacturing execution systems is another factor resulting in the need for the transfer of more data. Even though the systems at this facility are relatively modern, they already are operating at the limits of their capacity after just a few years of use.

As part of these improvements to the site's harbor facilities, Yokogawa Germany has upgraded the existing CENTUM CS 3000 system to CENTUM VP and replaced the legacy safety instrumented system (SIS) with ProSafe-RS. This SIS is fully integrated with CENTUM VP. In addition, the company has installed the latest version of the Exaquantum plant information management system (PIMS).

The Challenges and the Solutions

In the past, the control system for the harbor facilities was arranged in two coupled segments, the components of which were connected by means of a system bus with a capacity of 10 megabit/s (Mbps). Installed back in 1999, the old bus system was no longer adequate to meet the demands arising from technology changes such as the increase in computing power and memory capacity in the field control stations (FCSs) and the safety programmable logic controllers (PLCs). The system had reached the limits of its performance.



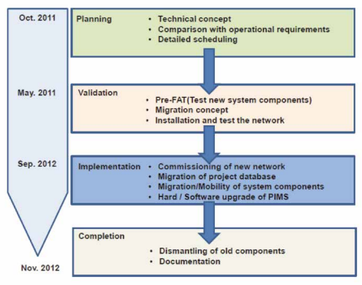
Overall system configuration

CENTUM VP integrated with ProSafe-RS
ABK = human machine interface
PMK = field control station
SPS = safety control station

As part of a comprehensive modernization project, the existing bus architecture was replaced with an Ethernet based, star topology, gigabit fiber optic network with six branches linking all the site's most important control rooms. All in all, more than 10 km of fiber optic data lines were laid for this purpose. The SIS, which is split between segments I and II, was connected via another gigabit bus to the header segment (segment V) containing all human interface functions. Since there was no change in the allocation of segments for the safety PLCs, only minimal modifications were necessary. Segments III, IV, and VI were each hooked up to the header segment via a 10 Mbps bus and a router, and their routers were connected to either two or three FCSs. With the distribution of data traffic over three separate 10 Mbps buses, capacity was significantly increased. In line with these changes, each of the existing FCSs was given a new, more powerful CPU and the central memory was doubled to 32 MB. In addition to the cost gains from not having to replace the FCSs, this made the modernization work much easier. In addition, well over 90% of the I/O channels could be reused as is in the new system.

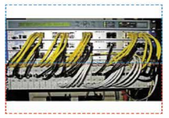
The final change made to the system was the upgrade of the Exaquantum PIMS hardware and software. To prevent the loss of data, a step-by-step approach was adopted whereby the old and new systems were connected to an OPC server and operated in parallel for an interim period.

The modernization of the control system was actually carried out over a 15 day period between mid-September and November 2012. The work was based on a precisely formulated roadmap with detailed checklists for every control cabinet, process station, and network component. The preparation phase was very intensive, because Yokogawa wanted to keep the conversion time as short as possible. Among other things, the whole fiber network was installed and meticulously tested upfront. Most of the new hardware components had already been checked and pre-configured at Yokogawa. Furthermore, their interaction during the conversion and migration was simulated there before the systems were transported to their place of use. This pre-FAT (factory acceptance test) turned out to be rather complicated, but it helped in the detection and correction of technical defects and planning errors at an early stage, and saved a lot of time later on. Seemingly simple engineering measures can sometimes help things run much more smoothly. For example, patch panels for segments I, II, and V were installed on the gigabit bus downstream from the network switches, and were then fully wired up to the FCS and safety PLC DIN rail patch sockets and tested.



Modernization project phases

Patch panel rear JR3



Patch panel front

ProSafe-RS

All that remained to be done during the subsequent conversion was to remove and insert short cable segments in the ports of these sockets – with no tangled cables and no risk of wiring errors that could have resulted in substantial delays to analyze and repair faults. It ultimately took less than an hour to port all of the field control stations in this way.

Customer Satisfaction

Dr. Arndt Glowacki, manager of the harbor and storage facilities in Marl, sums up: "Everyone who contributed to the project was totally satisfied with the outcome. I had high expectations of Yokogawa – after all, our experience of the company from previous projects was very good. And thanks to the formidable quality of the concept and the preliminary work, I wasn't disappointed! In particular, that says a lot about the excellent cooperation between all stakeholders."

Thomas Bagsik, manager of Technical Services for Evonik Industries' harbor facilities, set out his top priorities for this project: "Serving our customers by ensuring the availability of our facilities is always my number one goal. That's why we plan continuously to meet future needs. The modernization of our production and process control system is a key pillar in our efforts to reliably handle the steadily growing volume of information. The solution also has to remain affordable, of course."

He continues: "By discussing things and designing and planning together, we know the workflows at our company better than anyone else. We're also in a position to assess the business risks realistically. We need to communicate this information to our automation partner in a structured way if we want everything to run like clockwork later. In my opinion, the ideal partner for a project of this kind is a system supplier that is thoroughly familiar with the hardware and software and also possesses the necessary engineering expertise. At the same time, it makes a huge difference to the teamwork if people already know each other: they're no longer afraid to speak their minds and they have no inhibitions about placing their trust in the other team members."

Plans are already in the pipeline for the next evolutionary step in the automation of the harbor facilities: a new production management system will automate many of the tank logistics processes to an even greater degree, enabling procedures to be standardized and best practices implemented. The harbor facility managers are hoping this new project will benefit them in the form of increased efficiency. One example of this would be higher transhipment volumes with no extra burden on staff. Once again, Yokogawa has been selected to oversee this work.

Mr. Bagsik (left), with Thomas Schindler of Yokogawa Germany

Chemical
(Base Chemical, Fertilizer, Petrochemical)

Plant Information

- Location: Rayong, Thailand
- Order date: October 2007
- Completion: October 2008

SCG Chemicals

CENTUM CS 3000 Production Control System Contributes to Smooth HDPE Production

Executive Summary

SCG Chemicals is a subsidiary of the Siam Cement Group (SCG), Established in 1913, SCG Chemicals is one of the Group's five core businesses, the others being paper, cement, building materials, and distribution. SCG entered the chemicals business in 1989 and, at present, SCG Chemicals manufactures and supplies a full range of petrochemical products, including upstream petrochemicals such as olefins; intermediate petrochemicals such as styrene monomer, PTA, and MMA; and downstream petrochemicals such as polyethylene, polypropylene, polyvinyl chloride, and polystyrene resin. SCG Chemicals is now one of the largest integrated petrochemical companies in Thailand and is a key industry leader in the Asia-Pacific region.

SCG Chemicals has a high density polyethylene (HDPE) plant in Rayong that produces 200,000 t/y of this petrochemical, which is supplied only to the domestic market, centering on the automobile industry. As this HDPE plant uses a legacy Foxboro I/A Series control system that is longer supported by Foxboro, SCG Chemicals decided to replace this with a Yokogawa CENTUM CS 3000 Integrated Production Control System. Engineers from Yokogawa Thailand worked closely with their SCG Chemicals counterparts to complete this replacement project.

The Challenges and the Solutions

The challenge for this replacement project was in completing the work and starting up the new CS 3000 system as soon as possible, keeping downtime to a minimum. Working together, the SCG Chemicals and Yokogawa Thailand project teams completed the wiring for approximately 2,000 I/O points, reconnected them to new field control station cabinets, and carried out two site acceptance tests (SAT) in just a nine-day period. The start-up progressed smoothly and the work was flawless. A Modbus communications link was established between the CS 3000 and an existing TRICONEX safety system, making it possible for operators to monitor data from the safety system at the CENTUM system's terminals.

SCG Chemicals' plant operators have appreciated the following improvements that have been achieved with the new CS 3000 system:

- SCG can now easily insert guidance messages that appear in the graphic displays, making it clear for operators what they must do in each operation phase. This helps them clearly confirm each important step of an operation.
- The system's CALCU block automatically performs complex tank volume calculations and outputs reports, saving operators considerable time and effort.
- Parameters for each PID control loop can be easily set by engineers, speeding up the control loop tuning process.
- Data can be automatically output each day in Excel spreadsheets, saving operators considerable time.
- Exaplog alarm collection and analysis eliminates spurious alarms and helps operators work more efficiently.

Human machine interface SAT in main control room

Field control station SAT in rack room

Customer Satisfaction

Pornwit Rattanawijit, the Control Pool Service Section Manager for SCG, said, "We are very happy with Yokogawa's DCS and service support. The most important thing is that the system has a high reliability. We appreciate that its availability exceeds seven 9s. We can operate this plant smoothly without any major system failures. Now we are considering the use of Exapilot to automate the plant startup, shutdown, and other processes to improve quality and efficiency. We are happy to be working together with Yokogawa Thailand."

Project team members at Yokogawa's Rayong office

Chemical
(Base Chemical, Fertilizer, Petrochemical)

Plant Information

- Location: Duque de Caxias/Rio de Janeiro, Brazil
- Order date: December 2006
- Completion: April 2009

NITRIFLEX

Introduction of CENTUM CS 3000 Maximizes Productivity and Improves Product Quality at Special Polymer Plant

Executive Summary

Nitriflex, a Brampac Group company, was founded in 1971 and has its headquarters in Rio de Janeiro. A major supplier of special polymers and nitrile rubber with a wide range of products, the company has made a name for itself on the international market.

Nitriflex's plant was controlled by board instrumentation and legacy PLC/SCADA systems. To improve automation of its production processes, Nitriflex decided to upgrade to the CENTUM CS 3000 distributed control system (DCS). The reasons for this were as follows:

- Upcoming projects required the handling of more complex data, improved quality assurance, and reduced costs and risks, with minimal human intervention.
- Various technologies ranging from pneumatic instrumentation to PLC and SCADA systems were in use throughout the plant. In addition to having different control philosophies, these systems could not communicate with each other.
- The registration and control of data was essentially a manual process, compromising traceability, process monitoring, and management.
- Cycle times were long due to the high reliance on manual operations.
- Competitiveness was negatively impacted by quality issues resulting from high variability in critical process variables.

Nitriflex established clear targets before starting this modernization project.

- Improve product quality and process variability by reducing the inherent process oscilation due to the utilization of conventional instrumentation.
- Reduce operating cycles by using automatic sequencing between steps, eliminating dead time.
- Optimize development, operation, maintenance, and engineering activities and make more effective use of resources by ensuring real-time access to precise data.
- Integrate production and business management by delivering information on production, inventories, raw materials, cycles, etc. to executives and providing relevant corporate data on production planning, logistics, and other items to the people on the factory floor.

Project Overview

- A multidisciplinary project team with personnel from production, engineering, maintenance, and technology R&D was established to define project targets and objectives.
- A preliminary automation master plan for the technical backbone was drawn up that specified the technology, architecture, number of I/O points, I/O interfaces, communication protocols, legacy system interfaces, and so on.
- The project phases and the goals for each phase were defined.
- A techno-economic feasibility study analyzing the return on investment was carried out by Yokogawa Brazil, with the support of Nitriflex.
- Yokogawa Brazil was selected to provide a turnkey CENTUM CS 3000 DCS solution based on Nitriflex's specifications.
- A PIMS tool was introduced to support 6-Sigma methodologies.

Feasibility Study

After extensive information gathering on site, Yokogawa Brazil recommended an approach that focused on using automation to improve the company's competitiveness by reducing process variability (improving product quality) and making better utilization of critical raw materials (increasing yield).

Phased Implementation Strategy

Based on a prioritization of strategic issues that included the need to reduce process variability, achieve greater competitiveness, and lower costs by increasing production efficiency, the decision was made to conduct the project in the following phases:

1st phase - Monomer recovery: Optimizing process conditions to more efficiently recover all residual monomers from polymerization reactions and class A raw materials for this process.

2nd phase - Polymerization: Includes the full automation of solution preparation and reactor loading (automatic recipes) and optimization of the polymerization conditions (cynetic control) to improve quality and reduce cycles. This phase is scheduled to be completed in March 2011.

3rd phase - Advanced process control implementation: Inference and control of polymer quality variables such as conversion, composition, and molar mass. The main objective is to reduce the variation in the value of highly-aggregated-value polymers. Other objectives include improving productivity and reducing residual emissions to the environment.

Results

A major improvement as a result of this project is that butadiene monomer recovery efficiency jumped from 76% to 98%. The estimated benefit to Nitriflex is US$2 million per year.
In addition, there were the following benefits for Nitriflex:

- Environment: A remarkable reduction (near complete elimination) in residual monomer emissions into the atmosphere and a reduction in liquid effluents through the installation of a collection system.
- Safety: Improved monitoring and control systems ensure a safe and timely response to changes in process conditions and reduce the likelihood of human error by eliminating the need for direct operator intervention.
- Agility:Shorter production cycles allow a more agile response to shifts in demand and greater stability in product quality ensures increased flexibility in production scheduling.
- Intermediate stocks: The increased production capacity makes it possible to keep less intermediate stocks, improving the balance among all production areas.
- Process variability: The reduced need for direct operator intervention reduces process variability.
- Speed: The use of PIMS and other special tools to distribute real-time production information to sales, planning, engineering, and other functions throughout the company speeds up its operating and commercial activities.

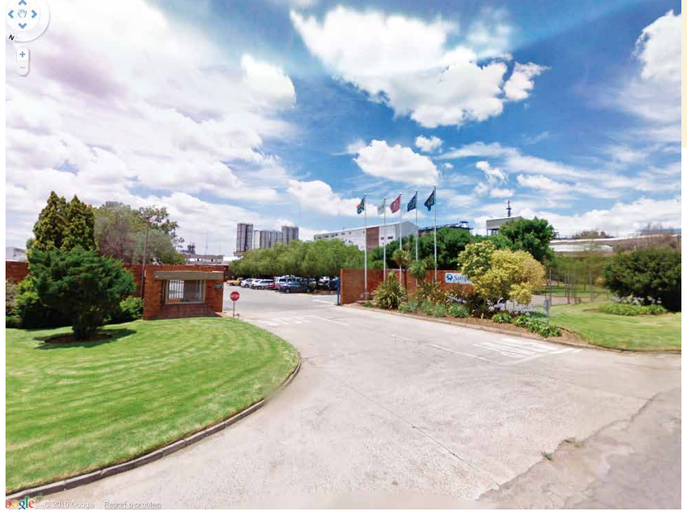
The central control room before

The central control room today

Customer Satisfaction

Luis Carlos
senior process engineer

Speaking about this project, Luis Carlos, senior process engineer for Nitriflex, says, "We are very happy to be using Yokogawa's CENTUM CS 3000 to improve production. To meet the requirements of end users and compete in the global market, we will increase the agility of our production activities and improve product quality." He went on to say, "We are always thinking about sustainable manufacturing, and for this we need a strong partner like Yokogawa."



Plant Information

- Location: Sasolburg, Dorset, South Africa
- Order date: March 2005
- Completion: March 2007

Safripol

First STARDOM Controller in South Africa Revitalizes Integrated Compressor Control System

Executive Summary

This compressor control upgrade project for a polymerization plant operated by Safripol. in Sasolburg, South Africa, is a showcase of Safripol and Yokogawa's integrated control philosophy. Here, a single control room concept was followed in the integration of an existing Yokogawa CENTUM CS (DCS) for core process control with a fast STARDOM Network-based Control System (NCS) for high-speed compressor control.

