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Birth of a Norwegian giant

In 2008, Det norske discovered hydrocarbons in the Ivar Aasen field some 180 kilometers off the Norwegian coast. When the plan for development and operation was approved by the Norwegian parliament in May 2013, the company immediately started preparing to build an offshore platform to exploit the field – an important milestone in the company’s history. Through Ivar Aasen and with a comprehensive and advanced technology package from Siemens, Det norske will become a leading oil producer on the Norwegian shelf.
The project

New fixed platform in the North Sea, Norwegian Continental Shelf

- EPC: SMOE / Wood Group, Mustang London
- Yard: SMOE
- Operator: Det norske

Siemens provided a comprehensive package for electrical distribution, instrumentation, control, and telecommunications

- Integrated control and safety system
- Field instruments
- Electrical distribution
- Telecommunications
- Integrated operations
- Project management and engineering
- Integrated team
- Package standardization

named after the famous Norwegian poet Ivar Aasen, the field is Det norske’s first major development project as an operator. The project comprises resources in several fields and includes two neighboring deposits: West Cable and Hanz. The field’s lifetime is expected to be 20 years, and, at present, reserves are estimated to be 200 billion barrels of oil equivalents. With Statoil, Bayerngas, Wintershall, VNG, Lundin, and OMV as partners, Det norske will invest 27 billion Norwegian kroner to ensure a good and safe development of the field. “Ivar Aasen makes us a significant player in the oil and gas industry on the Norwegian shelf,” says Geir Westre Hjelmeland, vice president of the Ivar Aasen asset for Det norske. “That is why we have carefully selected partners for this project, as close cooperation and alignment are critical to secure a project that delivers on HSE standards, quality, schedule, and cost.”

An integrated solution for integrated operation

One major package comes from Oslo and Trondheim in Norway, where a team of dedicated oil and gas specialists from Siemens has worked hard over the past two years to create the foundation for integrated operation at the Ivar Aasen project. Specifically, the team had to present a solution for networking the onshore control room at Det norske’s headquarters in Trondheim with the offshore control system, plus supplying a data acquisition and visualization system for operations management based on XHQ.

For Det norske, integrated operation is key to meeting production goals and facilitating an efficient work process, both offshore and onshore. For this purpose, the company has two mirroring control rooms, one located offshore on the Ivar Aasen platform and the other onshore in Trondheim. The question, says Hjelmeland, who is also part of the project leadership team for the Ivar Aasen development, is how to best utilize available resources to ensure safe and efficient offshore operations. That includes support for maintenance scheduling and planning; the ability to effectively hand over tasks between the onshore and offshore teams; and support for daily offshore operations through analysis, studies, and good planning.

With Simatic PCS 7 and XHQ, Siemens was able to provide the right solution for this integration of teams, data, and expertise. Siemens also offered
the best overall package for the entire electrical, instrumentation, control, and telecommunications (EICT) package, for which Det norske wanted to contract as few suppliers as possible. All the systems for electrification, process automation, and operations management had to be delivered as one project. But technology alone was not everything, as Hjelmeland explains: “We saw that in addition to offering proven and reliable technology, Siemens also had the right spirit to bring to the project – we wanted a team that would support the hands-on approach that we had chosen for the project, that would be proactive and work as a joint team with all the other partners to find the best solution. And Siemens was able to live up to this expectation.”

Comprehensive scope
The EICT package comprised an integrated control and safety system based on the Simatic PCS 7 process control system with dedicated oil and gas libraries, field instruments, systems for electrical distribution, and telecommunications. Det norske specified that the engineers for the EICT package

who led the Siemens Ivar Aasen EICT project. This reflects a larger industry trend of shifting more risk onto suppliers by choosing single vendors. Hjelmeland agrees: “Different project set-ups each have their benefits and challenges. By splitting such a large project into multiple packages, you create many interfaces that you have to monitor and manage. For Ivar Aasen, we assessed this and chose a solution supporting aligned teams and integrated operation – and that is basically what is reflected in the EICT systems.”

Global team approach
Following receipt of the official order in March 2013, Siemens set up a global team of experts to optimize collaboration with the various project partners. Project management, administration, and technical lead engineers for the EICT project execution were based in Oslo, where Siemens has a strong and dedicated team of offshore oil and gas experts. The Oslo team was responsible for the engineering and procurement activities for all disciplines. The detail engineering for the HMI systems was supported by the Siemens Center of Competence in Mumbai, India. A dedicated team of EICT engineers based in London supported the engineering company Mustang in the basic design. Field instrumentation was provided through the Siemens organization in Karlsruhe. Siemens was also responsible for the delivery and standardization of all low-voltage motors for SMOE and the package vendors.

The engineering phase was completed in late 2014. Through 2016, Siemens will continue to support

Integrated operation
The concept of integrated operation, often also called the Digital Oil Field, is a combination of IT, automation, and instrumentation to improve the existing technologies in the oil and gas industry. It aims at faster and easier data analysis through efficient data management, providing a more realistic image of the reservoir and the availability of resources, helping to optimize the production process, and rendering operations safer through remote surveillance and collaborative environments.
Produced water for Ivar Aasen

Ivar Aasen receives pressure support from reinjected produced water mixed with seawater. Mixing seawater and produced water has a high risk of scaling in the injection systems – which might lead to reduced production or even loss of production. Siemens offshore experts in Norway have designed and delivered a water treatment system that reduces the sulfate content in the seawater, which is what causes the scaling.

Most commonly, the produced water – that is, the water separated from the oil – is treated before being discharged into the sea. Reinjecting the produced water both eliminates the source of pollution and provides pressure support for the reservoir. This also helps lift exploitation rates. On average, reservoirs are exploited to a mere 30%. On the Norwegian shelf, advanced production methods have raised this rate to 50%. The target in Norway is to reach 70% through water-based enhanced oil recovery methods. In Norway alone, increasing the exploitation rate by 1% amounts to a full three years’ worth of production.

