



# ABB and Norske Shell Partners in productivity

## Partners in productivity



Norske Shell operates two oil and gas fields on the Norwegian Continental Shelf: Draugen and Ormen Lange. Both fields operate at exceptional levels of availability and productivity, thought to be the highest in the oil and gas industry. ABB has played an important role in helping Norske Shell achieve these distinctions.

Draugen is Shell's northernmost oilfield. It is located 150 km off the Norwegian coast at a depth of 250 m. When production started in 1993, the field had a recovery factor of less than 40 percent and was estimated to have an operating life of 17 to 20 years. Draugen has since more than doubled its recoverable reserves, and now has a recovery factor of around 70 percent, one of the highest in Norway.

Ormen Lange is Norway's second largest gas field. It supplies up to 20 percent of the UK's natural gas requirements. The reservoir lies 120 km off the coast of Norway and almost 3,000 m below the surface of the sea. Gas from the reservoir is transported through two pipelines to an onshore processing plant at Nyhamna, Norway, where it is dried and compressed. After processing, the gas is transported through the 1,200 km Langeled pipeline to a gas terminal on the east coast of England. Langeled is the second longest subsea pipeline in the world.



### ABB solutions power and automate the fields

ABB has a large installed base of power and automation technologies at Draugen and Ormen Lange. Integrated ABB process automation, safety and information management systems monitor and control the subsea and topside production processes at both fields, including the huge onshore processing plant at Nyhamna. Field operations are supported by ABB simulators that replicate the safety and automation systems; they are used by Shell for operator training, engineering and testing.

ABB also supplied the Nyhamna onshore plant with electrification solutions that distribute electricity safely, reliably and efficiently throughout the production areas. At Nyhamna the solution includes ABB electric drive systems that drive the gas compressors optimally at variable speed, thereby significantly reducing energy consumption and carbon dioxide emissions.

### Field expansion and lifetime extension

Shell is currently extending the life of Draugen. Several upgrade projects (both subsea and topside) are ongoing to support life extension. In response to Shell's requirements

ABB is prolonging the operating life of the 20-year-old process control and safety systems by an additional two decades, far beyond the usual lifetime of automation hardware and software.

Nyhamna is also a center of major expansion activities. Shell is increasing the plant's export capacity with new facilities to handle gas from the new 480 km Polarled pipeline. ABB is extending the integrated process control and safety system at Nyhamna to include the new facilities, and is providing three large electric drive systems to boost the pressure from the reservoir and export the gas through the Langeled pipeline after processing at Nyhamna.

*"Our documented experience from Ormen Lange provides evidence that the use of the simulators has provided us with good safety routines in the process, as well as significant savings in the start-up period of the facility."*

Geir Fillip Håseth, Operations Engineer in 2013, Norske Shell



In 2007 Shell awarded ABB a seven-year contract to provide service, support and modifications for the process control, safety, information management and telecommunications systems at Draugen and Ormen Lange. The work performed by ABB under the contract has successfully contributed to cost savings and efficient production at the two sites. Shell renewed the service contract with ABB in 2013 for an additional five years and with options for two + two years.

#### Proven ABB service concept

The contract is based on a complete service and support concept that covers the full scope of ABB solutions for oil and gas facilities. Known as Service Environment™, the concept is used extensively by ABB throughout the Norwegian Continental Shelf.

Service Environment is comprehensive in scope, but flexible and customizable in practice. ABB has molded it to meet Shell's requirements and adjusts it year by year as those requirements evolve and change.

#### Integrated operations

The Shell-ABB collaboration covers all three pillars of the Service Environment program – Service, Operations, and Modifications. These in turn are based on work procedures and knowledge support systems that ABB has created to efficiently manage the equipment in its huge installed base at the sites.

Remote monitoring and integrated operations is a key element of the ABB concept. Authorized ABB personnel have remote access to the safety and automation systems at Draugen and Ormen Lange from several remote monitoring and operations rooms at ABB locations in Norway. This enables ABB to safely implement changes, troubleshoot, provide support and carry out health checks by remote.

Thousands of hours of work are performed each year by ABB on behalf of Shell at the remote centers, thereby reducing the need for Shell to deploy its own expertise at the sites. If an incident occurs, ABB has all the required skills on hand to work on a solution immediately and implement it by remote. Around 200 ABB specialists support Shell in this way in a relationship of cooperation that is led by Shell.

#### Working together as one

One of the secrets behind the Norske Shell-ABB success story is the organizational structure and operational procedures that the two companies have developed to ensure that their team members work together as a single entity.

These procedures range from clearly defined roles and responsibilities to monthly meetings, joint key performance indicators, and the visible involvement and support of senior management. Communication is the key principle. Strict adherence to it is written in stone. If communication between the two teams falters, the issue is immediately escalated to senior management where it is quickly resolved. These and other tools enable a spirit of trust and true collaboration to thrive between the two companies, the result of which is a continuous flow of new ideas and improvements at the two sites.