According to Mike Dukas, a process control engineer at this plant, "Making use of Yokogawa's different control platforms having unique specifications but the same well known 'look and feel' operator interfaces allows us to avoid extensive operator training, yet provides both the right control philosophy on the plant floor and makes use of the existing management information software tools."

Through this project, Safripol achieved:
- A single 'look and feel' operator interface for the DCS and NCS
- A fast and controllable integration cycle
- A high speed hybrid compressor control solution
- A reduced OPEX for the compressor operation by replacing old and obsolete PLCs with a modern hybrid control platform.

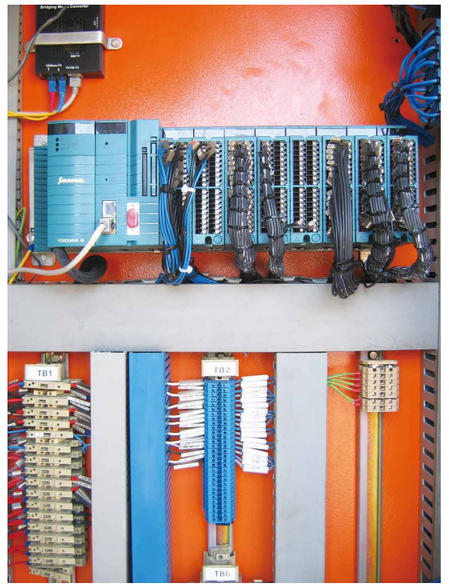
Mr. Dukas: "When we decided to replace the obsolete PLCs in the package units (for compressor control, propylene, ethylene and nitrogen), the following criteria were considered:
• Reliability
• Back-up service
• Cost
• Ease of programming
• Ease of communication with the DCS
• Ease of future expansion
• Ease of inter-communication and integration with other PLCs
• Self documentation and ease of maintainability
We felt STARDOM met all of the above criteria– and the decision was then taken to purchase and install the first STARDOM network-based controller in South Africa."

About the Project

The project was initiated to replace the existing PLCs with new technology that will be able to communicate with the Yokogawa CENTUM CS DCS via Ethernet. A total of four package units will be converted over the next few years. The first and second units, PK301 and PK401, are already in operation. The third unit , PK601, will be installed during a scheduled shutdown in March 2007. All units will communicate via a Yokogawa gateway unit to the DCS.

Central control room

Compressor



STARDOM unit

The Challenges and the Solutions

One of the objectives of Safripol was to avoid operator interference as much as possible in order to reduce costs and guarantee that processing could continue undisturbed after switchover. By making use of a STARDOM hybrid controller, a single 'look and feel' operator interface could be established, enabling the continued use of the DCS software and hardware while maintaining the PLCs' high-speed process response.

The second challenge faced was the criticality of the compressors in the process. Stopping the compressors meant losing money. A tight changeover schedule and accurate pre-testing was essential.

"The changeover was virtually bumpless. Besides the planned mini-shutdown time, we did not experience any additional downtime. The first controller has been running now for over a year without any problems," Mr. Dukas explained. "The first STARDOM unit was installed with the help of Yokogawa South Africa and, due to time pressure, this was done without official training. Programming the controller was done with remote assistance from Yokogawa SCE in the Netherlands and Japan. The changeover took place without any failures or plant delays and was well within the planned time and budgets. More units will be placed during the course of 2006, eventually replacing all existing compressor control systems with Yokogawa's STARDOM."

The third objective was to make sure the new compressor control system was easy to program and maintain. This allows future expansions and modifications as well as the installation of additional units. According to Bennie Coetzer, a process control engineer at the polymerization plant, "Even without training on the system, it is simple to find your way and start with the first steps of programming. After a 3 day training course one really feels the power and flexibility of the STARDOM system. Working with Yokogawa equipment gives me great satisfaction, because I know that if I need a solution, it only takes a phone call and the response is immediate."

"The old saying still applies, you cannot control what you cannot measure. But to get all these signals to and from the DCS using old technology, cabling, and junction boxes costs a lot of money. We decided to keep costs down by using modern technology that met all our requirements. A lot of options and product combinations were evaluated and STARDOM with Ethernet communication came out to be the best for our business," said Mr. Dukas.

About Safripol (Pty) Ltd. Safripol Polypropylene Resins

Safripol (Pty) Ltd. offers an extensive line of traditional polypropylene resins to a wide variety of markets including automobiles, consumer durables, rigid and flexible packaging, health and hygiene, compounding, and fibers. Safripol's resins deliver an optimal balance of price and performance, while covering a wide range of product applications in the areas of film, injection and blow molding, sheet extrusion, and thermoforming. Safripol's resin line includes homopolymers for stiffness, impact copolymers offering impact resistance over a wide range of temperatures, and random copolymers for clarity and sealability. Safripol's polypropylene resins offer consistent processability, high heat resistance, good clarity and gloss, low water absorption, high stiffness/hardness, excellent moisture barrier and chemical resistance, enhanced mold filling and releasability, and excellent fatigue resistance.

Plant Information

- Location: Rayong, Thailand
- Order date: October 2006
- Completion: January 2008

Thai Oleochemicals Co., Ltd.

Rapid Implementation of Integrated CENTUM CS 3000 and ProSafe-RS Systems at New Oleochemical Plant

About TOL's New Oleochemical Plant

In response to rising demand in Thailand for oleochemicals, which are environmentally friendly biodegradable substances used in applications such as fuels and personal care products, Thai Oleochemicals Co., Ltd. (TOL) has recently completed the construction of a new oleochemical production facility. The new plant is located at the Map Ta Phut Industrial Estate in Rayong, Thailand, which is 160 km southeast of Bangkok, and is capable of annually producing 100,000 tons of fatty alcohol, 200,000 tons of methyl ester (ME), and 31,000 tons of glycerine from crude palm oil.

The ME produced at this plant is blended with petroleum diesel to create biodiesel, a biodegradable and clean burning fuel than has the same combustion properties as conventional petroleum diesel fuel.

To ensure that the new plant would operate reliably and safely, TOL relied on a solution from Yokogawa based on the CENTUM CS 3000 Integrated Production Control System and the ProSafe-RS Safety Instrumented System.

Oleochemical samples

The Challenges and the Solutions

- Multiple licensors and consultants were involved in this project, so a key issue was maintaining consistency in all the information and specifications handled during the engineering stage. From the beginning of this project to the completion of the plant startup phase, Yokogawa's engineers worked with everyone on the project team to ensure a successful conclusion.
- Only four months were allocated for hardware installation and plant start-up. Within this tight timeframe, the CENTUM CS 3000 and ProSafe-RS system hardware had to be installed in the plant's control and rack rooms and their functions checked. Transmitters were also installed and loop checks were performed. Many software changes had to be accommodated quickly and flexibly. All this work was performed within specifications and on schedule.
- Plant safety and efficiency also had to be maintained by automating plant operations to the maximum possible extent. To accomplish this objective, the ProSafe-RS and CENTUM CS 3000 systems were fully integrated. The combination of feedback and sequence control with the graphic display of trend data, alarm summaries, operator guide messages, and other information have greatly enhanced operations at this plant. The highly reliable CENTUM CS 3000 system has also helped TOL maintain high productivity at this facility.
- Finally, as TOL only has a few DCS engineers who are available to work on these systems at short notice, the company relies on support provided by personnel from Yokogawa's Rayong service office. Its 24/7/365 support is very much appreciated by TOL.

Rack room

Main control room

Customer Satisfaction

"Yokogawa's engineers were all very patient and cooperative during the early engineering and start-up phases. We worked as one team through to the completion of this plant project," said Sayan Saesue, TOL's Engineering and Maintenance Division Manager.

Mr. Sayan in the control room

System Details

Control system:	CENTUM CS 3000, ProSafe-RS, CCTV
Transmitters:	HART communication
Number of I/O points:	3,000 for CENTUM, 600 for ProSafe-RS
Software package:	Exaquantum

Chemical
(Base Chemical, Fertilizer, Petrochemical)

Plant Information

- Location: Roozenburg, The Netherlands
- Order date: September 1999
- Completion: September 2001

DOMO

Replacement Control System

Replacing control systems is a hot issue in The Netherlands at this moment. These revamps are complicated trajectories in which the users themselves are key-players. After all, their input is crucial for the way in which the migration will take place. DOMO, formerly Targor, is an excellent example.

DOMO manufactures polypropylene at its Rotterdam location. DOMO thermoplast can be found in all aspects of our daily life. The control system in use for the past 15 years was due for replacement. Security, flexibility and quality were main issues during the replacement.

Marcel Kelder, field sales manager systems at Yokogawa Netherlands explains the policy: “We have chosen for a conceptual approach in which technology is obviously an important element but is in fact only a means to an end.”

The project was executed in phases. For instance during the selection phase an in-depth inventory was made concerning all expectations and requirements. The Yokogawa Engineering and Maintenance departments have been involved from the beginning so that all available expertise was used, according to Marcel Kelder. This was only feasible because DOMO accepted our approach and gave us the opportunity to hold interviews. Based on the suggested solution DOMO decided to place an order for a CENTUM CS 3000 control system to be combined with a PI information management system.

Quality care

Yokogawa formed a project group for the project. “Yokogawa knows exactly how our production works,” says Tes Wells, project manager for DOMO. “Safety, traceable receipts and quality care are key elements. These aspects should ensure that we always can retrace what has happened to a product. Yokogawa sensed this concern.”

The next step was to write a Functional Design Specification (FDS), describing typicals for control and sequences, conventions for graphics and procedures. The success of this report is mainly determined by the customer input. Jan Willem Mulder, manager Engineering: “It has been a very intensive part of the project for DOMO, a lot of documents had to be reworked. When the FDS was finished a beginning was made with the configuration of the CENTUM CS 3000 system.”

DOMO deliberately chose to involve the operators because they will work with the new system. In this kind of revamp projects their commitment is absolutely essential, according to Jan Willem Mulder. The involvement was reached by placing a completely virtual CENTUM CS 3000 system with DOMO application in the control room at a very early stage so the operators could practise.

Yokogawa and DOMO have drawn up a commissioning plan and maintenance plan so that they are well prepared for the start of the new system. These plans however are not static. Cost saving and increased flexibility will continually give impulses to adjust these plans.

System Details

System:	CENTUM CS 3000
Total I/O:	4,405
System Configuration:	8 x HIS(Human Interface Station), 5 x FCS(Field Control Station), Engineering Workstation, Recipe Management Station, PIMS Server and Test and Training Station
Scope:	Interface to 27 users and PIMS System, CS Batch 3000

Chemical
(Base Chemical, Fertilizer, Petrochemical)

Plant Information

- Location: Marl, Germany
- Order date: First order placed in 1999
- Completion: 2007

Stockhausen GmbH

"Built in" Migration Capability for Stockhausen Acrylic Acid Plant

Executive Summary

An acrylic acid production plant in Marl, Germany provides a good example of how a CENTUM DCS can be adapted over time to meet the changing needs of a plant owner. Operated by Stockhausen GmbH, formerly a company of the Degussa Group and now part of Evonik Industries AG, this plant has been expanded several times since 1991 and currently has an annual capacity of 200,000 tons. The acrylic acid is mainly used in the manufacture of super absorbers, which are used in diapers and other products.

In 1999, in the course of the construction of a new production line, the decision was made to migrate from the plant's existing control system to a Yokogawa CENTUM CS 3000 R2 DCS. Due to continuous and ongoing modifications at this acrylic acid plant, its automation was especially challenging and inevitably required a DCS that could be smoothly and easily modified.

Migration Roadmap

By design, CENTUM DCS solutions are fully compatible with all sorts of migration objectives, including:

- Expansion of field instrumentation
- Upgrade of bus systems
- Upgrade of core DCS hardware and software components, including field control stations (FCS), human interface stations (HIS), and engineering workstations (EWS)
- Integration with MES and ERP systems

The migration process at the Stockhausen acrylic acid plant was conducted in the following phases (Fig. 1):

Phase 1 (1999)
- Immediate startup of new production line with newly installed CENTUM CS 3000 R2 system
- Replacement of existing control system with minimal interruption to operations on the plant's original production line

Phase 2 (2004/2005)
- Release upgrade of HISs to CENTUM CS 3000 R3, which mainly involved the replacement of old PCs and conversion from Windows NT to Windows XP

Phase 3 (2006)
- Implementation of a new Vnet/IP bus segment to expand the DCS
- Release upgrade of all FCSs to CENTUM CS 3000 R3

Phase 4 (2007)
- Hardware release upgrade and Windows XP rollout for the remaining HISs

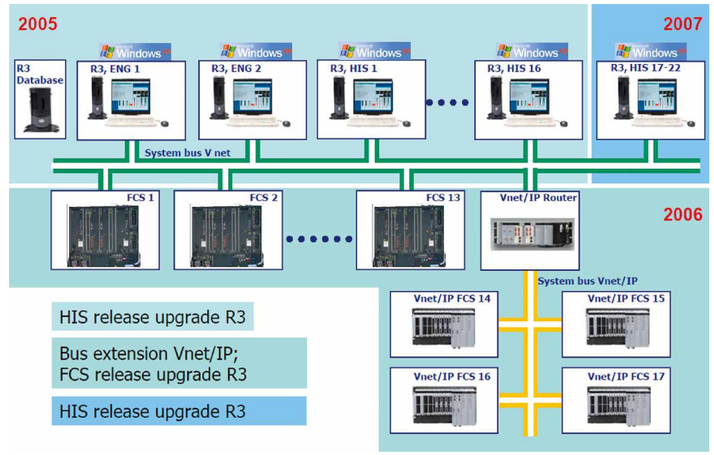


Fig.1 Major migration phases for the CENTUM system

Results

The initial migration in 1999 began with the installation of the CENTUM CS 3000 R2 DCS for the new production line. Following the startup of the new line, work commenced on migrating the plant's original production line from a third party control system to the new DCS. This was accomplished with a minimum of plant downtime. By spring 2001, the CENTUM DCS comprised 13 FCSs, 23 HISs (including two EWSs), and a total of 9,900 I/Os. A subsequent upgrade in 2004/2005 introduced the latest HIS PC hardware and software and was implemented in a highly systematic way so as to allow for easy maintenance. In 2006, the DCS was expanded by another 2,500 I/Os and four more FCSs, and a new Vnet/IP bus segment was introduced. Modifications undertaken in spring 2007 mainly focused on the replacement and upgrade of six HISs that had been used for archiving purposes. The system currently has a total of 21 FCSs and 13,000 I/Os and relies exclusively on CENTUM CS 3000 R3 and Windows XP.

Customer Satisfaction

Dr. Jürgen Mosler, Head of Technical Operations at Stockhausen, explains why Yokogawa was selected as DCS provider: "In 1999, we were looking for a competent partner who, on the one hand, could reliably deal with the migration of the old DCS, and, on the other hand, provide a new system with a convincing concept for future adaption and expansion. This is why we decided to go for Yokogawa."

Dr. Mosler is also highly content with the subsequent migration steps: "In 2005, we could perform the release upgrade without any shutdown at all. All the FCSs just continued to operate, making this upgrade a very simple and cost-efficient procedure. In 2006, we opted for the Vnet/IP implementation although our V net installation had not yet reached its limits. This was in order to ensure a maximum of flexibility also for the future."