How does it work?
Every oil reservoir contains water. The amount of water lifted from the wells increases as the reservoir ages. This water is separated from the oil on the platform and is then reinjected into the reservoir. However, produced water can provide sufficient pressure support only after five or six years of production, as initially the water content in the oil is too low. For this reason, seawater is used as a makeup source. In order to prevent scaling in the injection equipment, piping, and formation, the dissolved sulfates present in seawater must be removed by membrane nanofiltration. Sulfate removal also prevents hydrogen sulfide production (souring) in the formation, which degrades the oil quality and produces hazardous gases.

Why is it special?
On Ivar Aasen, Siemens Norway has designed and installed a water treatment system that can operate reliably in a harsh offshore environment such as the North Sea. In addition to removing sulfates, the system will also remove any sizable particles and reduce the oxygen in the seawater to prevent corrosion of pipes and equipment. On a platform, space is very valuable, so the size and weight of modules is very important. The ultrafiltration system from Siemens is currently the most compact and lightweight available on the market. Moreover, it is fully automated and can easily be integrated into the operation control system, so it can be monitored and controlled from an onshore operations center. In the Ivar Aasen project, the Siemens design was the only system that could fit in the allocated space for this solution.

What is next?
The systems for ultrafiltration and sulfate removal have already been delivered to the Singapore yard for installation. Siemens will also provide additional support during installation, commissioning, and operation. In the meantime, the Norwegian offshore water treatment experts are already working on several orders for seawater treatment systems in Norway. Siemens will soon deliver compact ultrafiltration systems for two floating production, storage, and offloading (FPSO) vessels in West Africa.

1. Oil reservoirs contain a natural water layer called formation water that lies under the hydrocarbons.

2. To increase oil recovery, water is injected into the reservoir.

3. Water injection helps lift exploitation rates. Average rates are 30%. The top producers in Norway achieve 50%. Experts think 70% is possible. A 1% increase in recovery in Norway amounts to three years of oil production.

+ 1% = 3 yrs
On track for first oil

In mid-2015, the jacket for the new platform was shipped from the yard in Sardinia and installed on the seafloor above the Ivar Aasen field. At the same time, Siemens delivered the systems for the EICT package to the yard in Singapore, where they will be installed on the platform modules. The onshore control room at the Det norske headquarters was set up. The next big milestone is scheduled for 2016, when the platform topside will travel by sea from Singapore to the North Sea for installation and commissioning. After that, in late 2016, Det norske will be ready for "first oil" – as the next big step toward becoming a leader in oil and gas production on the Norwegian shelf. Although the project is not yet complete, Hjelmeland is pleased with the progress so far: “When you work with so many teams and partners, trust is very important. You have to understand each other’s motivation to create the best possible solution, and you have to work together as an integrated team. And I have to say that with Siemens, we have a partner that is very like-minded in that respect: they take a very proactive approach to the project and have proven to be a reliable partner – which is just what we are looking for.”

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Det norske started as a small, independent company in the Norwegian oil and gas industry. Our goal is to build one of Europe’s largest independent exploration, development, and production companies – both through developing new assets and through targeted acquisitions. In October 2014, the acquisition of Marathon Oil in Norway was finalized, resulting in considerable production growth. At the same time, Det norske continues its active exploration program on the Norwegian shelf.

We are the operator for the Alvheim, Volund, Vilje, and Jette producing fields. Det norske is also the operator of the development of the Ivar Aasen field. Ivar Aasen is a big and important project for us. It is our first large development project, and it is an important factor in our growth strategy. By operating the field, we can build our production knowledge so that we can optimally exploit this valuable asset. During the project, we often have to make tough decisions about meeting deadlines and milestones, but we always need to bear in mind that these decisions will also impact the operational phase of the platform. The choices we make today will have consequences for the next 20 years – and in the project, we need the right mindset to balance milestone and lifetime perspectives.

We chose a hands-on approach to the Ivar Aasen project, being deeply involved with all the project partners and working closely with them. That way, we can make the best possible use of all the individual strengths and combine them into something that is indeed greater than the sum of the individual parts.

I firmly believe that being and getting involved is key to making people give their best. We have people with an enormous amount of skills and knowledge, and these people are working for us because they can be part of this journey of a small company growing big, and they can influence and change things. And this is the spirit that we look for in our partners as well.

Being a top producer means we must consider many aspects – the safety of our operations, which we always put first; the value we create for our owners and society; and the trust and reputation we earn, but also maintaining our spirit of always aiming for new and better solutions. One part of this mind-set is exploring new ways of using our valuable human resources – and this is why we want to operate Ivar Aasen as an integrated production site from both offshore and onshore. Very early on in the project we were researching new answers to questions such as: How can we communicate efficiently, share knowledge, and work together with the aid of technology so we can be the best? Integrated operation is not just a cost issue; it is how we want to support offshore operations most efficiently from onshore.

Siemens has played an important part in this project, because the company is providing a package that by nature has a lot of interfaces to many different disciplines and will provide the technical basis for our integrated operation concept. Working with Siemens has been a very positive experience for us, as we have found a partner with a very similar mind-set.

Ivar Aasen is a big milestone for us. Siemens is helping us deliver what we promised and will help us get the best value from this huge asset in the future.

Looking forward to “first oil”: Geir Westre Hjelmeland in the onshore control center at the Det norske headquarters in Trondheim, Norway. As vice president of the Ivar Aasen asset, he will be responsible for the successful operation of the field.
Woodside, Australia

Top float

An Australian oil and gas company’s floating production, storage, and offloading facility has benefited from Siemens technology. An upgrade will keep the systems in line with technology evolution as well as provide new features.

Woodside, Australia’s largest independent oil and gas company, is recognized globally for its world-class capabilities as an explorer, developer, producer, and supplier. Its proven track record and distinctive capabilities are underpinned by 60 years of operational experience, characterized by strong safety and environmental performance in remote and challenging locations. The company operates the Okha floating production, storage, and offloading facility (FPSO), which was commissioned in 2011. The facility is located offshore about 135 kilometers northwest of Karratha in Western Australia and stands in 80 meters of water. It connects to 10 subsea wells with an estimated production capacity of 60,000 barrels of oil per day and has a storage capacity of 925,000 barrels. The Okha FPSO has been designed to extract, process, store, and offload oil as well as export gas from the Cossack, Wanaea, Lambert, and Hermes (CWLH) fields. The topside processing facilities consist of oil, water, and gas separation systems, and gas compression equipment. Oil from the CWLH fields can be produced through the wells via five production manifolds connected to the Okha FPSO. In addition, the facility has one gas-lift integrated manifold, which supports gas export into the North West Shelf Project’s trunk line for onshore processing at the Karratha gas plant.

