



Integrated Operations

Process control commissioning at Ormen Lange

Development of Ormen Lange

Faster commissioning, reduced downtime and improved energy efficiency have been the results of process control performance services carried out at the plant serving Ormen Lange, one of the largest natural gas fields in development on the Norwegian continental shelf. The services were carried out alongside commissioning by a team from ABB's Integrated Operations department.

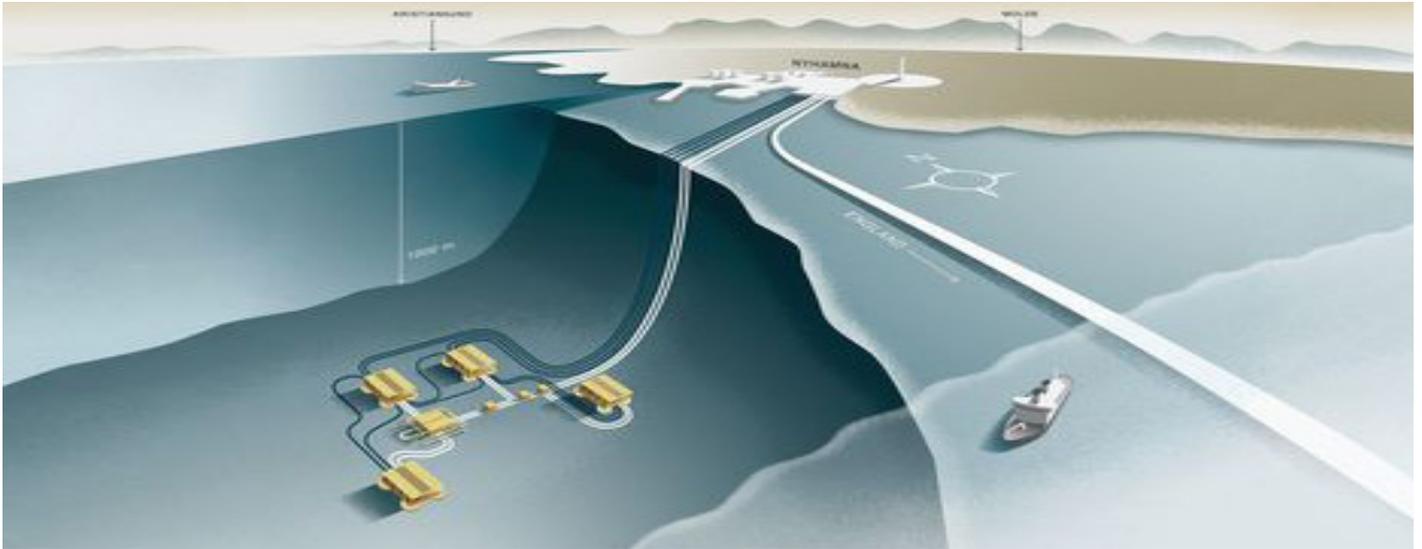
The Ormen Lange gas field is located in the North Atlantic, 120 km northwest of Kristiansund, where the depth varies between 800 and 1,100 meters. The reservoir is 3,000 meters below sea level, covering an area 40 km long and 8-10 km wide. The field does not feature any conventional offshore platforms. Instead, 3 subsea templates on the ocean floor are connected directly by two 30 inch, 120 km long pipelines to the onshore process terminal at Nyhamna.



The wellheads on the ocean floor are connected to the onshore process terminal at Nyhamna.

Process control optimization of the onshore plant was carried out alongside commissioning.





The wellheads, 800 to 1,100 meters below sea level, are connected directly to the onshore terminal; the reservoir itself is 3,000 meters below sea level.

The gas from Ormen Lange is blended with gas from other fields at the Sleipner platform in the North Sea and transported to Easington in the UK via the 1,155 km Langeled pipeline, the world's longest subsea export pipeline. The Ormen Lange field can supply up to 20 percent of the UK's demand for gas.

The field was discovered in 1997 by Norsk Hydro's oil and gas division, which has since become part of Statoil. Following the start of production in September 2007, responsibility for operation was handed over to Norske Shell.

Norway's biggest project ever

The development of the field has been the largest single project in Norwegian industrial history. ABB supplied automation, electrification, telecommunications and operator training systems. A comprehensive automation, safety and information management system oversees all applications for operation, maintenance, planning and reporting, using a distributed control system with 15,000 I/Os. The engineering contractor for the facility was Aker Solutions.