Plant Information

- Location: Merbau, Singapore
- Order date: May 2008
- Completion: December 2008

The Polyolefin Company

Smooth Migration to CENTUM CS 3000 at Production Facility Operated by The Polyolefin Company (Singapore)

Executive Summary

First started operation in February 1984, the Polyolefin Company (Singapore) Pte. Ltd. (TPC) was the first company to launch large-scale production of polyolefin in Southeast Asia. The company expanded its manufacturing plant in 1997. This has enabled TPC to become one of the largest and most successful polyolefin producers in the region.

TPC's facility originally relied on a Yokogawa CENTUM-XL control system. This system proved to be highly reliable and no major problems were encountered for the more than 15 years that it was in operation. Due to the announcement of the end of service for CENTUM-XL, TPC decided to replace this with an all new CENTUM CS 3000 system.

Working rapidly, Yokogawa Engineering Asia successfully migrated the existing CENTUM-XL system and trend recorder consoles over to the CS 3000 in a very short period.

Product storage

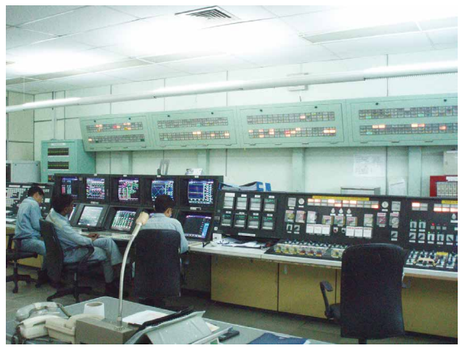
The Challenges and the Solutions

The first challenge with replacing the CENTUM-XL system was making sure there would be no disruptions in plant operations. While the pellet transfer section previously relied on customized software, it now uses the CS Batch 3000 package. Thanks to the good capabilities of this software, it was very easy to make modifications to product transfer.

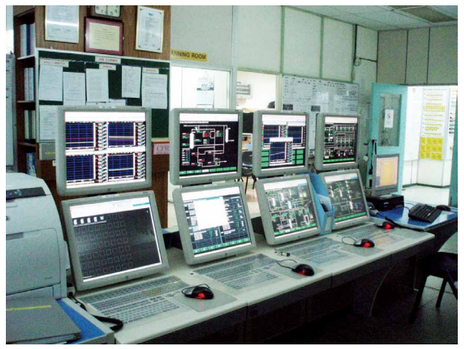
The second challenge was the need to minimize shutdown time, with the goal of continuing operations around the clock, 365 days a year. The high reliability of Yokogawa's CS 3000 system ensured that operations could continue nonstop, meeting TPC's high expectations.

The plant also had to comply with Singapore's stringent environmental protection regulations. With the new CENTUM CS 3000 system, data from combustible gas sensors set up all over the plant to detect gas leaks can be monitored on the human interface station (HIS) in the central control room, ensuring timely detection and response.

In addition to the above, training for new plant operators and engineers was provided at Yokogawa Engineering Asia's training center. Here, TPC personnel mastered the fundamentals of measurement and control strategy, gained experience in operating a production control system, and learned how to perform system configuration.



CENTUM-XL



CENTUM CS 3000

Customer Satisfaction

Peter Tan, Deputy Instrument Manager for TPC, said, "We are very happy to use Yokogawa's system and products because of their high reliability and Yokogawa's good service support."

Plant Information

- Location: Yunnan Province, China
- Order date: February 2006
- Completion: June 2008

Yunnan Dawei Ammonia Co., Ltd.

CENTUM CS 3000 Efficiently Controls and Monitors Coal Gasification and Air Separation Processes at Ammonia Plant

Executive Summary

Yunnan Dawei Ammonia Co., Ltd. (YDAC) is located near a very large anthracite coal mine in China's Yunnan province. Through a series of coal gasification and air separation processes, YDAC synthesizes 500,000 tons of ammonia each year from the anthracite produced by this mine. These processes rely on the latest technologies to produce ammonia from coal, as opposed to the more commonly used natural gas or crude oil, and the combustion is emissions free. The coal gasification process uses technology that has been licensed from Shell.

Ninety five percent of the anthracite is used in the gasification process, and any fly ash remaining after the coal passes through the plant's furnace can be used to make cement or bricks. The air separation process produces oxygen for the coal gasification process and the nitrogen needed to synthesize ammonia.

Coal gasification facility

Production management center

Rack room

Central control room

The most important concern at this integrated plant is the stable operation of the coal gasification process: if there is any interruption in the supply of synthetic gas from this process, the ammonia plant has to be shut down.

To ensure maximum efficiency in its ammonia production operations, YDAC turned to Yokogawa control technology. A project engineering team from Yokogawa China successfully installed a CENTUM CS 3000 production control system in the plant's central control room that allows YDAC's production management center in a separate location to monitor and manage all of this plant's production processes. The CS 3000 human interface stations (HIS) in this production management center are remotely connected to the central control room by means of a network of redundant fiber optic cables.

The Challenges and the Solutions

Project Engineering

Three engineering companies and three process licensors were involved in this project. To maintain consistency in the specifications for the CS 3000 production control system, the Yokogawa project engineering team compiled the information from the project participants and integrated that in the system. This approach to system configuration brought major benefits by ensuring a system that was easy to operate and whose hardware and software was easy to maintain.

Safety

The control strategies for the coal gasification process are very complicated and it is difficult to fine tune burner, load, and coal-oxygen & steam-oxygen ratio control. However, with the CENTUM CS 3000's modulating control and sequence control functions, YDAC can now easily configure these items and safely operate the coal gasification process, without making mistakes. Start/stop operations can be executed using an easy-to-read graphic display. Once an operator selects "Start," the necessary instructions are sent to all plant equipment via the sequence control. All the status information along with guidance messages are displayed for operators on the graphic display. An online maintenance function allows control strategy to be modified at any time. This is especially important at start-up, when modifications are frequently necessary. This, together with the ability to download a new configuration, has greatly improved efficiency.

Reliability

The coal gasification process requires temperatures and pressures up to 1500℃ and 40 bar, and significant damage can result if there is any shutdown of the production control system. Fortunately, the CENTUM CS 3000 is highly reliable, and its flawless performance in controlling the plant startup and shutdown sequences helps significantly reduce the total cost of ownership for the plant's facilities.

Customer Satisfaction

Liu Xin, Deputy General Manager for the Yunnan Group, said, "Yokogawa completely realized the control and monitoring of our integrated plant using the most current digital technology. We are very much satisfied with the high reliability of the CENTUM CS 3000 and with Yokogawa's capable project team."

Chen Xuedong, Production Department Deputy Manager, said, "We are looking for continuous and stable operation of the coal gasification process, so we need Yokogawa's continual support and backup." He added, "YDAC is one of the most successful coal gasification plants in China."

Mr. Chen Xuedong

Plant Information

- Location: Lancashire, UK
- Order date: January 2008
- Completion: September 2008

Lucite International

CENTUM VP Batch Replaces Legacy System and Improves Production Efficiency at Acrylic Plant

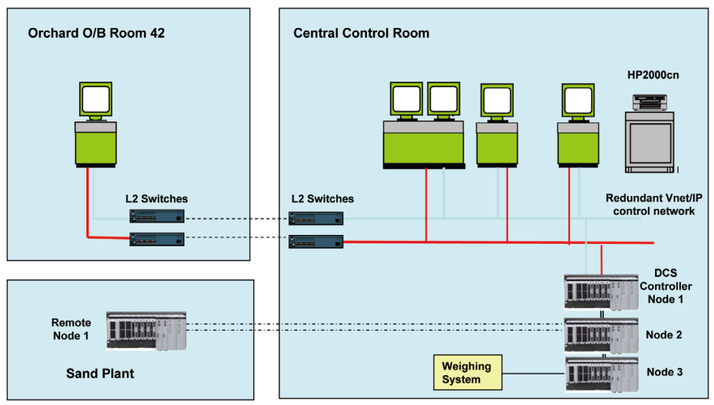
Executive Summary

Lucite International is the world's largest producer of acrylic monomers, and the company's plant in Darwen, England produces high quality acrylics for use primarily in bathroom and kitchen fittings. The plant formerly relied on a Honeywell PlantScape Batch control system that ran on Windows NT4 servers. Due to the difficulties of maintaining this legacy system, Lucite opted for its replacement. Through this change, the company aimed to achieve continuous improvements in the areas of plant safety, worker health, environmental protection, and cost performance. Toward this end, Lucite evaluated the system reliability, lifetime support, and engineering capability of various control system vendors and decided on a Yokogawa CENTUM VP solution. Yokogawa United Kingdom successfully installed this system within a short period of time.

The Challenges and the Solutions

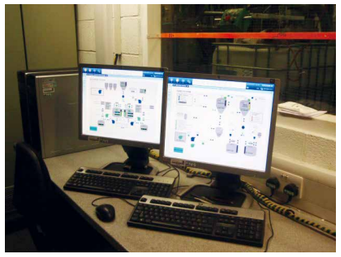
Project execution

Due to the age and condition of the legacy system, the project team could not find the existing system configuration and detail specifications by proper documentations. However, by working through the system one section at a time, Yokogawa and Lucite engineers were able to collect all of the configuration data and transfer it to CENTUM VP. This approach allowed Yokogawa to develop an excellent relationship with the Lucite project team and gave Lucite confidence in Yokogawa's capabilities as a solution provider. As a result of careful planning and preparation, the project team was able during a short 14-day plant shutdown period in September 2008 to remove the PlantScape system and install, start up, and commission the new CENTUM VP system.



System configuration

Before (Legacy system)



After (CENTUM VP HMI)

Efficient batch operations

The overall competency of Yokogawa's engineering team, particularly in the area of batch applications, was well appreciated by the Lucite project team. The CENTUM VP Batch package can handle everything from recipe management to batch report handling and unit management. Its capabilities are superior to those of the system that it replaced, and it is much easier for the Lucite engineers to use, ensuring error-free batch operations. The package has a function that shows the operation procedure, current step, and current phase during normal operations, ensuring very high production efficiency and safe operation. In addition, the ergonomic design of the CENTUM VP human machine interface (HIS) helps improve operation efficiency. Lucite is very happy with the high reliability, availability, and flexibility of the CENTUM VP system, and has experienced no major system failures since this system was started up in the fall of 2008.

Integration with weighing system

Integration with the weighing system in use at this plant is very important for batch operations. The weighing data is essential for the tracking of batch operations and management of raw materials. Data from the weighing system is received via a Profibus interface. An operator can monitor this on a graphic display and confirm its status before starting a batch operation. The visualization of all operation data helps improve quality.

Customer Satisfaction

Ray Jones, a Technology Manager, had the following to say about the new system: "Yokogawa's CENTUM is a very flexible system and easy to use. Settings for control strategy changes, recipe settings for new products, and other modifications can be easily configured from an engineering station in the engineering department."

Mr. Jones added, "We are planning to upgrade the existing safety system and to integrate all systems in our plant for safer operations and more sustainable manufacturing. We have a five-year engineering service contract with Yokogawa and are working closely together with them."

Chemical
(Base Chemical, Fertilizer, Petrochemical)

Plant Information

- Location: Rayong, Thailand
- Order date: December 2005
- Completion: December 2006

IRPC-HDPE

Reinstrumentation Project at HDPE Plant to Replace Legacy Pneumatic Instruments and PLCs with Integrated CENTUM CS 3000 and ProSafe-RS

Then (pneumatic panel)

Now (PCS/DCS)

Executive Summary

Integrated Refinery and Petrochemical Complex Public Co., Ltd. (IRPC) in Rayong, Thailand has a refinery (215,000 B/D) as well as several petrochemical plants that produce chemicals such as olefins (360,000 t/y) and aromatics that are used as feedstock at various types of plastics plants. One of these facilities, a 152,000 t/y high density polyethylene (HDPE) plant, relied principally on legacy pneumatic instruments and a PLC based safety system. (Some of the pneumatic instruments had been replaced with single loop controllers.) Due to high maintenance costs and the need for higher efficiency and productivity, IRPC decided to revamp its plants by installing new control systems and instrumentation based on the latest technologies.

Through the course of this project, Yokogawa Thailand successfully installed a fully integrated CENTUM CS 3000 production control system (PCS) and ProSafe-RS safety instrumented system (SIS) together with a plant information management system (PIMS) and an asset management system (PRM).

Customer Satisfaction

Phadet Prarom, PD11 Division Manager, said, “We are now very comfortable operating the HDPE plant and are experiencing no major problems with Yokogawa’s systems. Yokogawa’s systems and products are highly reliable.” He went on to say, ”We actually reduced the number of operators after introducing the PCS. The integrated production control system is functioning well. We are proud of our new control room, the brain of a VigilantPlant.”

The Challenges and the Solutions

The biggest challenge was applying the latest digital technology. Digital and pneumatic systems are fundamentally different in design and function.

It took about five months to do a detailed study of all the control loops and configure the production control system, and another month to do all cabling/wiring and systems installation. In addition to the wiring of about 5,000 I/O points for the new systems, some field equipments were replaced.

At the same time, operators underwent training in the new PCS at Yokogawa’s Rayong office and engineers and maintenance personnel went to Yokogawa’s Bangkok office for training in system configuration using feedback and sequence control functions. Yokogawa Thailand provided customer support from start to finish of this reinstrumentation project.

To improve safety, the ProSafe-RS SIS was installed to give the polymerization process an emergency shutdown capability, and the SIS was integrated with the PCS. With this system, every point in the SIS can be monitored from the human machine interface (HMI) in the same manner as the PCS. In addition, all PCS and SIS HART field devices can be monitored from the central control room with the Plant Resource Manager (PRM) package, enabling a more predictive and proactive maintenance approach that reduces total cost of ownership (TCO). Also, all process data can be handled in an integrated manner by the Exaquantum PIMS for improved product quality and system operation.

Through solutions such as these, Yokogawa Thailand is working with its customers to help them achieve a VigilantPlant.

About HDPE

Marketed under the POLENE trademark, this polymer resin features properties such as high density, high stiffness, high impact strength, opacity, and good chemical resistance. HDPE is used in a variety of applications including consumer packaging, beverage bottles, pipes, and ropes.

Chemical
(Base Chemical, Fertilizer, Petrochemical)

Plant Information

- Location: Rayong, Thailand
- Order date: December 2006
- Completion: April 2009

PTT Phenol Company Limited

Yokogawa Provides CENTUM CS 3000, ProSafe-RS, and FOUNDATION™ Fieldbus (FF) Solutions as Main Instrument Vendor for New Phenol Plant

Executive Summary

PTT Phenol Company Limited is a subsidiary of PTT Public Company Limited, a Thai state owned oil and gas company. PTT Phenol was the first company to produce phenol in southeast Asia , the world's largest market for this chemical. Phenol is used as a raw material in the production of plastic polycarbonate for the auto, computer, and electronics industries, and the company produces approximately 180,000 tons of this chemical each year. In response to rising demand for this material, PTT Phenol is building a new phenol plant at its complex on the Map Ta Phut Industrial Estate in Rayong, Thailand.

For this plant construction project, PTT Phenol relied on the main instrument vendor (MIV) approach to reduce engineering costs. As the MIV for this project, Yokogawa Thailand worked together with a project management consultant (PMC) and an engineering procurement construction (EPC) contractor to supply a DCS, safety instrumented system (SIS), instruments, control valves, and a tank gauging system. In the first phase of this project, which began in 2006, a project team consisting of personnel from Yokogawa Engineering Asia and Yokogawa Thailand took care of front end engineering design (FEED) and created the functional design specifications. In the second phase, the project team developed detailed design specifications (DDS) describing the functionality of these systems and products. In the third phase, a staging and factory acceptance test (FAT) was conducted in which all systems were rigorously tested with simulated inputs, and the interaction and communication between the various subsystems were extensively tested. The fourth and final phase covered installation, the site acceptance test (SAT), and commissioning.
Everyone from PTT Phenol, the PMC and EPC, Yokogawa Engineering Asia, and Yokogawa Thailand worked closely as a unified team to successfully complete this project on schedule and within the budget.