24/7, 365-days-a-year operation
The Okha FPSO is designed with a closed-loop flare system so that under normal operating conditions no continuous flaring occurs. The surplus gas from the production system is redirected to the cargo tanks to provide a 100% hydrocarbon blanket, and subsequently it is used as lift or export gas. The facility operates 24 hours a day, 365 days a year, supporting production and maintenance activities. Production involves receiving hydrocarbons from the CWLH fields via subsea infrastructure, followed by onboard processing and storage, and finally export of oil to tankers and gas to the trunk line. The Okha FPSO facility and supporting subsea infra-
structure are inspected and maintained regularly to ensure safe and reliable operations. The Okha FPSO also has a turret mooring system that can be disconnected to allow it to safely sail away in severe weather, such as cyclones.

**Integrated control and safety system**

The Okha’s integrated control and safety system (ICSS) is based on a Simatic PCS 7 process control system with fault-tolerant controllers and a combination of standard and safety I/O systems used downstream. The OS level comprises three redundant OS servers (topsides and vessel, fire and gas, and package), 11 OS clients, a central archive server, an asset management server, and an offshore data provider server. A total of 11 fault-tolerant controllers (4 process controllers and 7 safety system controllers) make up the AS level. Because the package units for the boiler, gas compressor, connect/disconnect system, and nitrogen system are automated based on Totally Integrated Automation from Siemens as well, they can be easily integrated into the ICSS.

Woodside also uses Comos Walkinside 3D virtual reality software for work on Okha and other FPSOs. The software allows operators and maintenance personnel to familiarize themselves with the layout of the vessel through a 3D simulation onshore, prior to flying out to the facility. The Comos Walkinside solution can be used for immersive operator training and delivers tools for efficient data exchange with third-party applications as well as distributed real-time collaboration. As a result, service and maintenance work can be planned, simulated, and executed efficiently.

**Services for lifecycle performance**

The Siemens experts in Australia have been involved in the Okha project from its early stages and provided a comprehensive training program for Woodside engineering and maintenance personnel. They also supported the project during and after commissioning, as well as during system optimization and process improvements. Subsequently, Woodside established a maintenance contract with Siemens for the complete ICSS, which is reviewed and renewed annually, including on-call support, weekly health checks, and services for preventive maintenance. Siemens will also develop and manage a lifecycle road map for the facility. The teams are already planning the next steps, such as upgrading the Simatic PCS 7 system to the latest version in order to keep the solution in line with technology evolution as well as provide Woodside with new features.

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Woodside’s Okha FPSO is situated in Commonwealth waters about 135 kilometers northwest of Karratha in Western Australia. An integrated control and safety system (ICSS) based on Simatic PCS 7 ensures safe and continuous operation.
The demands of a rapidly changing market in floating production, storage, and offloading mean Excel Marco is always looking to innovate and improve its systems. Employing the Simatic PCS 7 process control system has allowed the company to boost its efficiency and effectiveness without compromising strict safety requirements.
Excel Marco is an automation and safety solution provider focused on the oil and gas, petrochemical, and chemical industries. The company, founded in 2000, is based in Singapore but also has offices in Shanghai and Rio de Janeiro. Excel Marco's services include front-end engineering design, project management, panel design and fabrication, software configuration and programming, factory acceptance and site acceptance tests, site commissioning, maintenance programs, training, and site services. Its quality system is certified by Lloyd's Register as compliant with ISO 9001:2000 standards for quality management systems. One strong business area is floating production, storage, and offloading (FPSO) vessels and drilling rigs, together accounting for more than 100 completed Excel Marco projects worldwide.

Quality, reliability, and long-term support
Because Excel Marco is aware of its need to innovate and improve its systems in response to the demands of a rapidly changing market, the company partnered with Siemens to use Simatic PCS 7 as a process control system for its integrated control and safety system (ICSS). Simatic PCS 7 is a commercially proven off-the-shelf technology of the highest quality and reliability and with long-term lifecycle support – two aspects that Excel Marco was looking for in a new solution. Excel Marco managing director David Ong says: “Excel Marco has had a close relationship with Siemens ever since our early days, and we have implemented many successful projects using Siemens automation technology, including our first major one back in 2003 – with SBM for the FPSO Marlim Sul.” The Singapore company will always turn to Siemens, unless a client insists otherwise, because it has a well-field-proven integrated system architecture, adds Ong. It is the concept of integrated control and safety that is the key ingredient in Siemens’ successful partnership with Excel Marco. “With an ICSS, you use the same engineering workstation for both the control and the safety functions. So the programming language is the same, the graphics are the same, the faceplates are the same,” says Ong. In terms of hardware, there is commonality across all features, including power supplies and communications cards. This results in a more efficient approach to system integration and maintenance. “The customer does not have to keep different sets of spares, and the engineers and operators only need to be trained on one system and do not have to learn several types of software,” adds Ong.

Seamless integration
PCS 7 offers seamless integration on the same platform as the process control, emergency shutdown, and fire and gas systems, and has a user-friendly HMI as well as an established communication-linked protocol. The technology also has an established software library, is easy to maintain, and has a safety system compliant with Safety Integrity Level 3. Because PCS 7-based ICSS have been implemented in many other FPSOs offshore in Brazil, Africa, the Asia-Pacific region, and the Gulf of Mexico, the systems are built to comply with different regulatory requirements in each region. All the members of Excel Marco’s 100-strong team are familiar with Siemens’ products, with about two-thirds of them having specific knowledge of the PCS 7 system. Siemens’ provides a four-week PCS 7 course, which many of the Singapore company’s engineers have completed. The course covers all the system’s hardware and software requirements and it concludes with a written and practical exam. In addition, several Excel Marco staff members have also been certified through the Siemens Functional Safety Expert program.