*"Ever since the start-up phase in 2007, uptime at Ormen Lange has been more than 99 percent for most months of the year. Such high availability is unusual for a plant as large and complex as this. We've invested significant resources in continuously fine-tuning the plant, which has benefitted us enormously. Our experience from Ormen Lange tells us that it pays to invest in optimization."*

Reidar Haugsgjerd, Process Control Engineer, Norske Shell

# Process Safety



A contributing factor to good process safety is the seamless integration of the process control and process safety systems. In the oil and gas industry process safety and process control are traditionally independent systems, often supplied by two different vendors. With ABB the two systems are seamlessly integrated into a 'single yet separate' entity. Both systems use the same control architecture and human machine interface, share the same controllers and field equipment, and use the same software tools, yet their functionality remains separate. This simplifies operations for Shell.

## Single point of contact

ABB aims to be the single point of contact for automation system service at the two sites, regardless of vendor or task. Every time a graphic is altered or a configuration changed or an incident occurs, it is logged in a database in accordance with strictly defined procedures. Each change has to be approved, first by the ABB technical account manager (TAM) and then by Shell. There are three ABB technical account managers, each of whom has a deep and extensive knowledge of the safety and automation systems and the applications at the two sites.

The outcome of these procedures is not only an exceptional process safety record but a vast bank of information about the performance, status and history of thousands of objects in the sites' safety and automation systems.

## Simulation and security

ABB has supplied two 800xA Simulators for Ormen Lange and two for Draugen. The simulators replicate the process control and safety systems at both sites, and are used for operator training, engineering and testing. Every single change to the automation system is first tested in a simulator before its implementation is approved by the TAM and Shell, thus minimizing the risk of error. At Ormen Lange the simulators played a lead role in enabling the facilities to start production ahead of schedule.

Shell was an early adopter of cyber security measures, so ABB invested in cyber security at an early stage of the Ormen Lange and Draugen projects. The cyber security measures taken include standard ABB practices such as restricting access to authorized users only, anti-virus updates, the installation of Microsoft patches in a safe and secure manner, back-up and restore, and the testing of all changes before they are approved and deployed in the field.

*"Shell took an early and leading position in the development of Process Control Domain IT Security standards. Norske Shell in partnership with ABB further developed these into a solutions and service provision for the Ormen Lange facility in 2007 (externally verified by Det Norske Veritas). These services are continually being adapted to meet changes to global standards and the emerging threats within the industry."*

Torbjørn Mikalsen, PCD Information Security Focal Point and Rune Wærstad, System Owner Safety and Automation Systems, both of Norske Shell



The data that ABB collects from the safety and automation systems at Draugen and Ormen Lange is continuously analyzed by Shell and ABB to find new ways to increase productivity. Several of these opportunities have led to increases in production.

#### Automatic choke control

There are currently 16 wells in production at Ormen Lange. Each well extends 2,000 m below the seabed and is surrounded by gravel and sand. If production in the wells is ramped up too quickly, the gravel and sand will collapse into the well and destroy it. Previously, the wells were started up slowly at a preset speed to prevent them from collapsing. It typically took 9 hours to ramp up a low pressure well and 15-20 hours for a high pressure well. The process was safe, but it did not take into account what was happening in the wells in real time.

To speed up the process and increase production, Shell asked ABB to create an automatic choke control solution that monitors and controls critical variables in the well during ramp up. By knowing precisely what is happening in the wells' process dynamics, the speed of the ramp up can be adjusted accordingly.

Thanks to the solution, the wells can now be opened much faster than before and with reduced risk to well integrity and safety. On average it now takes only 2 hours to open low pressure wells and 6 hours to open high pressure wells.

#### Dynamic MEG control

Ormen Lange uses vast quantities of anti-freeze, also known as mono-ethylene glycol (MEG). The MEG is stored at Nyhamna in two colossal tanks and injected into the subsea wellheads to prevent water in the gas from crystallizing and blocking the pipelines. The MEG is then transported back onshore with the gas, and cleaned in three regeneration trains for recycling.

Although the amount of MEG pumped into each well was safe and sufficient, there were opportunities for improvement by taking process dynamics into account. Shell asked ABB to create a dynamic solution that measures the concentration of MEG required for each well and adjusts the speed of the onshore pumps in accordance with real-time conditions.

The solution has reduced the amount of MEG used and enabled Shell to shut down one of the three regeneration trains (the two tanks at Nyhamna hold more MEG than the world produces in a single year). The reduced amount of MEG in the production pipelines means there is more space for gas, which has enabled Shell to optimize production. In addition, the dynamic speed control of the powerful onshore pumps that pump the MEG through the pipelines to the wells has cut energy consumption at Nyhamna.

#### System evolution and life extension

Draugen was initially designed for an operating life of 17-20 years. So too were ABB's safety and automation systems. In response to Shell's requests and requirements ABB has developed an evolution program to prolong the life cycle of the safety and automation systems so that they match the projected extension period of the field's life.

The program plots an upgrade or replacement path for each item of hardware and software over the coming years, as well as the scheduled shutdown when the work is to take place. This minimizes risk and expenditure for Shell. It is made possible by ABB's ability to extend the operating life of control assets far beyond their normal obsolescence phase, while safeguarding the high availability rate those assets have so far attained.

# Contact us

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