The Challenges and the Solutions

Applying FF technology

Nearly 500 FF devices were installed at this plant, and all of the data from these devices can be monitored using the PRM asset management package. Rather than donning protective wear and going out periodically in hot weather to conduct patrols, a maintenance engineer can monitor the status of these devices from an office desk. PRM provides a great deal of detailed diagnostic data, allowing engineers to detect problems before devices fail. This reduces TCO and ensures asset excellence for PTT Phenol.

Plant safety

Given that this plant is engaged in a critical production process, safety is a paramount consideration. All loops were assigned safety integrity level (SIL) 3 in the ProSafe-RS SIS. As ProSafe-RS is integrated with the CENTUM CS 3000 production control system, all critical loops can be consistently monitored from the CS 3000's human machine interface (HMI). Furthermore, ProSafe-RS has been certified by TÜV to be in full compliance with the IEC61508 recommendations. This safe and highly reliable emergency shutdown system brings PTT Phenol safety excellence.

Data gathering and analysis

Real-time plant data can be utilized to improve product quality and historical data is essential to product tracking. By using the Exaquantum plant information management system (PIMS) in this integrated system, engineers in different departments can access plant data and use distribution, trend, and histogram charts to analyze the data and make improvements according to the Plan-Do-Check-Act (PDCA) cycle. This contributes to production excellence at PTT Phenol.

Process simulation

An OmegaLand simulator was installed in PTT Phenol's engineering department that allows its process and instrument engineers to confirm modifications and find effective ways to optimize their process and control strategies.

Customer Satisfaction

Pornchai Rattanawijit, an instrument engineer in the maintenance department, said, "We are happy with Yokogawa's system and look forward to maintaining a good, long-term relationship with Yokogawa." He added, "We have introduced many new technologies and achieved a VigilantPlant that realizes safety excellence, asset excellence, and production excellence."

Plant Information

- Location: Sasolburg, South Africa
- Order date: July 2004
- Completion: November 2004

Safripol

Exapilot is Effectively Applied to Polypropylene Plant and Optimizes Operation, Cost Savings

About Safripol

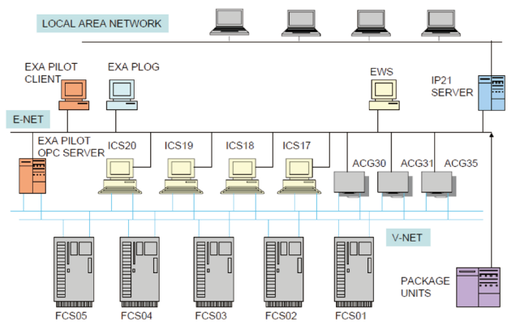
Safripol is a leading plastic manufacturer in South Africa. Safripol can produce 120,000mt/year of polypropylene (PP), utilizing LyondellBasell's Spheripol technology and also produces 160,000mt/year of high density polyethylene (HDPE). PP and HDPE are used for plastic components and products, from food wrapping to automotive parts.

System Overview

The polypropylene plant uses Yokogawa's CENTUM CS for more than 15 years without any major problems, including the following environments.

- MODBUS communication between the DCS and other systems (Siemens, Yokogawa Analyzers, Moore Apacs, other companies like Sasol and Natref)
- ExaPlog is using for the alarm management system
- ExaPilot is used for grade change procedure
- STARDOM is used for compressor control

Safripol started the migration process to CENTUM CS 3000 in 2007 and CENTUM VP will be installed by the end of this year.

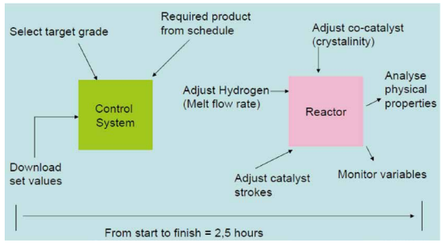


The Challenges

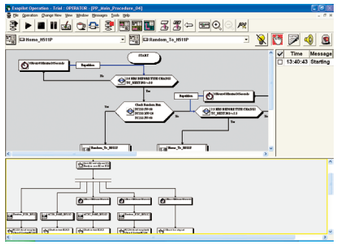
Due to Global competition Safripol is striving for high efficient plant operation. Safripol is also improving the quality of the product by PDCA method for further sustainable manufacturing. The following issues were raised in the production department and the challenges were addressed.

- Keep consistency of operations and product quality
- Reduce transition material
- Training for new employees
- Reports for every batch operation as a product tracking data storage
- Optimise, standardise and reduce procedures
- Cost Saving
- Empower the operational team in order to assess new ideas

The existing grade change procedure takes 2.5hours and the overview of the procedure is shown below.
Safripol configured this procedure into Yokogawa's Exapilot.



Grade change procedure



Operational window

The Benefits

Due to the natural differences between individuals, each operator will do the same job differently, although manual standard operating procedures are available. Although the operators did their best, issues were raised regarding the consistency of the operations during grade changes.

By using Yokogawa's Exapilot, Safripol were able to eliminate product variations and kept the operations consistent, thereby reducing operational costs drastically by eliminating "off spec" products during transitions.
Safripol also uses Exapilot in order to facilitate operator training regarding grade changes - The available modes allow the new employees to run a procedure without influencing the plant.

Exapilot also allows the assessment of procedures to ensure flawless execution.

An Exapilot report is available in order to give a step by step report of every action taken, in order to track the procedure from start to end.

Customer Satisfaction

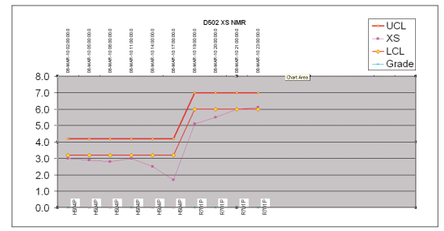
Here are some comments from the operators;
"It gives me more time to concentrate on other plant related issues, while the Exapilot takes care of the grade change."
"It ensures consistency of grade changes."
"It eliminates the inconsistency introduced by new operators"
"It provides an opportunity to test run procedures/sequences to get a feel for the effects it may have on the process before making permanent changes to the logics."
"Valuable operational knowledge is not lost due to natural migration of older employees."

And finally, the Process Information Engineer commented about Exapilot as follows.

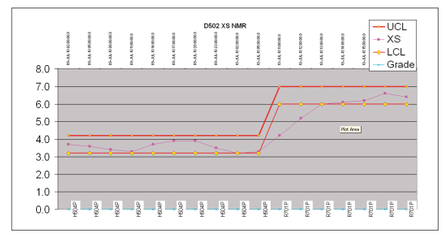
- It's an electronic tool that combines the knowledge of the process Engineer and the Super operator into an interactive, electronic procedure which communicates with the DCS and does exactly what the procedure require, every time and without any deviations.
- It reads from the DCS, compare variables with specific values and if satisfied carries on and write values or actions to the DCS, without any required action from the operator, but if required conditions are not met, the procedure does not continue.
- It's main purpose is to take the complicated repetitive tasks out of the hands of the operator, in order for him to concentrate on the rest of the plant.
- This is your ultimate operator – highly skilled and does not show any complications associated with a normal working force.

Quality Measurements

Final product Xylene Soluble content measured by NMR – Before ExaPilot
Difficult to coordinate two contradicting process settings during grade change (C2 increase vs Donor increase) Poor consistency



Final product Xylene Soluble content measured by NMR – After ExaPilot
Excellent coordination and repetitiveness facilitated by ExaPilot



Chemical
(Base Chemical, Fertilizer, Petrochemical)

Plant Information

- Location: Takasago, Hyogo Prefecture, Japan
- Order date: January 2009
- Completion: February 2010

Kaneka Corporation

Optimization of Control Strategy Helps BTG Plant Save Energy and Operate More Efficiently

About Kaneka Corporation

Spun-off from the Kanegafuchi Spinning Co., Ltd. in 1949, Kaneka Corporation's initial main products were caustic soda, soap, cosmetics, edible oils, and electrical wires. Later the company diversified into polymers, fermentation, biotechnology, and electronics. Its business activities now span a broad spectrum of markets - from plastics, EPS resins, chemicals, and foodstuffs to pharmaceuticals, medical devices, electrical and electronic materials, and synthetic fibers. The company has been a leader among Japanese chemical companies in establishing overseas operations, beginning in 1970 with a subsidiary in Belgium and progressing to the establishment of operations in the United States, Singapore, Malaysia, China, Australia, and Vietnam.

Kaneka Corporation is set on both staying globally competitive and protecting the environment, a stance that is consistent with its corporate philosophy. This states: "With people and technology growing together into creative fusion, we will break fresh ground for the future and tie in to explore New Values. We are also committed to challenge the environmental issues of our planet and contribute to upgrade the quality of life." Specific initiatives undertaken by Kaneka Corporation include the reduction of energy consumption, complying with global environmental standards, reducing industrial waste, and reducing risk through the development of various production technologies.

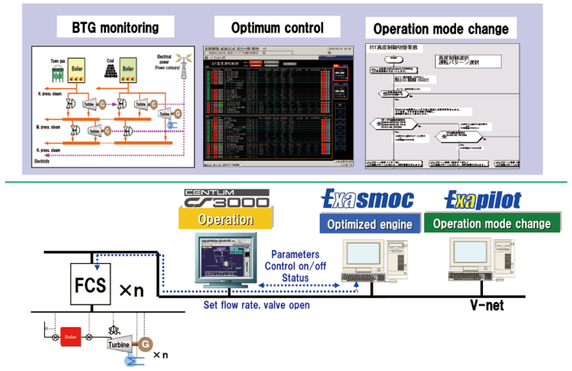
The Background

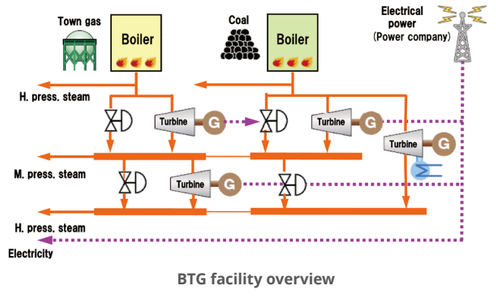
In the midst of a global economic downturn precipitated by events such as the bankruptcy of Lehman Brothers, Kaneka Corporation is accelerating its efforts to reduce its operating costs. As the company's Takasago Plant is a large consumer of energy, it currently is engaged in an "Advance 17" initiative to slash its energy costs.
Almost all the fuel and electricity consumed by the Takasago Plant is for its boiler, steam turbine, and generator (BTG) facility. With the rising price of crude oil, Kaneka Corporation has urgently needed to implement countermeasures that would reduce this facility's energy costs. And in keeping with its corporate philosophy, the company is intent on reducing its CO_2 emissions. A further aim of the company is the improvement of efficiency and reduction of labor costs.

The Challenges

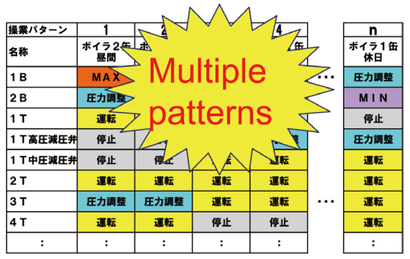
The BTG facility has two boilers and four sets of steam turbines and generators, and this equipment all varies in energy efficiency. In addition, the price of electricity fluctuates depending on the season and the time of day. The operation and maintenance of all this equipment has to be balanced in such a way that cost is minimized and the steam and electricity requirements of the Takasago Plant are fully met. Before this project, the BTG facility's operators were kept busy around the clock monitoring all process values in real time and manually adjusting to load changes. Because the facility had a variety of operation patterns, each of which required different procedures for minimizing costs, operators were required to have very high level skills and their work was very stressful.

Combination of the CENTUM DCS, Exapilot, and Exasmoc





BTG facility overview



Operation patterns

The Solutions

The engineers at the Takasago Plant had reached the limit of what they could accomplish through hardware modifications, PID control, and sequence control strategy to improve energy efficiency at the BTG facility. After considering the use of an operational support package and a PIMS, they turned to Yokogawa for an advanced process control (APC) solution that could be fully integrated with their existing control strategy.
Although the plant's engineers fully understood the benefits that an APC solution could have in automating the BTG facility's operations, they were also well aware of their plant's complexities and knew that they would need an experienced partner that could help them apply this technology and derive its full benefits.
They knew that with Yokogawa, which has a long track record in implementing over 400 APC solutions worldwide in a wide variety of process industries, they would have a tried, tested, and proven partner.

Working closely with their counterparts at the Takasago Plant, the Yokogawa team assembled for this project installed and integrated

Toshihiko Hayashi, Director of the Energy Department at the Takasago Plant

Engineers from Kaneka Corporation's Production Technology and Energy Departments

the Exasmoc multivariable predictive controller and the Exapilot operation efficiency improvement package with the monitoring, control, and operation functions of the plant's CENTUM CS 3000 DCS. The Exasmoc APC controller uses models to optimize plant behavior by computing sequences of variable adjustments. This has made it possible, for example, to rapidly adjust set points when boilers and turbines are started up or shut down. The Exapilot package enables the automation of operational sequences such as plant start-up, shutdown, and product switchover by storing system procedures based on the expertise of experienced plant operators.

The Results

Through the integration of the CENTUM CS 3000 DCS with the Exapilot operational support and Exasmoc APC solutions, the BTG facility's operations could be fully automated, significantly reducing operator workload and achieving an 85% reduction in alarm situations. The plant can now be operated much more smoothly and flexibly. Operational efficiency is up, energy costs have been reduced 0.21%, and CO_2 emissions are down 1,000 tons annually. The achieved improvements are exactly on target.
Further improvements in energy efficiency are foreseen in the immediate future at the Takasago Plant. Efforts to secure additional improvements at this plant are ongoing, and range from the improvement of stability at low loads, optimization of control strategy based on alarm analysis, and the reduction of changeover times when the plant switches from daytime to nighttime operation.

Plant Information

- Location: Dushanzi, China
- Order date: November 2010
- Completion: October 2011

PetroChina Company Limited

PetroChina Dushanzi Petrochemicals Polyethylene Plant System Migration

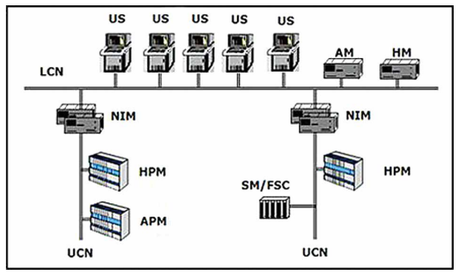
Executive Summary

PetroChina Company Limited is China's largest oil and gas producer and distributor, and plays a dominant role in the country's oil and gas industry. Dushanzi Petrochemicals, a primary subsidiary of PetroChina, operates China's largest refinery and petrochemical complex. Operational since 2009, it can process 10 million tons of crude oil and produce 1.2 million tons of ethylene per year as well as a range of fuels and other refinery products. In 2007, Yokoshin Software Engineering (WuXi) Co., Ltd., a Yokogawa subsidiary, successfully installed the distributed control systems (DCS) for this megasize complex.