Moving to the Gulf of Mexico
The benefits of the ICSS with Simatic PCS 7 are now being recognized by one of the world’s deepest FPSOs, in the Gulf of Mexico. On this project, Excel Marco is using a failsafe Simatic PCS 7 architecture for process control, emergency shutdown, and fire and gas systems, as well as compliance with Achilles Practices Certification (cybersecurity) and the International Electrotechnical Commission System for certification to standards relating to equipment for use in explosive atmospheres (IECEx system). Cybersecurity focuses on protecting computers, networks, programs, and data from unintended or unauthorized access, change, or destruction. While not every incident can be prevented, Excel Marco can mitigate the risk escalation so that people and assets are well protected. In doing so, the company can develop organizational resilience to manage these incidents as just another part of the business. IECEx facilitates international trade in equipment and services for use in explosive atmospheres while maintaining safety requirements. Excel Marco has designed and fabricated IECEx-certified control panels and deployed them in various locations, such as the Gulf of Mexico. In view of the area’s sensitivity to incidents in oil production, Excel Marco had to meet the most stringent standards – and was able to do so with proven technology from Siemens and the right expertise. “Siemens has been a very good partner to work with,” says Ong. “We are thankful for that and look forward to more projects with PCS 7 automation technology as it continues to evolve.”
CAD Control Systems, United States

Excellence in control

When it comes to oil and gas exploration, performance and safety take precedence over everything else – a rule that CAD Control Systems and Siemens know quite well. They have been working together for more than a decade to build blowout preventer control systems for drilling rigs. So when the opportunity arose for CAD to participate in a pilot program with its longtime business partner, the company welcomed the news.

The program consisted of reengineering an existing blowout preventer (BOP) control system to include the Simatic S7-1500 programmable logic controller (PLC) – a move that not only improved reliability, display capabilities, and wiring procedures but also cut product configuration and programming time through the use of the TIA Portal integrated engineering framework. Furthermore – and perhaps most important – it helped set the stage to meet anticipated future regulatory requirements by enabling the remote diagnostic and data collection capabilities needed for a safer and more efficient drilling environment.

Continuous improvement

Providing equipment to global drilling contractors in more than 30 countries, Broussard, Louisiana-based CAD Control Systems emphasizes performance over cost, taking pride in its use of the highest-quality components, proven engineering practices, and the latest technology to produce equipment that is safe, reliable, and durable – all of which are critical to BOP control systems.

BOP valves are vital to drilling safety because they allow operators to regulate and monitor wellbore pressure. “With BOP control, there is no margin for error, no room for failure,” says Brian Wright, CAD’s chief operations officer. “Control systems must be able to function in highly hazardous atmospheres and explosive gas environments.”

When Siemens approached CAD about participating in the pilot program for its Simatic S7-1500 PLC, it was an easy decision to make. “We were pleased when Siemens reached out for our help,” adds Wright. “We didn’t have any issues with our system as it was, but this was an opportunity to make a
»The Simatic S7-1500 saves us time in engineering, building, wiring, designing, troubleshooting, and, most important, programming.«

Jonathan LeBlanc, Senior Electrical Engineer, CAD Control Systems

better product for everyone. It’s these kinds of efforts that resonate throughout the industry for many years to come."

As part of the program, a system equipped with the Simatic S7-1500 was rolled out onto a predetermined platform after in-house testing. The results were so positive that CAD hopes to expand use of the controller throughout its product line within the next 12 months. “These changes were revolutionary,” says Jonathan LeBlanc, a senior electrical engineer at CAD Control Systems. “We’d been using Simatic S7-300 PLCs for quite a few years, and we have a good system with that controller. However, we felt the Simatic S7-1500 would save us time in engineering, building, wiring, designing, troubleshooting, and, most important, programming.”

An impact on the entire industry

As a result of the pilot program, CAD has also been able to expand system capabilities for remote control from multiple points. Since the 2010 Gulf of Mexico Deepwater Horizon incident, the offshore oil exploration industry has sought to promote data gathering in an effort to prevent similar occurrences – comparable to the way an airliner’s black box helps investigators analyze airplane crashes to build a safer airline industry.

Wright believes that eventually the US government will require remote diagnostics and control on all floating drilling operations. Once that happens, he says, operations around the world will likely follow suit. “We’ve looked at aeronautical, nuclear, and naval standards to see how they might help the oil exploration industry improve products, processes, and procedures in ways that would increase safety and protect the environment. A big part of that effort involves being able to acquire, store, and transmit data.”

Remote diagnostics and data collection, however, are still in their infancy in this industry. “Not a lot of data exist for drilling that takes place in previously unexplored areas or in deep water,” explains Wright. “CAD Control continues to be a leader in incorporating diagnostic and data collection capabilities into its own systems as well as adding them to other manufacturers’ systems already in operation. Siemens is a valued partner in making these modifications because of the advanced capabilities of its products.”

Partners for a safe and secure future

CAD Control Systems plans to incorporate the Simatic S7-1500 series PLC into its equipment as quickly as possible. As the industry scrutinizes BOP control systems more closely, equipment requirements are expected to become more stringent. Consequently, demand for a higher-end product will increase, and CAD Control will look to Siemens to help meet that demand. “The features of this controller will be required in the future. Yes, there is a price difference, but when you look at the cost of a problem, the value of a safe and high-quality control system becomes apparent. Siemens is a valued business partner that we’ve enjoyed working with on projects like this because it gives us the opportunity to make the industry safer as a whole.”

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GPS Chemoil, a joint venture between Gulf Petrol Supplies and Chemoil Energy Limited, currently owns and operates two oil storage terminals at the bunker hub in Fujairah. The facility, which began operations in April 2013, is leased out to provide storage for a range of petroleum products. It is connected by pipeline to all the oil terminals in Fujairah and all nine berths, including recent connections to Berths 8 and 9, becoming the first terminal to operate with Berth 8 at the Port of Fujairah’s oil tanker terminal. Terminal 1 of the storage facility is located due west of the Port of Fujairah jetties, while Terminal 2 is situated within the Port of Fujairah premises. Terminal 1 consists of nine fixed-roof tanks with cone-down bottoms and has a total capacity of 94,914 m³. It handles Gasoil and Fuel Oil transfers and discharges, using up to six electric-driven screw pumps, as well as Gasoil truck loading via two electric-driven centrifugal pumps.