Dushanzi Petrochemicals also has refinery, polyethylene, utility, and other facilities at this complex that date back to the 1990s. Some of these relied on older control systems that were experiencing steadily rising failure rates and issues with the availability of spare parts. In consideration of Yokoshin Software Engineering's success in implementing the systems for the refinery & petrochemical complex megaproject and Yokogawa's rich system migration experience, Dushanzi Petrochemicals awarded Yokogawa a contract in November 2010 that included the revamp of the legacy Honeywell TDC3000 DCS at the complex's polyethylene plant. This was successfully completed in October 2011 after a 50-day shutdown period and site acceptance testing (SAT). With the conclusion of the system migration work at the Dushanzi complex, most of its DCS systems are now from Yokogawa, significantly reducing its maintenance costs.

About This Project

The plant's TDC3000 system had eight DCS controllers, one safety controller, ten HMI/ENG stations, one application module, and one history module. With Triconex responsible for upgrading their legacy safety system, the scope of Yokogawa's work was limited to the replacement of the TDC3000 system with a CENTUM DCS. There was no manufacturing execution system (MES) at the plant. Based on documents about the polyethylene production process (a BP gas-phase technology) and discussions with the customer's engineers, Yokogawa understood it would be a demanding project, with many complex sequence controls, calculations, interlocks, and loops in the existing DCS.



A typical TDC3000 system layout

The Challenges and the Solutions

Throughout the revamp, which included the challenging creation of function design specifications (FDS) as well as factory acceptance testing (FAT) and SAT, Yokogawa took a team approach and worked closely with the customer. With the strong support of Dushanzi's management and employees, this work was completed on time.

Pre-revamp CCR with legacy Honeywell TDC3000 system

Post-revamp CCR with CENTUM system

How to create an FDS for a revamp project

Creating an FDS is always our first aim during a plant revamp project. As the customer required us to realize all of the TDC3000 system's functions, its system database was the focus of our investigation. The existing plant had been completed in 1995 and expanded in 2002, so some of the function definitions could be found in the TDC3000 database, but it was not possible to identify the corresponding functions in the production process. Yokogawa's engineers checked every item in the database and worked with the customer to confirm a list of objects for the database conversion.

The TDC3000 database could only show Yokogawa's engineers what kind of function blocks had been implemented. Not enough information was available to understand the production process or the operation procedures at the polyethylene plant, both of which were of key importance in migrating to the new system. The Yokogawa personnel set about trying to interpret the database by referring to the original documents that had been released in 1995 by the licenser of the polyethylene production process and Honeywell. In addition, Yokogawa's global engineering team assisted by providing analytical insights and tools that aided in the conversion of database control language and the visualization of logic functions.

The customer's instrumentation and operations experts were very knowledgeable about the TDC3000 system and the polyethylene plant, so Yokogawa's engineers could clarify all unclear points in discussion with them and explain how Yokogawa would implement and realize existing functions on the Yokogawa CENTUM system, particularly those where changes were necessitated by architectural differences between the two systems.

As the customer was involved throughout the FDS creation process, Yokogawa could quickly complete this work and customer approval went smoothly. The following formula expresses Yokogawa's best practice in creating an FDS for a migration project: FDS = existing database + original documents + knowledge of customer's experts

Three factory acceptance tests (FAT)

As part of this project, Yokogawa conducted a pre-FAT, an official FAT, and a post-FAT to mitigate potential risks in the SAT phase. More than 13 experts were dispatched from the customer's process, instrumentation, and operation departments for the official four-week FAT. Working with Yokogawa's engineers, five teams were mobilized respectively to check all items in sequences, complex loops, complex calculations, logic, and graphics. The customer experts played a very important role by providing necessary clarifications to Yokogawa personnel on a number of points and giving many constructive suggestions on modifications.

Site acceptance test (SAT)

The plant was shut down for about 50 days, giving Yokogawa enough time to do a cold cut-over to the new DCS. All Honeywell terminal boards were dismantled, leaving nothing but Yokogawa system hardware.

The following approach was taken to optimize the SAT process:

- Digitally Enhanced (DE) protocol instruments were changed to HART or analog mode to reduce workload.
- To ensure the integrity of the existing TDC3000 database, rather than immediately making changes to it to correct a problem reported by the customer, we investigated carefully to find the actual cause. For example, during the SAT, the customer requested an increase in the valve delay time to resolve a transient alarm. However, a detailed investigation found that the positions of two valve switches had been reversed.
- To prevent mistakes, a policy requiring multiple approvals for function modifications requested by customer engineers was adopted.A team of over 30 people from Dushanzi, Yokogawa, and subcontractors assisted with the system installation and cut-over.

Customer Satisfaction

Zhaoshan Sun, Chief Instrument Manager, said, "In 2007, Yokoshin Software Engineering performed flawlessly on the refinery & petrochemical complex megaproject. Their strict, careful, and effective approach in their work ensured a successful startup and stable operation of the DCS. The Dushanzi project strengthened Yokoshin's reputation in China's petrochemical industry. When we were considering a revamp of the legacy system at our polyethylene plant, we chose Yokoshin as our migration partner based on our assessment of their capabilities and strengths."

Mr. Sun went on to say, "Yokoshin's project manager and engineers worked closely with us to understand every technical problem and control the project schedule. The experts from Yokogawa headquarters also gave us timely support by sharing TDC3000 knowhow. To clarify details of the sequence program and calculation formulas, their engineers often worked late with us. Their rigorous, serious, and responsible approach not only helped overcome all difficult problems, but also made a good impression. The process unit has been running well and is problem-free since the start-up, and we wish to express our heartfelt thanks for this to Yokoshin!"

Plant Information

- Location: Geleen, Limburg, The Netherlands
- Order date: December 2011
- Completion: July 2012

OCI Nitrogen

Dutch Fertilizer Plant Improves Terminal Operations with Yokogawa Automation Solution

Executive Summary

As the demand for food is increasing worldwide, fertilizers are playing an essential role in improving agricultural productivity. OCI Nitrogen (hereinafter OCI) is a leading producer of mineral fertilizers and the world's largest producer of melamine, which is used to make adhesives and resins for a wide range of applications, such as furniture panels, laminate flooring, coatings, paints, and plastics. The company also is a major producer of ammonia, a key ingredient in fertilizer and melamine production.

OCI operates ammonia, nitric acid, nitrate, and granulate plants at the Chemelot Industrial Park, which is near the town of Geleen in the Netherlands' Limburg province. This area has long been home to much of the Netherlands' fertilizer and chemical industries, and OCI produces an annual total of 1.45 million tons of fertilizer here. The shipment of this material necessitates the issuance of some 42,000 waybills every year. As the company had been doing this manually and it was a very time consuming process, the company decided to automate this and all other shipment processes, including those for the loading of trucks at the fertilizer plant's shipping terminal.

Mr. Pijl

Sitech, a provider of engineering, maintenance, procurement, and project services to several of the chemical companies operating at the Chemelot site, selected Yokogawa to automate these processes. Martien Pijl, a senior project engineer for Sitech, commented as follows: "Yokogawa was selected because they were already a main supplier of the integrated production control and safety systems used at these plants. We asked them to come up with a smart, sustainable, and reliable solution to debottleneck the loading facility. We found them to be an excellent partner because they provide standard, fully integrated solutions that can be used for every loading/unloading and storage process and be tailored to any requirement. Furthermore, they have deep expertise in shipping terminal operations."

The main objective of the automation project was to change to an environment in which terminal automation, production automation, and the enterprise resource planning (ERP) system form a seamless whole. "That appeared to be highly feasible with Yokogawa's solutions and services," said Mr. Pijl. "Yokogawa supplied OCI a state-of-the-art and fully-automatic terminal automation system (TAS) solution, based on its Terminal Logistic Suite VP. This terminal automation has had many positive effects. For instance, we can complete 25% more loading actions per day, and operators make fewer input errors. Also, management has gained deeper insights into these processes."

The Challenges and the Solutions

Smooth project execution

An intensive collaboration between OCI, Sitech, and Yokogawa started at a very early stage, resulting in a very positive project outcome. "A conscious decision," said Mr. Pijl. "Practical experience teaches us that companies that are involved in the early stages of a project are better able to formulate the specifications for the project. That's the case here too." As a result, this project could be completed on budget and on time, in just eight months. The collaboration between Yokogawa, OCI, and Sitech continues even after the delivery of this project. In the event of a malfunction, service engineers at Yokogawa's office in Amersfoort can remotely access the system to perform troubleshooting. This service is helping to guarantee extreme high availability for many years to come.

Efficient terminal operation

To ensure efficient and flexible truck loading operations, Yokogawa's Terminal Logistic Suite VP automation solution was implemented. Commenting on the results that were achieved, Mr. Pijl said, "Due to the implementation of Terminal Logistic Suite VP, the loading facility is no longer a bottleneck for the complete supply chain." The Terminal Logistic Suite VP solution has the following features:

• A total solution

Terminal Logistic Suite VP is a true level 3 (production / MES layer) solution. Modular in design, it has been developed for the automation of operations at terminals where oil, gas, LNG, LPG, chemicals/petrochemicals, and other materials are loaded on/unloaded from trucks, trains, and ships. In addition to having a direct link to the operating environment and an ERP interface with the office environment, it has separate modules for loading/unloading, blending, movement operations, path generation, jetty scheduling, nomination, data management, inventory management, order management, security control and audit trail, system maintenance, stock control, and reporting.

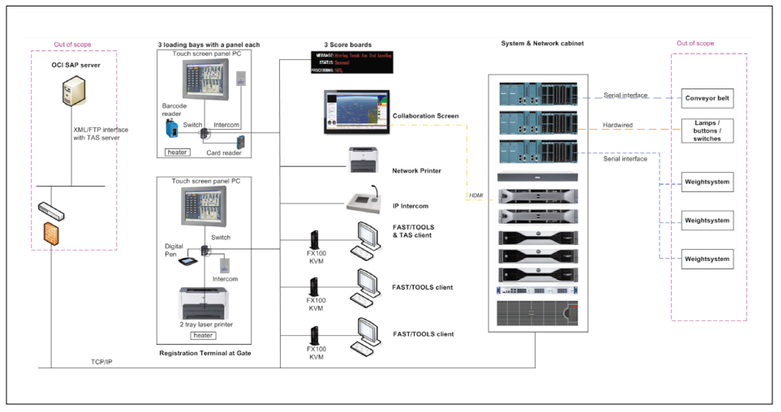
• Versatile system architecture

OCI's Terminal Logistic Suite VP has an interface to the ERP system for the automatic processing and monitoring of orders, the performance of related administrative tasks, and the creation of all necessary documents and waybills. The system automatically validates the order number and information on the vehicle/driver, customer, destination, etc. This data is automatically backed up for added security.

At OCI, Terminal Logistic Suite VP is also linked to Yokogawa's STARDOM network-based control system to accurately control the loading/unloading process. Amongst other functions, STARDOM controls the transfer of "Nutramon" (an OCI brand name) calcium ammonium nitrate from the storage bunkers to the loading stations by operating specific conveyor belts. Furthermore, STARDOM interfaces with the weighing system, the remote loading panels, traffic lights, and multi-color scoreboards in each loading bay that inform the truck drivers about bay assignments, loading progress, etc.
Yokogawa's FAST/TOOLS supervisory control and data acquisition package was installed for the monitoring and manual operation of the loading facility.

All data on loading operations is displayed in a well organized, clearly understandable format on a single large screen so that operators can monitor the entire process.

All data is visualized on a large, integrated screen



Overview of OCI's system architecture

OCI Nitrogen

The Results

The TAS implementation has brought several positive effects such as 25% more loading actions per day, fewer input errors by operators, completely automated administration, and clear reporting to management.

Moreover, truck drivers who drive back and forth to the harbor every day no longer need to get out of their trucks. They only need to hold an identification badge in front of the loading panel's card reader to start the automatic loading process.

In addition, the TAS provides many supplementary capabilities. A large variety of data is configured and verified for various purposes. For instance, when drivers enter their final destination on the loading panel's touch screen, the maximum allowable load is determined automatically, fully in accordance with the ADR guidelines which are applicable throughout Europe. This is a standard feature with Terminal Logistic Suite VP and it ensures that end-users, producers, and truck drivers do not need to worry about the prospect of being fined for exceeding weight limits.

All bays are furnished with a loading panel equipped with a touch screen, intercom, barcode reader, card reader, and emergency button.

Each bay has a multi-language scoreboard giving guidance to the truck driver on bay assignment, ordered weight, loading progress, etc.

No need anymore for the drivers to get out of their trucks. All components are integrated into Yokogawa's terminal automation system.

Customer Satisfaction

Rien Kloet, head of logistics at OCI, said, "As result of the reduction of all the manual paperwork, our employees are now able to be more closely engaged in harmonizing supply with demand. In our field, it is truly unique to have a fully automated central control room where there is no need for human intervention."

Mr. Pijl added, "Automation of these types of processes requires an automation vendor with very specific knowledge. With its execution of such complex projects, Yokogawa has proven to be a very reliable and skilled partner."

Mr. Kloet

Plant Information

- Location: South Africa
- Order date: October 2001
- Completion: February 2002

FOSKOR Richards Bay

The Legacy DCS is Replaced with a Yokogawa CS 3000 in a Surprisingly Short Time

Introduction

Foskor Richards Bay is a major chemical company in South Africa that supplies 14% of all the phosphoric acid that is traded internationally. The company currently produces 720,000 tons per annum of phosphoric acid at two phosphoric acid plants, and also operates three sulfuric acid plants and a granular fertilizer plant.

Responding to a Challenge

In 2001, Foskor Richards Bay launched the Sulphos project to expand phosphoric acid production capacity from 550,000 to 770,000 tons per annum. As part of this project, Yokogawa contracted with the main project vendor to provide its CENTUM CS 3000 system for a phosphoric acid plant and a sulfuric acid plant that were under construction. In addition, Yokogawa was asked to replace a DCS from another vendor that was in use at the company's existing phosphoric acid plant.
Although the Sulphos project seemed to be on track, the control system at the existing phosphoric acid plant unexpectedly failed on December 19, 2001, when its hard disk drive crashed. As a result, the entire production operation had to be shut down and the project database was lost.

The customer was forced to make a quick decision between re-engineering the old system or installing the CENTUM CS 3000 three months ahead of schedule. The decision was made to go with the CENTUM CS 3000. Work on this got started on December 20 and the plant went live on December 28. The successful installation of this system in such a short period of time can be attributed to the following:

- Panel manufacturing and DCS engineering were done ahead of schedule.
- A dedicated team consisting of personnel from Foskor, Yokogawa, and Industrial Automation & Control (a local site engineering company) was assigned to the task.
- Work was done in 15 hours shifts for eight straight days, including Christmas.

Remarkable and Unique Solutions that Produce Results

Project Sulphos was successfully completed and the Yokogawa CENTUM CS 3000 is now running both the old and new phosphoric acid plants as well as the new sulfuric acid plant. And Yokogawa's contribution is not limited to replacement of the DCS; Foskor Richards Bay has also implemented the following unique solutions in its new production systems:

- Radio telemetry link between an effluent pumping station and the CS3000
- Remote login function that enables the customer's engineers to access CS3000 engineering stations from home
- Maximum demand load controller that protects a steam turbine co-generator
- Modbus interface link to remote telemetry and to feeder protection relays
- Wonderware INSOL8.0 long-term data historian that performs data collection via the Yokogawa Exaopc interface and provides trend data and reports via the company network and email

Foskor Richards Bay expects in the near future to complete installation of the CENTUM CS 3000 at its old sulfuric acid plants and at the granular fertilizer plant. It also plans to work closely with Yokogawa and Industrial Automation & Controlto link its production operations with a manufacturing execution system.