The facility’s instrumentation is made up of a Supervisory Control and Data Acquisition (SCADA) system, tank transfer gauging, and truck loading arms with mass flowmeters. Four jetty pipelines – two for Gasoil and two for Fuel Oil – are utilized for loading, discharging, and terminal-to-terminal operations. Terminal 2 consists of 21 tanks – 16 for Class II products, and five with internal floating roofs for Class I clean petroleum products. It has a total capacity of 603,811 m³. The terminal uses 17 electric-driven pumps – 11 twin-screw positive replacement pumps and six centrifugal pumps. Both terminals offer a full range of transfers – ship-to-terminal (via two oil tanker terminals), terminal-to-ship, terminal-to-terminal, and intertank transfers – as well as blending, heating, and truck loading. Quality, health, safety, and environment (QHSE) management systems are implemented throughout the facility to ensure that the terminals offer customers the benefits of the industry’s best practices and latest developments in technology. A systematic training and empowerment program ensures that all staff are able to participate in ongoing improvements to the QHSE system.

**Process and safety automation**

Siemens’ involvement in the Fujairah facility was part of the Phase IV design improvements. It can be traced back to Siemens’ work with Chemoil Energy, which had used the German company’s automation system for process...
and safety at its former Helios terminal in Singapore. GPS Chemoil directly proposed and accepted Siemens’ involvement. Siemens was preapproved in the engineering, procurement, and construction (EPC) contract as the vendor for automation systems. The Phase IV project was executed by Topaz Engineering as the EPC, which subcontracted L&T Automation, Dubai, for the Simatic PCS 7 work, with engineering carried out by the Abu Dhabi–based company Tebodin. The company met the process control and safety solution requirements with its Simatic PCS 7 automation system, together with other components, including Siemens medium-voltage Sinamics Perfect Harmony GH180 drives (450 kW to 850 kW), Sivacon low-voltage panels, and Loher Atex medium-voltage and low-voltage motors. An additional four medium-voltage variable-frequency drive units were retrofitted on the centrifugal pump motors for process enhancement and maximum plant operational availability. This was achieved by a successful collaboration with the Siemens retrofit team for engineering, procurement, and in-house installation and commissioning.

A seamless solution
The decisive argument in favor of Simatic PCS 7 was the system’s ability to integrate process control and safety applications, both in engineering and at runtime. Simatic PCS 7 provides the performance required to meet the application’s highspeed requirements and serves as an open, flexible control framework that can connect to field devices via many different bus systems and is based on a scalable hardware and software platform. All the automation functions are provided through a seamless, uniform solution without the need for special gateways or interfaces. The system also seamlessly integrates continuous and safety control, including uniform software tools, and it integrates with other subsystems, such as inventory management and fire and gas detection units. The system consists of eight HMI workstations with distributed functionality: two are for operations, one for engineering, one for enterprise resource planning (ERP), one for the tank management system, and one for the fire alarm system, with the remaining two as redundant HMI workstations. The subsystem includes built-in diagnostics to warn of impending failures, and it operates independently, irrespective of the operating status of the interconnected system. The equipment has guaranteed support for 15 years – from the takeover date or from withdrawal of the equipment from the market, whichever is later.

Abdul Rahman, head of GPS Chemoil’s electrical and instrumentation department, actively coordinated the successful completion of the project in April 2013, and the system is backed by service support from the Siemens Dubai office. Since installation of the system, GPS Chemoil has received valuable support and services from Siemens, which the company views as one of the key factors in the system’s successful performance and achievement. Ever since the engineering, commissioning, and retrofit jobs, the information and support from Siemens Dubai have been prompt and perfect.

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Governance for excellence

Operational excellence can mean many different things to different companies. To the Bahrain Petroleum Company B.S.C. (Bapco), it means improving the performance of refinery operations and then sustaining that performance for many years to come. One key tool in meeting these goals is XHQ Operations Intelligence, which helps Bapco improve its efficiency, reduce costs, and streamline its operational governance.

When it comes to operational excellence at Bapco, providing the highest possible level of safety across the company’s operations, with zero recordable incidents, is a top priority. A key aspect of that initiative is the involvement of the company’s leadership. Bapco leaders have always been committed to operational excellence; however, before the introduction of the XHQ Operations Intelligence software, tracking the fulfillment of that commitment was a major challenge, for a number of reasons. One of the biggest problems was the difficulty in locating operations data. In some instances, even after the data were found, multiple versions existed. As a result, significant time and resources were often required to put the data together in any meaningful way. This is precisely where operational governance can be most beneficial, and it’s where XHQ had the biggest impact at Bapco. “Governance is a powerful means of ensuring that people do what they say they will do. Governance need not be onerous, intrusive, or burdensome, but it does need intelligent design and facilitation,” says Nathan Wright, superintendent of the Bapco operational governance program.

Business and operational data platform

XHQ Operations Intelligence is a platform for aggregating, relating, and presenting operational and business data in real time. One way in which XHQ helps support governance at Bapco is by providing an automated, online reporting system that requires “zero prep” from operations personnel. All the data that come into XHQ from various Bapco information systems are available through the governance

XHQ supports users with explorer views to deliver insight into the status of actions. One example is the Actions Explorer (right), which provides access to filtered actions such as “My activities” (top).
reporting system. This centralization not only streamlines the governance process but also creates a high level of transparency in the business. At any given time, staff members can retrieve the current status of a section’s governance and view vital data in areas such as personal and process safety, leadership engagement, engineering projects, safety culture, reliability, critical maintenance, process upsets, environmental compliance, and others.

In addition to role-based and generalized views of mission-critical data, personalized employee information snapshots are available for activities from seven different data sources. Employees can log into the XHQ system to view a personalized screen with information such as open incidents that involve the employee; open actions, including overdue actions as well as those about to become overdue; and management-of-change orders (MOCs) that apply to the employee. The system allows decision-making personnel to see detailed data regarding plant personnel without tedious and time-consuming preparation, making it crucial to governance in Bapco’s refinery operations.

Measurable benefits
XHQ Operations Intelligence has become a vital component in Bapco’s quest for operational excellence. “Using XHQ to support operational excellence at Bapco – specifically in the areas of governance and compliance – has delivered benefits that are measurable and continue to provide compounded dividends,” adds Wright. Enhanced governance has also produced significant gains in plant reliability, with XHQ being the primary driver of this success.

In the coming years, Bapco will look to extend the benefits it has seen with the utilization of XHQ Operations Intelligence. The company will continue to refine the automated reporting system – adding further value to strategic initiatives. In addition, because personalization is a proven way for employees to see the status of many different work processes, Bapco will aim to add greater personalization for XHQ users. The operational governance program at Bapco has yielded such positive results that the company has decided to use the model in other (nonoperational) divisions of the organization.
Total S.A. first used the Comos Walkinside immersive training simulator (ITS) on its Pazflor FPSO (floating production storage and offloading) unit off the coast of Angola. The system quickly evolved into a useful tool for increasing safety and productivity by training personnel in how to deal with even the most unusual circumstances before they physically set foot in the field.

When Captain Chesley B. Sullenberger took command of US Airways flight 1549 moments after it took off from New York’s LaGuardia Airport on January 9, 2009, he could never have predicted the chain of events that would ensue.

But with years of experience under his belt and hours upon hours of training in a simulator, he was able to make decisions that saved the lives of all 155 people on board. It is this same approach that French oil and gas giant Total is bringing to the operation of its FPSOs. And the Comos Walkinside immersive training simulator (ITS) is helping the company do so.

A virtual environment for real-life situations
Comos Walkinside offers a virtual 3D environment of a plant and provides the opportunity to simulate real-life situations, allowing workers to see and experience what tasks they need to perform, and rehearse procedures and workflows associated with any number of scenarios. The ITS has enabled Total to create training that reaches everybody. The training puts workers in a true 3D virtual environment and teaches them what to do and when to do it so that safety is maximized.

In addition to making offshore operations safer, the ITS is also helping Total improve productivity. Case in point: the Pazflor FPSO project. With daily operating production of 220,000 barrels, Pazflor can bring in $20 million per day. So any type of disruption or delay can result in significant monetary loss. By providing workers

With the Comos Walkinside ITS, operators can become familiar with their surroundings before they arrive at the real facility

»If you participate in immersive training simulation you have less loss of production due to human error; we minimize the loss of production.«

Nicolas Tarisse,
Field Operations Training Manager,
TOTAL E&P, France
Comos Walkinside ITS at Total: the benefits

- Improves personnel safety through virtual training in a realistic environment
- Allows for more efficient collaboration and interaction between teams
- Counteracts the growing shortage of experienced personnel
- Offers high value in dangerous and remote working environments
- Allows training to begin before operators even set foot in the facility

with training that allows them to perform their jobs effectively, the ITS has helped increase efficiency, lower risk, and improve asset uptime on Pazflor, all of which have enhanced the return on investment. The next project is already in the making: the CLOV FPSO project, another deep offshore development in Angola with a capacity of 160,000 barrels per day. With CLOV, Total wants to go one step beyond the Pazflor project. The objective was to get workers to learn and understand all CLOV equipment processes using 3D visualization from the wells to the export systems before they even set foot in the facility. Health, safety, and environment (HSE) objects and immersive effects were integrated to help prepare operational personnel for unusual events such as leakages and fires, so that they were ready to react to possible incidents.

Capabilities beyond training
Although Total’s primary use of the ITS was to ensure that operators were familiar with the equipment on the FPSO where they would be working, the technology itself has the potential to develop further. In essence, by placing the 3D virtual plant on the desktops of operations, maintenance, and engineering staff, Comos Walkinside lets operators consolidate activities across a wide range of geographically dispersed areas. Everyone shares the same up-to-date model, which allows for efficient collaboration. Users can walk through the virtual plant to reach a certain area, jump to a specific element, and even extract data. 3D objects can be added to the virtual reality model to show evacuation routes as well as emergency and firefighting equipment and signs. Sound effects are incorporated to enhance the realism of the setting.

In the case of Total, the ITS allowed operators to become familiar with their surroundings before their physical arrival at the facility. This led to a shorter learning curve, greater productivity, and a faster time to first oil.

All set for new tasks
Total is planning to develop the next level of training for the future. The aim is to create HSE scenarios so the personnel can be trained on specific topics. Total wants to couple the operator training simulator with the ITS to increase the number of potential applications, one of which involves black start procedures. This is critical for a deepwater installation because if the system is not restarted after a certain period of time, it is possible to lose the loop. This does not happen very often, but Total believes that everyone should be trained to prepare for this occurrence.
It has been almost seven years since TransCanada filed for its presidential permit to build the Keystone pipeline expansion from Alberta to Nebraska, and while the project has yet to receive approval, the Canadian oil and gas giant is already at work – partnering with Siemens to implement equipment and systems that will make Keystone XL one of the safest, most advanced pipelines ever built.

Plans for the Keystone XL pipeline include not only the pipes but also an automated system that will send more than 20,000 data points from pump stations along the pipeline to an oil control center in Calgary every five seconds. Siemens provided a large majority of the equipment for the project, including pumps, motors, variable-speed drive systems, switchgear, contactors, and control systems. “TransCanada has spent $2.4 billion on the system already – buying motors, pipes, and other components that are scattered throughout warehouses in North America,” says Corey Goulet, president of Keystone Pipeline Projects. “Right now, they’re all just waiting to be used.”

Pump stations are typically located about every 50 miles along the pipeline. “Today it takes 56 pumping stations to get oil from Hardisty, Alberta, to the Gulf Coast. With Keystone XL, there will be 36 pump stations,” adds Goulet. “We can get oil from the western Canadian sedimentary basin to the Gulf Coast in less than a month. No other pipeline can do that, and it’s important because there’s a value associated with getting it there quickly.”