Through the course of this very successful project, Foskor Richards Bay and Yokogawa have built a strong relationship, and this has been a positive factor in motivating and obtaining a greater contribution from the personnel involved. Yokogawa is proud to have had the opportunity to take part in this prestigious project.

Plant Information

- Location: Rayong, Thailand
- Order: August 2008
- Completion: June 2010

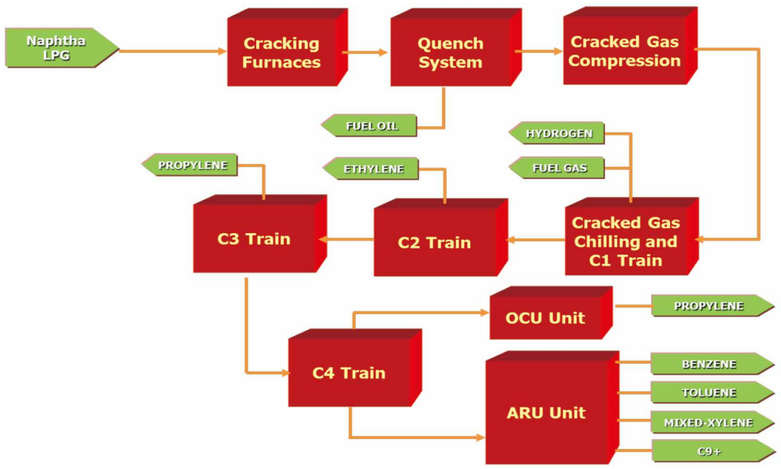
Map Ta Phut Olefins Company Limited

Operational Excellence by Asset Maximization, Utilizing Yokogawa's DCS, SIS, Analyzers, and Field Instruments

Executive Summary

Map Ta Phut Olefins Company Limited (MOC), SCG Chemicals 's subsidiary, operates a newly completed petrochemical complex at the Map Ta Phut Industrial Estate in Thailand's Rayong province. The complex produces 900,000 tpa of ethylene and 800,000 tpa of propylene, which is used in downstream plants to produce 400,000 tpa of high density polyethylene (HDPE) and 400,000 tpa of polypropylene.

Functioning for the first time as a main automation contractor (MAC), Yokogawa Thailand worked closely with the EPC contractor to deliver a comprehensive control and instrumentation solution for this greenfield project. This included the CENTUM VP production control system (PCS); the ProSafe-RS safety instrumented system (SIS); process gas chromatographs; analyzers; an advanced analytical instrument management system(AAIMSTM); HART differential pressure transmitters, temperature transmitters, and flowmeters; InsightSuite AE asset excellence services; an Exaplog event analysis package for alarm reduction; and the Exasmoc advanced process control package.



Wireless transmitter

Central control room

The Challenges and the Solutions

Project execution

In such a large greenfield project, it is important to start engineering and determine the basic specifications at an early stage. As the MAC, Yokogawa Thailand proceeded from front end engineering design (FEED) to the engineering phase, then undertook configuration & implementation, staging, and startup & commissioning. By executing this project as the MAC, Yokogawa Thailand was able to effectively manage the overall project schedule and reduce maintenance costs by maintaining consistency in the specifications.

Safety and efficiency

The CENTUM VP PCS and ProSafe-RS SIS were integrated using the same engineering environment. This reduced the overall engineering costs and resulted in a system that operates smoothly and efficiently. The PCS and SIS faceplates have the same look & feel, and security measures are in place that restrict access to the SIS faceplate.

The ethylene plant has multiple crackers and decoking is essential to maintaining efficient ethylene production. The InsightSuite AE analysis package calculates an optimum decoking algorithm that is used to optimize steam consumption, for greater efficiency and improved plant safety.

Asset maximization

To manage the more than 5,000 Yokogawa field instruments installed throughout this large complex, MOC opted for a remote monitoring solution based on Yokogawa's PRM plant asset management package that reduces the maintenance workload for field technicians and generates summary reports for future reference. This is backed by InsightSuite AE services that work 24/7 to identify issues and implement corrections that improve both availability and performance rate and reduce maintenance costs over the entire plant lifecycle.

The olefins plant has approximately 20 critical safety valves that are rated for SIL levels 1, 2, and 3, and they need to be checked periodically to determine that they are in correct working order. PRM's partial stroke test (PST) function allows these tests to be run from the control room, eliminating the need for technicians to go to each device to manually check its operation. This reduces workload and ensures safety.

Analyzer maintenance and data acquisition

Nearly 60 gas chromatographs and a large number of other types of analyzers in several analyzer houses are utilized throughout this petrochemical complex. An AAIMS is used to monitor, evaluate, and improve the performance of these on-line analyzers in a cost-effective manner. An AAIMS executes statistical analyses for analyzer validation; calculates validation KPIs such as availability rate, breakdown rate, checking rate, reproduction rate, and standard deviation; and generates SQC validation, maintenance, and key performance reports. An AAIMS has the following benefits:

- A flexible and reliable tool that centralizes the monitoring and management of analyzers
- Automates the collection of analyzer data in real time from the PCS, through an OPC server
- Automates the analyzer validation process

Working at an AAIMS workstation, operators, QMI personnel, and maintenance personnel can also manually enter and edit data like sample test results and maintenance records.

The information on gas chromatographs and other types of analyzers that is gathered with this system can play an important role in maximizing the efficiency of plant operations.

Customer Satisfaction

Witoon Pradubsripetch, the olefins production manager at the MOC complex, said, "We are striving to operate this plant safely and efficiently, and to make maximum effective use of all assets. That's why we are using field digital technology with FDT/DTM, PRM, and AAIMS. We have started using ISA 100 wireless devices at our raw material tank yard. All systems in this plant are integrated in the central control room. Our operators can clearly see everything that is happening in the plant. They know the status of each operation and have all the information they need to make correct and timely decisions. We appreciate the support given to us by Yokogawa Thailand."

Plant Information

- Location: Dushanzi, Xinjiang Uygur, China
- Order date: June 2006
- Completion: January 2010

PetroChina Company Limited, Dushanzi

Yokogawa Provides Control System and Field Instruments for New Refinery and Petrochemical Complex in China

Executive Summary

PetroChina, a subsidiary of China National Petroleum Corporation (CNPC), is China's largest oil producer. The company has recently completed construction of a huge integrated refinery and petrochemicals complex at Dushanzi in the Xinjiang Autonomous Region, in China's far west. The complex includes a 10 million ton per year (t/y) refinery and a 1 million t/y ethylene production facility, and is an important part of the China-Kazakhstan energy cooperation strategy.

The facility mainly processes Kazakhstan high sulfur crude from the Kazakhstan-China pipeline.
A total of 30 billion Chinese yuan ($4.4 billion) was invested in this integrated refinery and petrochemical complex, making this one of the country's largest construction projects. The refinery has 10 processes, including a 3 million t/y diesel production process, a 2 million t/y paraffin process, and a 1.2 million t/y delayed coking process. The petrochemical plant also has 10 different facilities, and these include 600,000 t/y HDPE, 550,000 t/y PP, and 600,000 t/y aromatics facilities.

While following PetroChina's basic philosophy of "Safety, Quality and Cleanliness," an Integrated Project Management Team (IPMT) completed this project in just 25 months, and the start-up of the various facilities proceeded quickly and efficiently. Of the approximately 100 major construction projects that were underway around the country at the time, this was number one in efficiency, an achievement that was recognized on the occasion of the country's 60th anniversary.

For this new integrated refinery and petrochemical complex, Yokogawa China successfully installed the CENTUM CS 3000 process control system and the Plant Resource Manager (PRM) package.

Petrochemical plant

Central control room

The Challenges and the Solutions

Integration of plantwide process control system for production excellence

CNPC is always striving to improve production efficiency and product quality. One of the key issues at this integrated refinery and petrochemicals complex is the collective management of all process data. Yokogawa's CENTUM CS 3000 production control system and PRM package are integrated with an analyzer system and other PLC systems via a Modbus interface, so all process data and status information can be monitored at the human machine interface (HMI) stations in the central control room (CCR). Based on the collected process data, which is accessed using the CENTUM CS 3000 system, many kinds of plant key performance indexes are calculated and analyzed to produce further improvements in efficiency throughout this integrated complex.

Safe operation for safety excellence

At such a huge refinery and petrochemical complex, plant safety is a primary concern. The core CENTUM CS 3000 production control system is integrated with a safety instrumented system (SIS), emergency shutdown (ESD) system, and compressor control system, allowing plant operators to have a comprehensive and detailed view of what is happening everywhere in the complex. They are thus able to take quick and decisive action whenever required, ensuring safety excellence.

Proactive maintenance for asset excellence

At this major complex, another important issue is how to minimize the total maintenance costs for more than 40 processes and over 100,000 instruments, including HART devices. Through the DCS architecture, CNPC Dushanzi wished to centrally manage many different devices from multiple vendors. Yokogawa's PRM package integrates all field device information and device diagnostic information into a single database, allowing real-time remote maintenance via the DCS network. During plant start-up, PRM helps the customer's engineers perform all the loop checks. When a problem occurs, the related instruments can be remotely checked and verified in just a few minutes.

Customer Satisfaction

Sun Zhaoshan, Chief Instrument Manager, said, "The basic starting point for reducing the total cost is to select the right instruments. The measurement method, accuracy, and type of material used in the wetted parts and the instrument body should be carefully checked right at the beginning of the project. Selecting the right instrument for each application ensures that it will work properly, and this can eliminate some problems that often occur later. This is based on my experience. For this big refinery and petrochemical complex, the biggest issue is how to minimize the labor time and cost of maintaining its nearly 100,000 field instruments. Yokogawa's PRM is a really good package for monitoring all of these field devices from my office." He went on to say, "We are going to use APC packages under the CENTUM CS 3000 system to access all of the field data, analyze the efficiency and other performance characteristics of the process units, and improve product quality. Yokogawa's CENTUM provides us a very reliable platform to achieve this."

Mr. Zhaoshan

Plant Information

- Location: Rayong, Thailand
- Order date: December 2007
- Completion: November 2008

IRPC

ABS Plant Migrates from CENTUM-XL to Integrated CENTUM CS 3000 Solution

Executive Summary

The Integrated Refinery and Petrochemical Complex Public Co., Ltd. (IRPC) in Rayong, Thailand has a refinery (215,000 b/d) as well as several petrochemical plants that produce chemicals such as olefins (360,000 t/y) and aromatics that are used as feedstock at various types of plastics plants. One of these petrochemical plants produces 140,000 t/y of acrylonitrile butadiene styrene (ABS). Although this plant had experienced no major problems with its CENTUM-XL process control system during the 19 years that it was in use, IRPC decided to upgrade to the latest technology when Yokogawa announced the end of service for CENTUM-XL.

To control complex production operations in a total of 17 batch reactors at this ABS plant, Yokogawa Thailand installed the CENTUM CS 3000 Integrated Production Control System together with CCTV equipment, a plant information management system (PIMS), the Exaplog Event Analysis Package, and the CS Batch 3000 package.

About ABS

This material is a terpolymer of acrylonitrile, butadiene, and styrene. Usual compositions are about half styrene with the balance divided between butadiene and acrylonitrile. Considerable variation is possible resulting in many different grades of acrylonitrile butadiene styrene with a wide range of features and applications. In addition, many blends with other materials such as polyvinylchloride, polycarbonates and polysulfones have been developed. Acrylonitrile butadiene styrene materials can be processed by any of the standard thermoplastic processing methods.

CENTUM-XL consoles

Instrument panel

DCS (Today)

The Challenges and the Solutions

IRPC wished to minimize the shutdown period for replacing the systems. Working together, Yokogawa Thailand and IRPC's project team carried out all configuration work for the new CENTUM CS 3000 system, and all functionality could be confirmed through a factory acceptance test (FAT) at Yokogawa Thailand's Bangkok facility. The plant only needed to be shut down for five days to install the new system and complete all rewiring to field devices.

The customer also wanted production operations at this ABS plant to run more smoothly and efficiently. The CS Batch 3000 package was installed to control the production of nearly 100 different polymerization batch recipes with this plant's 17 reactors and 3 strippers. By making it easier to configure, start up, and carry out these operations, production could proceed without interruption 24/7/365.

With the CENTUM-XL control system, the proliferation of both high and low process alarms and critical alarms was an issue. To ensure safe operations, it was essential for process alarms to be issued at the right time to the operators. The combined use of Yokogawa's Exaplog Event Analysis Package and the Advanced Alarm Administrator Suite (AAASuite) has improved alarm management at this plant. By eliminating alarm overload, operators no longer miss important alarms and are able to make a correct and timely response. The control room is much quieter and calmer than before and operator stress levels are down considerably. Large screens that display production data and CCTV video also improve efficiency by giving operators a much better overview of what is happening throughout the plant.

Customer Satisfaction

Wichian Art-ong, Instrument Supervisor, said, "We are very happy that we have been able to operate the ABS plant without any major problems. We have no complains with the Yokogawa systems." He went on to say, "The entire integrated production system is functioning well. We are able to view video from the CCTV cameras as well as other production data on large screens positioned near the CENTUM human machine interface (HMI) stations. Plant information can also be viewed from any location using a standard web browser.

Chemical
(Base Chemical, Fertilizer, Petrochemical)

Plant Information

- Location: Huizhou, Guangdong, China
- Order date: November 2002
- Completion: December 2005

CNOOC and Shell Petrochemicals Company Limited

Future-Proof Digital Petrochemicals Complex

Executive Summary

The largest FOUNDATION™ Fieldbus (FF) installation in the world
- 16,000 FF devices out of 60,000 I/O points
- Main Automation Contractor (MAC) from early engineering stage through start-up/commissioning
- DCS anywhere concept integration with site SAP system
- Long term maintenance contract - Sustainable development

Project Overview

The CNOOC and Shell Petrochemicals Company Limited (CSPC) has built and now operates a USD$4.1 billion world-scale petrochemicals complex, which is one of the largest capital investments for a Sino-foreign joint venture project to date in the People's Republic of China. The complex, covering an area of 2.6 square kilometres, is located in Daya Bay Economic and Technological Development Zone, Huizhou, Guangdong Province.

The joint venture partners are Shell Nanhai B.V., a member of the Royal Dutch Shell, with a 50 per cent stake, and CNOOC Petrochemicals Investment Company Limited (CPIL), also with 50 per cent. CPIL is owned by China National Offshore Oil Corporation (CNOOC) (90%) and Guangdong Guangye Investment Group Company Limited (10%).

The CSPC petrochemicals complex incorporates the world's most advanced technologies and utilizes modern management systems and international standards in the design, construction and operation phase. Its adoption of 13 patents through international bidding ensures it operates on the cutting edge of technology. Additionally CSPC applies the principles of sustainable development throughout the design, construction and operation of the complex, demonstrating its strong commitment to the community and the environment.