Connecting the parts
The Keystone pipeline thus far has been a collection of sections. It began with the Northern Border Pipeline, which connects Canadian production down to the Midwestern states, where gas is delivered. The base Keystone section went into operation in 2010 and stretches 275 miles. Another section of the pipeline, which was completed in early 2012, connects Steele City, Nebraska, to Cushing, Oklahoma. Beyond that is Nederland, Texas, on the Gulf Coast.

Siemens was contracted to equip 35 stations with medium-voltage motors, switchgear, contactors, variable-speed drives (VSDs), pumps, and automation control systems. TransCanada and Siemens are emphasizing scalability by implementing systems that are easy to program, maintain, and expand if needed. On the automation side, Simatic S7-300 programmable logic controllers (PLCs) and Simatic ET 200 remote units provide a scalable yet standardized foundation for process and system control. “We designed and built the system modularly, so if it needs to be expanded, that can be achieved by simply adding modules,” says Brad Wojcik, senior lead engineer at Siemens.

A soft start for a tough job
With such a large project, the project team had a special focus on the drive solution for the pump sta-
tions, which are key to getting the oil through the pipeline. One such station is located in Stanton, Nebraska, and was implemented as part of Keystone Phase I. It moves roughly 550,000 barrels of oil a day and is equipped with four motors that drive the pumps sending oil through the system. Each motor is started with the VSD for smooth acceleration to operating speed and to minimize fluid pressure pulsations. The pump motor is then bypass-powered directly from the utility. One motor is always left on the VSD to provide adjustable pump speeds for regulating pump station pressure and flow in the pipeline, and to accommodate different types of crude oil products and grades.

In addition to transporting oil from Canadian oil sands, the Keystone XL pipeline will carry product from other producers in Texas, Oklahoma, Montana, and North Dakota. “Keystone has 47 different approved commodities,” says Virgil Pfennig, Stanton’s station manager. “There can be 100 different batches in the line at any given time.” The pumps regulate the flow with varying pressures. Oil comes into the first pump at approximately 290 psi. Each pump that follows will increase that pressure. The number of pumps used will depend on the grade and density of the crude coming through the line, both of which can be monitored by personnel operating the stations.

The Keystone XL pipeline extension project will link Canada with the US Gulf Coast

Keystone XL: the project

**Keystone Phase III – Gulf Coast**
- 40 pumps (6,500 HP)
- 40 medium-voltage motors (6,500 HP)
- 10 medium-voltage variable-speed drives
- 10 variable-frequency drives (VFDs) electrical shelters
- 10 medium- and low-voltage distribution electrical shelters
- 10 unit control (automation) systems

**Keystone Phase IV – US Steele City**
- 95 pumps (6,500 HP)
- 95 medium-voltage motors
- 20 medium-voltage variable-speed drives
- 20 VFD electrical shelters
- 20 medium- and low-voltage distribution electrical shelters
- 20 unit control (automation) systems
- 3 electrical substations

**Keystone Phase IV – CA Steele City**
- 40 pumps (6,500 HP)
- 40 medium-voltage motors
- 20 medium-voltage variable-speed drives
- 8 VFD electrical shelters
- 8 medium- and low-voltage distribution electrical shelters
- 8 unit control (automation) systems
- 1 electrical substation

Pressure-control valves (PCVs) are also used to regulate the flow of oil. The control system is designed as failsafe, meaning that if there were ever an over-pressure, everything would shut down.

Remote yet real-time control

Pump stations are monitored primarily through the oil control center in Calgary, which has three consoles: one for monitoring the pipeline and pump stations, one for the terminals, and one to monitor the leak detection system. While stations are largely unmanned, personnel are always on call. Data are communicated through satellite connections, though there is a landline backup if needed. “All data are received from each pump station, terminals, and delivery station every 5 seconds, and from each valve site every 30 seconds. It’s pretty much in real time,” Pfennig says. Once approved, the nearly 1,200-mile expansion would become part of the existing Keystone XL system, creating a faster route for getting product from the oil sands of Alberta to refineries on the Gulf Coast.

INFO AND CONTACT

siemens.com/oil-gas
GasSecure, Norway

Tried and tested

GasSecure needed to test its wireless gas detector in an environment that would re-create the integrated control and safety systems (ICSSs) for which it has been designed. Collaboration with Siemens provided the Norwegian company with the solution to safely deliver secure gas measurements in a timely manner.

Norwegian company GasSecure was set up in 2008 by Knut Sandven; Dr. Haakon Sagberg; and Scandinavia’s largest independent research organization, Sintef. GasSecure worked on the development of a complete gas detection system for use with products and technology in testing environmental conditions. In particular, the company’s system was targeted for use on oil and gas installations in extreme environments, such as the North Sea, Alaska, and Australia. Market demands also meant that the gas detector system should have wireless capability. Sagberg’s research had resulted in the development of an optical sensor with very low energy consumption. That was an ideal starting point for developing the wireless, battery-driven gas detector. The GasSecure offering consists of a gateway, several gas detectors, a sender, and a receiver. The GasSecure GS01 Wireless Gas Detector is certified to the Safety Integrity Level 2 (SIL2) standard. In basic terms, SIL measures the performance of a safety-instrumented system under European safety standards centered on IEC 61508. There are four levels, with 4 being the most dependable and 1 the least dependable.

Test program

GasSecure still had to overcome another challenge to show the market the value of its gas detector. The Norwegian company needed to test its wireless gas detector in an environment that would re-create the ICSSs for which it has been designed. Collaboration with Siemens started in 2014 and provided GasSecure with the solution to safely deliver secure gas measurements in a timely manner. Siemens provided a Simatic PCS 7 engineering and operator station and a redundant AS410H fault-tolerant automation system. Siemens helped build a test program and also helped GasSecure define how the AS410H and the gas detector gateway should communicate. “Siemens has enabled us to test with a proper system set-up,” says Roger Hoem-Martinsen, industrial communications specialist at GasSecure. “It is important for us to be confident that we are delivering safe gas measurements with fast response through the whole safety loop,” he says.
Because the gateway already had an industrial Ethernet interface, developers decided to make it a Profinet device utilizing the Profisafe protocol. A GSDML file was also developed for the gateway, which, along with the GSD files, was written in XML format. These files, describing the features of the Profinet device, had to be tested for proper communication via Profisafe. The Profisafe communication was also tested separately. Hoem-Martinsen says, “In this project, we have demonstrated an SIL2-certified system for wireless gas detectors via Profisafe over Profinet, using both single and redundant set-up of the gateway. In addition, we are now starting to test the set-up using a redundant programmable logic controller and two gateways.” Hoem-Martinsen describes the new test as “promising” and continues, “The hardware configuration using the GSDML file works the same as setting up an I/O station. First we insert the gateway, setting up the device name and address. Then we insert the number of detectors beneath the gateway,” he says.

**Market interest**
GasSecure has produced about 500 wireless gas detectors since production started in 2013, and it has sold more than 400 of the devices. The successful product sales and increasing market interest led to GasSecure being acquired in March 2015 by German company Dräger, an international leader in medical and safety technology. Since then, there has been no letup in the international oil and gas market’s interest in the wireless gas detector. The technology continues to attract market attention because of its simple and flexible installation, together with straightforward engineering and documentation. The gas detector also provides an estimated 70% cost reduction at the system level and can be applied as a retrofit or an upgrade of an existing gas detection system.

> **Siemens has enabled us to test with a proper system set-up. It is important for us to be confident that we are delivering safe gas measurements with fast response through the whole safety loop.**

Roger Hoem-Martinsen, Industrial Communications Specialist, GasSecure

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Capturing emissions and profits

In early 2015, when the US Environmental Protection Agency (EPA) restricted fugitive emissions from oil and gas production operations, the decision generated some surprising benefits – leading crude oil producers to embrace “going green” with unexpected enthusiasm. Taking advantage of Sitrans pressure transducers to improve the design of vapor recovery units, oil and gas producers can reduce emissions to EPA-mandated levels and earn an attractive return on investment in the process.

Leading the way in this positive response is a new vapor recovery unit (VRU) designed and marketed by Unimac LP, a company of Dallas, Texas–based Air Mac. Using differential pressure transducers from Siemens to provide precision control, the VRU is helping oil and gas producers reduce emissions to EPA-required levels by effectively capturing crude oil vapors for reuse or sale. In some cases, the recovery efforts have been successful enough to yield equipment payback periods as short as seven months, enabling producers to establish new and nontraditional streams of revenue.

The vapor recovery units help reduce emissions to EPA-mandated levels and earn an attractive return on investment in the process.
VRUs have been available in the marketplace for a number of years. However, it wasn’t until recently that they were approved by the EPA for handling fugitive emissions. Formally known as Title 40 CFR Subpart OOOO (or Quad O), the agency’s mandate to restrict emissions requires onshore oil and gas producers to reduce vapors flashed off in crude oil storage tanks by 95% and to limit methane emissions and the potential to emit volatile organic compounds to no more than 6 tons per year. With roughly half a million crude oil tanks dotted throughout US oilfields, the use of remediation methods like VRUs can be expected to proliferate.

Integrated solution for instrumentation
Unimac got into the VRU business at the request of an existing customer. With precision control topping the list of requirements, Unimac sought to develop a VRU solution that was accurate and reliable at very low pressures. Key to the success of the system was the Sitrans P DSIII differential pressure transducer. “We selected the Sitrans P DSIII because it gave us precise control within a very narrow range,” says Jim Keller, owner and president of Unimac and its parent company, Air Mac. “Without it, our control cascade couldn’t function properly, nor would it be fast or reliable enough to respond to the rapid pressure changes. The device’s local digital display and easy-to-use menu were also very useful, allowing us to change parameters in the field.”

Each Unimac VRU also features Sitrans P200 pressure transducers – compact, single-range transmitters that measure absolute and gauge pressure. “We use two Sitrans DSIII transducers and between three and five Sitrans P200s on every VRU, depending on the configuration,” adds Keller. “The Sitrans P200s are used primarily for monitoring. If a variable moves out of range, a Sitrans P200 will sound an alarm and, if necessary, shut the operation down.”

Keller discusses the workings of the VRU to illustrate how the Siemens instrumentation works together to achieve the required performance levels: “The Sitrans P DSIII has to control the variable-frequency drive (VFD), which controls the speed of the positive displacement compressor,” he says. “The faster the compressor runs, the more gas it consumes, or draws into the system. The slower it turns, the less gas it consumes. Because vapor production varies widely with conditions, we needed a controller that could reliably match compressor speed to vapor production.”

In a typical configuration, tanks are connected with a relatively large-diameter pipe coming off the top, where the vapors collect. The system is piped to a flare line equipped with a relief valve to handle any upset conditions. “One Sitrans P DSIII monitors the pressure in that line,” Keller continues. “All control must take place within a very narrow range. Essentially, we’re adjusting the proportional gain on these valves, which operate in a coordinated fashion with the VFD.”

»We selected the Sitrans P DSIII because it gave us precise control within a very narrow range.«

Jim Keller, Owner and President, Unimac and parent company Air Mac

Excellent return on investment
Thanks to this improved technology in VRUs, recovering the vapors and selling or reusing them is helping defray the cost of the control system enough to yield a reasonable return on investment, making it much more economical for oil and gas producers to be environmentally responsible. “We visited an installation with two VRUs in North Dakota last week that will pay for itself in 7 to 11 months,” said Keller. “That facility is actually making money off its vapor emissions.”

Unimac’s first units went into the Niobrara oil field in Colorado in 2012. Forty large units went into the Bakken field in North Dakota this year, and the company’s first unit in the Permian Basin in West Texas is also in the process of being installed. “Obviously, we’re very proud of the VRUs we’ve developed, and they were made possible with Siemens technology,” says Keller. “Feedback has been positive, and we are pleased to have created a product that allows oil and gas producers to comply with EPA regulations and improve their bottom line while doing so.”

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Our range of process instruments are becoming something of a hot topic. Whether you need to measure pressure, temperature, flow, weight, level, or you use electropneumatic positioners, our instruments are engineered to give you the most precise measurement possible. And because we understand accurate measuring is the key to increasing plant efficiency and improving product quality, we offer fully automated solutions for every stage of the process. Which means you can rely on our passion for precision throughout your entire plant. Because we believe every business success begins with great measuring.

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