The complex is an integrated petrochemical complex. The major facilities of the complex include 11 process units, steam and power generation and other utility provisions, storage and handling and shipping facilities, as well as effluent treatment and environmental protection facilities.
The majority of the production facilities are world-scale and all are being designed to international standards. The heart of the complex is a world-scale cracker producing 800,000 tons per annum ethylene and 430,000 tons per annum propylene. It is designed to take naphtha as well as heavy feedstock such as condensate. This is the first of its kind in China.
In total, the complex produces some 2.3 million tons per annum of products. It supplies products primarily to Guangdong and the high consumption areas of China's southeast coastal economic zones where demand is projected to remain strong.

The Challenges and the Solutions

Field auxiliary room

Plant Resource Manager (PRM), a real-time device management and advanced diagnostics software package, connects to the 16,000 FF devices and enables a problem to be diagnosed and an alert issued before the instrument actually fails and disrupts a process. The system continuously monitors the health of the instrumentation, resulting in increased reliability and fewer suspect measurements. With this preventive maintenance capability, plant operators can have greater confidence that their facility will perform as expected.

The system has an approximate total of 60,000 I/Os, of which 16,000 are FF devices.
There are 200,000 software I/O tags and around 3000 segments, and these are controlled by nine CENTUM CS 3000 distributed control systems and 120 field control stations (FCS).
To control the field instrumentation, there are three control centers and fifteen field auxiliary rooms, and they are connected by fiber optic cables to form a plant control information network (PI-LAN).

Yokogawa was selected as the main automation contractor for this project and the Yokogawa project team has been involved in this from the front end engineering design phase, ensuring complete consistency in specifications. The functional design specification phase, detailed design specification phase, staging, factory acceptance test, site acceptance test, and commissioning were all well organized and carried out together with EPC contractors through a project management contractor.

The DCS anywhere concept stresses the importance of having access to the control room from any location in the plant or office to perform diagnosis, monitoring, and management. Our plant information network is one of the most advanced in the world today.

A unique feature of this project is our sustainable development program. Yokogawa has not only worked together with CSPC to construct a large petrochemicals complex, it has helped train its local employees in process control and current process instrument technology.

Control center

Sustainable development program

Mutual trust

System Details

DCS :	CENTUM CS 3000 with FF devices Plant Resource Management Package (PRM)
Operational Data System (ODS) :	Yokogawa Exaquantum
Movement Automation System (MAS)	
Industrial TV :	FIELDEYE

Plant Information

- Location: Rayong, Thailand
- Order date: May 2009
- Completion: April 2010

PTT Aromatic and Refining Public Company Limited

Legacy DCS was Replaced by New Production Control Platform CENTUM VP in Aromatics Plant

Executive Summary

PTT Aromatics and Refining Public Company Limited (PTTAR, Current PTT Global Chemical Public Company Limited) is originally Aromatic Thailand Corp. (ATC). PTT AR is a huge petrochemical complex located at Rayong, Thailand. It processes condensate as the main feed and produces Benzene, Toluene, Paraxylene, Orthoxylene, Mixed Xylenes and Cyclohexane including by-products like Light Naphtha, Raffinate, LPG, Hydrogen-rich gas, Condensate Residue and heavy aromatics.

The process units include Feed Fractionation, Naphtha Hydrotreating, CCR Platforming, Feed Preparation, Sulfolane, Benzene/Toluene Fractionation, Xylene Fractionation, Parex unit, Tatoray and Isomar process units.
The unit produces 662 KMTA of Benzene, 1195 KMTA of Paraxylene, 200 KMTA of Cyclohexane, 66 KMTA of Orthoxylene, 76 KMTA of Mixed Xylenes and 60 KMTA of Toluene.

When the company started as ATC in year 2000, Yokogawa Thailand installed CENTUM CS which OS is based on UNIX. The CENTUM CS was continued utilizing in PTT AR nearly 10 years without any major problem. And the advanced process control packages such as Exasmoc/Exarqe/Exacoast were also implemented in all the process areas. Totally 18 SMOC controllers and 19 RQE's were implemented, in addition to 7 Exacoast ZBAL controllers for the various heaters. About this implementation, it was a significant achievement for Yokogawa as great satisfaction was expressed by PTT AR and the alliance partner, Shell Global Solution International. The entire project was completed in a record of 14 months. The major benefit was realized through the Exasmoc controller that had demonstrated that CCR feed could be comfortably raised by additional 3% by weight. The payout period is less than 4 months.

The existing CENTUM CS ICS have the end of service (EOS) and the spare part cost increases, some parts are obsolesced. It made high cost maintenance in the future. PTT AR decided to replace the CENTUM CS ICS with most current Yokogawa's DCS CENTUM VP HIS, but the controller still using CENTUM CS. Yokogawa Thailand successfully installed and commissioned the system.

Central control room

The Challenges and the Solutions

Central control room design

PTT AR needs higher efficient operation, so based on their daily work flow in the existing operation, Yokogawa Thailand proposed a design of a new central control room based on the ergonomics deign experiences. This new control room design contributes to improve the operation, productivity for further sustainable manufacturing as well as safety operation.

Smooth Migration

PTT AR needs to minimize the plant shut down period. PTT AR project member and Yokogawa's engineers were in "One Team" and the project member completed the hot cutover without any stop of the plant operation.
The biggest man hour spending part in this replacement project is to convert the existing graphic displays more than 200 pages into the new system. Yokogawa Thailand effectively used the conversion tool and reduced the lot of the engineering time. So the FAT was very smoothly executed without any big problems and the migration work is flawlessly executed.

Plant per formance monitoring

PTT AR needs to use the existing APCs continuously, because the benefit from this APC is remarkable.
All plant real time data are collected by PI and the plant performance is calcurated in this package and is always monitored and clearly visualized by the production members.
This plant performance data is used for the analysis of the product quality and the improvement through a plant lifecycle operation.

Customer Satisfaction

According to production manager, " We are very proud of using Yokogawa's production control system. We are now operating this aromatics plant 24 hours/7 days for whole year without stopping. We are working together with Yokogawa for further sustainable manufacturing. Yokogawa is solution provider company and Yokogawa is one of best partner company for us"

Plant Information

- Location: Tianjin, China
- Order date: September 2007
- Completion: January 2010

SINOPEC SABIC Tianjin Petorochemical Co., Ltd.

Yokogawa Provides CENTUM CS 3000, PRM, and Exaquantum Solutions for China's Largest Refinery/Petrochemical Complex

About the SINOPEC-SABIC Joint Venture and the Tianjin Projects

SINOPEC SABIC Tianjin Petrochemical Co., Ltd. (SSTPC), a 50/50 joint venture between Saudi Basic Industries Corporation (SABIC) and China Petroleum & Chemical Corporation (Sinopec), has constructed a huge, integrated refinery and petrochemical complex in Tianjin, China. The petrochemical facility at this complex was built at a total cost of 18.3 billion RMB (US$2.7 billion) and has an annual capacity of 3.2 million tons, of which 1.2 million tons is ethylene and the remainder is downstream products such as polyethylene, ethylene glycol, polypropylene, butadiene, phenol, and butene-1*.

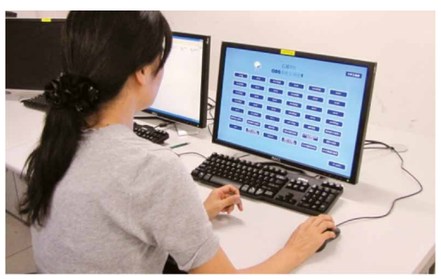
The ethylene cracker, eight downstream units, and all associated utilities took just 27 months to build and began commercial production in May 2010 after a three month pilot operation phase during which ethylene production capacity was ramped up from an initial 0.2 million tons to the present annual capacity of 1.2 million tons. The refinery initially had a production capacity of 5.5 million tons, but this was soon increased to the present 15.5 million tons.

In addition to expanding local production, the complex will upgrade the chlorine-alkaline industry in Tianjin and promote economic development of the New Binhai District and Tianjin municipality. Initial estimates indicate this will support an annual GDP increase of more than four percent in Tianjin and trigger investment of an additional 100 billion RMB (US$14.8 billion) in downstream and associated industries.

* Capacities for other downstream products produced at the Tianjin petrochemical facility:
Gasoline hydrogenation: 650,000 tons, LLDPE: 300,000 tons, HDPE: 300,000 tons INEOS Innovene S process), PP: 450,000 tons LyondellBasell Spherizone PP), EOEG: 420,000 tons (Dow technology, Phenol: 350,000 tons, butadiene, 200,000 tons, MTBE: 120,000 tons, butane: 50,000 tons

The Challenges and the Solutions

SSTPC wanted to achieve a major increase in production capacity through the construction of large-scale and fully integrated oil refining and petrochemical production facilities. The company was looking to achieve specific cost, safety, and environmental protection targets, and required a partner with high quality project execution capabilities. To accomplish these objectives and meet these challenges, SSTPC turned to Yokogawa. As the main automation vendor for the refinery and petrochemical facility projects, Yokogawa successfully installed CENTUM CS 3000 production control systems, Exaquantum plant information management systems, Plant Resource Manager (PRM) packages, and over 40,000 HART field devices, including Yokogawa EJA transmitters and valves. In this undertaking, Yokogawa engineers were involved from the very early project stages and worked closely with their counterparts at the Sinopec Engineering Institute (SEI) and 10 engineering companies.



Exaquantum for monitoring plant efficiency

A closer look at some of the product solutions provided by Yokogawa follows.

- Process data management is a key issue in the petrochemical complex because plant efficiency needs to be continuously monitored to prevent the occurrence of major problems that can lead to costly plant shutdowns. Once a shutdown occurs, a lot of work and energy must be expended to start it up again. Yokogawa's Exaquantum helps to prevent this by providing a window into the various processes at this huge complex by continuously analyzing their data.

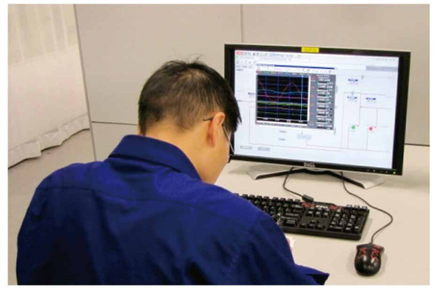
- Maintenance of thousands of HART devices throughout the refinery and petrochemical facilities would be very time consuming if field operators had to check them one at a time. With Yokogawa's PRM package, operators can determine at a glance whether field devices from Yokogawa and other vendors are in good working order. This allows a much more efficient proactive maintenance approach that results in significant savings in maintenance costs.

PRM for proactive maintenance

- For more efficient engineering work, CENTUM CS 3000 engineering stations and other vendor's engineering stations are all together located in this room. On-Line maintenance capability of CS 3000 is very much appreciated by SSTPC engineering department.

Plant wide engineering room

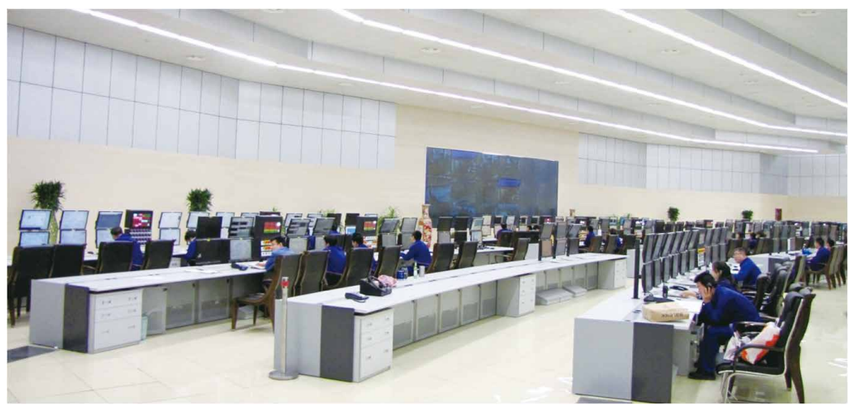
- Process engineers are always looking for the best control strategy to improve production efficiency and product quality. They need to confirm the current process situation and identify whether a new strategy can achieve the desired improvements. SSTPC engineers do this in the second floor system room.



Optimizing production

Customer Satisfaction

Zhang Senlin, Vice Deputy Director of the Equipment Managing Department, said, "We are very much proud that this huge refinery and petrochemical complex has been running very smoothly without any major problems since January 2010. We appreciate Yokogawa's project members working together as "One Team." We completed all configuration based on the same standard specifications and procedures. And we appreciate the easy configuration of the CENTUM CS 3000 system and its high reliability. It will bring huge savings in maintenance of the entire system."



The central control room for petrochemical plants

Chemical
(Base Chemical, Fertilizer, Petrochemical)

Plant Information

- Location: Dayawan, Huizhou, China
- Order date: November 2003
- Completion: December 2005

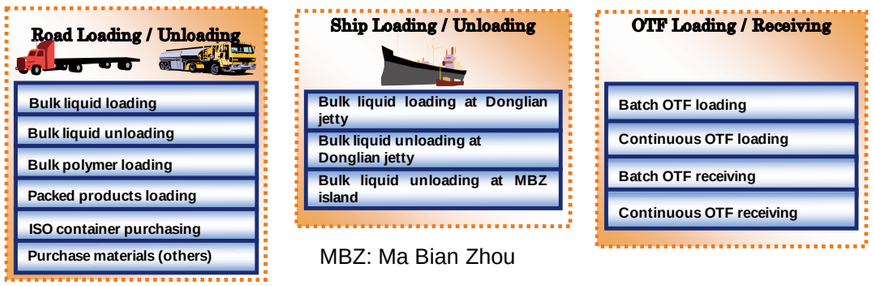
CNOOC and Shell Petrochemicals Company Limited

Yokogawa MAS Controls Product Movement and Distribution at Huge Petrochemical Complex

Executive Summary

The CNOOC and Shell Petrochemicals Company Limited (CSPC) complex at Dayawan in Huizhou, China produces 2.3 million tpa of various petrochemicals. This facility's diverse logistics and complex oil and solid product distribution and movement are controlled and managed by a Yokogawa movement automation system (MAS). The MAS is the backbone of logistical operations involving the loading/unloading of 250 trucks each day and 60 ships per month for delivery sales and the downstream shipment of products to outside the fence (OTF) companies for OTF pipeline sales.
The unique design and engineering of this complex has been a key factor behind the efficient and fully optimized management of CSPC's logistics. With its seamless interface to the customer's enterprise resource planning system (ERP), this MAS has enabled CSPC to efficiently and cost effectively load/unload a variety of products/materials.

The MAS system used by CSPC has the following operation categories for product movement.



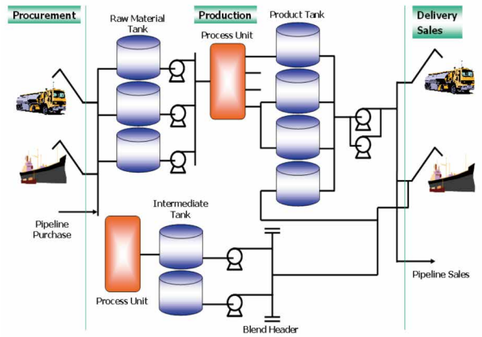
MBZ: Ma Bian Zhou

Logistics and MAS in Supply Chain Management

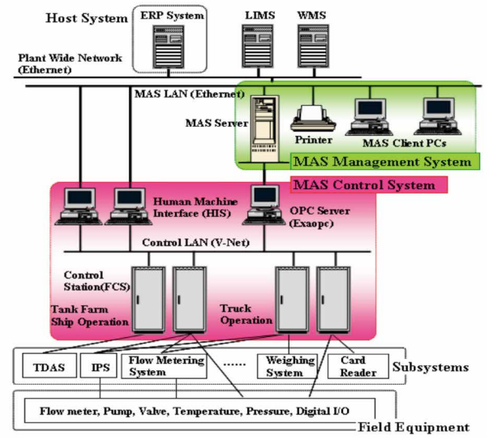
In the petrochemical industry, where the daily flow of product movements in and out of plants is automatically performed and continuously monitored, an MAS is an essential part of the logistical infrastructure. The following processes are controlled by an MAS:

- movements of procured materials
- feeding of raw materials to processing plants
- rundown of final products from process units to product tanks
- blending of multiple materials for production of component products
- distribution of discharged products to clients via truck or ship (delivery sales), or pipeline (pipeline sales)

The product distribution to clients and all the requisite product movements are managed and controlled by the MAS.



CSPC's product movements



TDAS=Tankage Data Acquisition System
IPS=Instrument Protected System

The MAS system architecture

About the MAS

The Yokogawa MAS is comprised of management and control systems. The management system employs a client/server architecture and mainly supports logistical coordination and supervisory activities through an interface to CSPC's higher level ERP system. A Yokogawa distributed control system (DCS) serves as the MAS control system. This oversees and monitors the loading/unloading of products. The high reliability of the DCS coupled with a very high system availability of 99.99999% makes it the perfect choice for product movement.

Key Challenges

The key challenges in the design and engineering of the MAS were the achievement of the following items in various operation environments and in such a way that the system functionalities could be easily adapted by system operators and users. With regard to road operations, i.e. truck loading/unloading, all of these challenges were taken into consideration during the design phase.

- Versatile interface with ERP system
- Logistical coordination and supervisory support functionalities
- Securing of the business control process in the operational business flow

Customer Satisfaction

With supply chain management, a business operation can achieve significant cost savings by optimizing and improving the efficiency of its logistics operations. The upfront investment in technology for a MAS system requires also a well thought out flow of business operations and robust business controls in its logistics operations. Operational Excellence in delivery and distribution can achieve tangible improvements in unit costs through the efficiency and optimization of operations and the reduction of rework and human error. The key to cost benefits is having robust design criteria that meet the operational requirements of the above challenges.

Chemical
(Base Chemical, Fertilizer, Petrochemical)

Plant Information

- Location: Texas, USA
- Order date: 2002
- Completion: 2003

Nisseki Chemical Texas Inc.

One-day Switchover Turns into Profit Increase

About Nisseki Chemical Texas Inc.

Nisseki Chemical Texas Inc. is a wholly owned subsidiary of Nippon Petrochemicals Company Ltd., which is the petrochemical division of Nippon Oil in Japan. The company was established in 1989 and the manufacturing plant was started up in 1994. Nisseki Chemical Texas Inc. was initially founded to produce a high voltage electrical capacitor fluid and a solvent that is primarily used in the manufacture of carbonless copy paper. Additional products have also been developed and the company now makes a variety of specialty chemicals and chemical intermediates.

Background of This Project

Nisseki Chemical was using a distributed control system (DCS) from another supplier but was dissatisfied with the huge costs that were being incurred to upgrade and maintain this system. To improve the productivity of the plant, the company made the decision to replace this legacy system and to do so with minimum disruption to its operations.

The Customer's Challenges

Against the above mentioned background, the customer faced the following challenges:

- Was using a legacy system that was becoming increasingly expensive to operate
- Needed to turn into profit increase
- Had to complete the replacement project in a short time

What the CENTUM CS 3000 Solution Contributed

Not a single wire touched

Yokogawa offered to migrate Nisseki Chemical to the world renowned CENTUM CS 3000 without touching a single wire in the field. This migration solution to a state-of-the-art control system was low cost, low risk, and cost effective. Due to the need for a rapid turnaround in this project, the cable switching was done within one day. No field re-wiring was required thanks to the use of a fully compatible field terminal assembly (FTA) board.

A simple and cost-effective migration solution

With Yokogawa's migration solution, Nisseki Chemical's legacy controllers and process interface units were replaced with CS 3000 I/O and processors utilizing special marshalling panels and adapter cables that connected to the existing terminal panels. Auto conversion of user applications was not necessary since the applications in use were simple and easily understood.

Dramatic Reduction in Process Downtime

None of the existing field wiring was disturbed and no new cabinets needed to be wired, achieving a dramatic reduction in process downtime. In fact, thanks to the compact design and high density of the CS 3000 cards, the number of cabinets required was reduced and valuable space was freed up for other uses.

Results

The actual replacement of Nisseki Chemical's legacy system took just one day and the entire project was completed with just five months of preparation. This project achieved the following results:

Faster commissioning

The elimination of field rewiring and the resulting rapid switchover from the legacy system to the CENTUM CS 3000 meant that Nisseki Chemical plant could minimize the opportunity cost incurred by having production lines shut down.

Productivity Improvement and Cost Effectiveness Achievement

The state of the art capabilities and high reliability of the CENTUM CS 3000 control system has reduced operating costs and improved uptime at the Nisseki Chemicals plant.

Customer's Satisfaction

Nisseki Chemicals has been very impressed at the speed and cost-effectiveness of the switchover from its legacy system to the CENTUM CS 3000 and is more than satisfied with the system's performance and functionality. They are pleased to have made the right choice in going with a Yokogawa migration solution.

Central control room

Plant Information

- Location: Puyang city, Henan province, China
- Order date: September 2010
- Completion: October 2011

Sinopec Zhongyuan Petrochemical

Stable Operation and Proactive Maintenance Realized at New Coal-chemical Plant in China

Executive Summary

Coal is an important resource of energy in China, and the conversion of coal to a wide range of chemicals has become increasingly important in recent years. Sinopec Zhongyuan Petrochemical Co., Ltd. (hereinafter referred to as "ZPC") is a large joint venture between China Petroleum & Chemical Corporation (hereinafter referred to as "Sinopec") and the government of Henan province. With significant support from its parent organizations, ZPC has built a new 600,000 t/y methanol to olefins (MTO) plant and a 100,000 t/y polypropylene plant, along with all the necessary utility and auxiliary facilities, in Puyang. These plants became operational in October 2011 and are of great strategic significance to the development of Sinopec's coal-chemical business.

An MTO plant uses catalysts to convert coal-derived methanol into olefins such as ethylene and propylene. This MTO project uses Sinopec's proprietary S-MTO process, which is characterized by high olefin selectivity, high methanol conversion, and low catalyst consumption. To ensure safe and stable operations at this MTO plant, which handles materials that are highly flammable and explosive, delicate process control is required.

For this large-scale greenfield MTO plant, ZPC and Sinopec Engineering Inc. (an engineering, procurement and construction company referred to henceforth as "SEI") selected Yokogawa China Co., Ltd. as the main control system supplier. For this project, Yokogawa China delivered the CENTUM CS 3000 process control system (PCS) and the Plant Resource Manager (PRM) software package for plant asset management (PAM).

The Puyang MTO plant

The MTO plant's central control room

The Challenges and the Solutions

Quick implementation

Because the control logic for the S-MTO process is so complicated, the engineering work for this project was very complex and time consuming. Yokogawa engineers made good use of their deep knowledge and experience in the ethylene and coal chemical fields to expedite work on this project and deliver ahead of schedule very high quality work, which helped to ensure a successful and efficient commissioning and startup. ZPC, SEI, and Yokogawa all took a team approach and worked closely from start to end. Thanks to their good synergy, they were able to complete this project ahead of schedule.

Safe and stable operation

To ensure safety at these plants, ZPC needed to closely monitor and control its processes, especially those involving chemical reactions and heat exchange. For this S-MTO project, Yokogawa's PCS was integrated with a third-party safety instrument system, compressor control system, and online process analyzer system via Modbus, which allows operators at the human machine interface (HMI) stations in the central control room to monitor and control operations throughout the plant, ensuring that they can respond quickly when faced with an abnormal situation. Plant safety and stability are thus assured.

Efficient maintenance

The MTO plant has a large number of HART-enabled pressure transmitters, flowmeters, valves, and other devices from different suppliers. Having real-time diagnostics for these devices helps operators keep close track of their status and identify maintenance issues before a device fails. For central management of these devices, they are all integrated with the Yokogawa PCS via the PAM software package. Using the HART protocol and the PCS network, the PAM system gathers all the device data and diagnostic information into a single database. If a device problem is identified, engineers are able to check the device in time and clarify the cause. This centralized asset management minimizes trips to the field and ensures a more proactive maintenance approach. During plant startup, this system also helped the engineers check all loops.

Customer Satisfaction

The Director of the Instruments Department at ZPC points out the following three factors about this project: "First, Yokogawa's CENTUM CS 3000 has excellent reliability and stability. We particularly appreciate its online maintenance capability. Configuration changes are immediately shown on the HMI without interrupting the control function. This is important in completing startup in a short time and improving and optimizing process control. Second, this is an S-MTO pilot project using Sinopec's proprietary technology. During control engineering, Yokogawa's engineers showed that they have a deep understanding of control solutions and a lot of experience in dealing with complex problems. They made good use of their know-how from the petrochemical industry and, working together with engineers from ZPC and SEI, were able in a very short time to produce high quality engineering. Third, ZPC's personnel have considerable experience operating Yokogawa's CENTUM CS 3000 system, enabling the project partners to perform to the best of their abilities during the project implementation phase. At the same time, Yokogawa's engineers were fully involved in the control engineering, FAT, SAT, and startup. Above all, the key to the success of this short-term project was the good cooperation and teamwork of ZPC, SEI, and Yokogawa."

Chemical
(Base Chemical, Fertilizer, Petrochemical)

Plant Information

- Location: Yeosu, South Korea
- Order date: July 2003
- Completion: May 2004 (CS 3000) + 2006 (Exapilot)

South Korean Petrochemical Company

Exapilot Automates Naphtha Cracker Decoking and Dryer Regeneration Processes at Large Ethylene Plant

Executive Summary

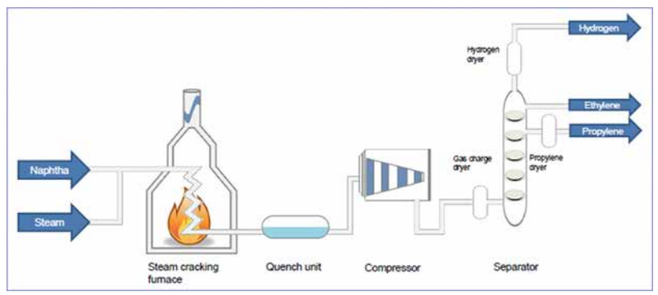
South Korea's petrochemical company is located in the town of Yeosu. The plant started from 350,000 tons of ethylene per year production and expanded to 1,000,000 tons per year now. There are twelve naphtha cracking furnaces in this plant. The naphtha used as the feedstock for this plant is fed to a pyrol-ysis (steam cracking) furnace, where it is combined with steam and heated to 980 to 1,080 deg C. Within this temperature range, the feedstock molecules "crack" to produce ethylene as well as methane, hydrogen, ethylene, propylene, butadiene, benzene, toluene, xylene, and other co-products. After the pyrolysis reaction is quenched, the rest of the plant separates the desired products into streams that meet the various product specifications. The process steps include distillation, compression, process gas drying, hydrogenation (of acetylenes), and heat transfer.

All of the processes at this ethylene plant are controlled by a Yokogawa CENTUM CS3000 pro-duction control system that was engineered, installed, and commissioned by Yokogawa Korea. To further enhance operations at this plant, Yokogawa Korea introduced the Exapilot operation efficiency improve-ment package in 2006.

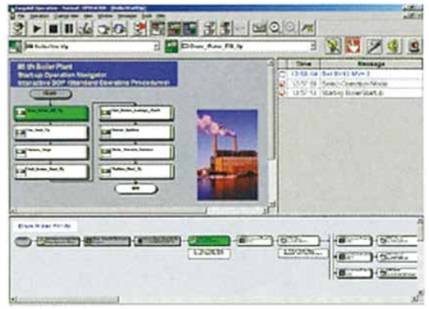
The Challenges and the Solutions

- **Automation of naphtha cracker decoking**

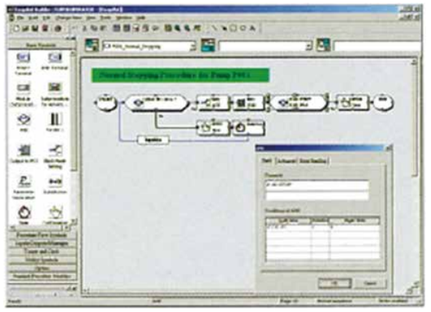
The pyrolysis reaction process in the ethylene plant employs naphtha cracking units (NCU), quench units, compressors, and dryer-equipped separators. The NCUs' operating temperature is carefully controlled to ensure efficient production. During the pyrolysis reaction, coke forms inside the NCU coils, resulting in decreased heat transfer and a decline in reaction efficiency. In the worst case, the coils can crack or rupture. To prevent this from happening, the plant operators need to perform a decoking process. For each of the twelve NCUs in this ethylene plant, this must be done either every 60 days that the furnace is in operation or when the furnace temperature reaches 1,080 degC, whichever comes first. An important consideration in this is scheduling as the plant's operators in the central control room have a very demanding workload.



Pyrolysis reaction process



Operational function for automation of manual operation



Builder function for automation of manual operation

The managers of this plant decided to automate this complex, non-routine process. After taking one year to plan the methodology and the necessary parameters and sequence of procedures, they decided to use Yokogawa's Exapilot solution to optimize the execution of the overall process. Using Exapilot, they created a program in flowchart format that specified all the necessary procedures and parameters. No special programming knowledge was required in this, and the resulting flowchart could also be printed out for use as a standard operating procedure manual.

On the Exapilot program screen, the icon corre-sponding to the procedure that is currently being implemented is highlighted with a different color, making it easy for operators to monitor the progress of the process. These icons can also be used by field and board operators to confirm DCS data settings and issue instructions to be carried out at specific points in the process. As a result, the NCUs at this plant are now operating more safely and efficiently.

- **Automation of dryer regeneration**

Three dryers are located adjacent to the separation unit: the charge gas dryer, hydrogen dryer, and propylene dryer. To maintain the efficiency of all sub-sequent processes, each of these dryers needs to be regenerated when it becomes saturated with moisture. This regeneration process is complex, requiring the operation of numerous valves. Exapilot is used to ensure that this essential process is carried out correctly, safely, and efficiently.

Customer Satisfaction

The leader of the naphtha cracking department at the Yeosu plant explained that Exapilot is easy to understand and use, allowing them to create flow-charts of standardized procedures based on the expertise of their best operators, and to easily make corrections whenever a procedure needs to be changed. Operators are now able to interactively navigate through the complex processes of decoking and dryer regeneration. Thanks to the near complete automation of these processes, operator workload has been drastically reduced and safety has been enhanced. The personnel here are now striving to improve many other processes at this large petro-chemical plant and believe that this and other Yokogawa solutions are helping to make them more globally competitive. They plan to keep working together with Yokogawa Korea to realize this goal.

Summary of Customer's benefits

1. Reduced operator workload
2. Fewer operator errors
3. Safer operations
4. Reduced steam consumption
5. Lower maintenance costs