Process control services, covering services to speed up commissioning of the control logic, as well as to increase the uptime and efficiency of the equipment, was an additional order placed by Norske Shell while planning the start of

operations, in the summer of 2007. The project was to run in tandem with commissioning of the automation system, aiming to adapt the control logic and its parameters to the actual production situation in an efficient way. Underpinning the project was a tight integration with Ormen Lange operations and hence access to their operational- and process expertise – this collaboration was key to the benefits achieved.

The result is faster commissioning and start-up. The project has also increased uptime by four to five days per year, which represents a significant increase in revenues, bearing in mind that the field production capacity is 70 million standard cubic meters of gas per day. In addition, energy efficiency has improved. The work also enabled Shell to learn about the system more quickly, helping the company to use the equipment in the most effective way.

The work was carried out by a team specializing in process and production optimization from Integrated Operations, a department within ABB that delivers solutions and services for more profitable operations and improved work processes. The value of the optimization project is \$4.3 million (25 million Norway kroner) up to 2010, an amount quickly recouped by Norske Shell through more rapid start-up and increased uptime. The contract was originally for three years but was extended by another two years in 2010.

Process control at Ormen Lange

The system that ABB's Integrated Operations team was taking on in the summer of 2007, with a view to optimize, is one of the largest automation systems ABB has ever built.

"This is an extremely large system. Although Norske Shell was involved throughout the design phase, we did not feel we had sufficiently detailed expertise to optimize the system," says Arne Røsdal, Norske Shell's operations support supervisor of Ormen Lange.

The comprehensive automation, safety and information management solution includes applications for daily operation and maintenance, as well as planning and reporting.

Automation system with 15,000 I/Os

The distributed control system is an ABB 800xA with 6 operator workplaces and eight engineering stations,

requiring 42 servers in six cabinets for the process automation and information management system. The 15,000 I/Os are mainly on HART and Profibus.

The process is monitored and controlled by 67 AC 800M controllers (43 single AC 800M, 12 single AC 800M HI and 12 redundant AC 800M HI), handling process control, process shutdown, fire and gas alarm, HVAC, power distribution control system, subsea control units and fire water pumps. Two safety systems for emergency shutdown and anti-surge systems are supplied.

The production process is monitored from a control room at Nyhamna. A curved wall with a large screen display provides the operators with an overview of the process facility. Camera monitoring of process sections is also integrated into the safety and automation system.

Process control services started at the same time as commissioning.





The production is monitored from a control room at Nyhamna.



The ABB team quickly moved from trouble-shooting to loop tuning, control logic improvement and operational support.

“With the expertise of ABB’s Integrated Operations team, it was easier to identify problems early and to solve them permanently”
Arne Røsdal, operations support supervisor for Ormen Lange, Norske Shell

“Early operations were greatly helped by a simulator of the automation system, provided by ABB, which enabled us to try different parameters. But there is a limit to how much you can do in a simulator. We decided it would be useful to have a team of experts from ABB to help with the tuning of the system during the start-up phase,” says Røsdal.

Control logic commissioning and tuning

“We started our process control services at the same time as commissioning,” says Lars Nummedal, technical lead of the ABB team, known to Norske Shell as “the tuning team”.

“We complemented Shell’s operational expertise with our process control expertise and the first objective was to get the plant and sub-systems up and running as quickly as possible. We started by tackling any obvious problems and then gradually moved on to loop tuning, control logic improvement and operational support.”

The members of ABB’s Integrated Operations team are specialists in chemical engineering and process control, typically postgraduates to MSc or PhD level. They work closely integrated with the Shell team, spending most of their time in the control room. A remote control room in Oslo, built by ABB and owned by Shell, is used for backup operations,

but ABB also has staff on site in Nyhamna. At any time, five to ten ABB staff are working on the project.

“Tuning support is always very useful at start-up, as there are often problems managing control functions. It is difficult to control the entire process while trying to predict how the different functions will influence each other”, says Røsdal.

“The Shell staff and the ABB team have an intense dialogue with each other and through this, we learn how the process works and what is possible to achieve.”

“As the project progressed, we also realised that the ABB team members had a useful competence in processing as they helped to sort out several problems in cooperation with the engineering contractor. This resulted in a problem-free start-up. Normally, when starting a plant, you tend to have long downtime periods while solving problems and then waiting for the plant to get back to stable operation. This was avoided when starting Ormen Lange,” says Røsdal.

“The members of our tuning team are experts of process operations, particularly the dynamic performance of the system. We know the way pressure and temperature fluctuate and how levels change. Using tailor-made tools and applications, we can put the finger on a problem and adapt the software or control strategy, as well as pinpoint issues with the mechanical equipment or the operational procedures. Simply put, we suggest and implement changes to ensure that the system behaves in the way the operators and engineers want,” explains Nummedal.

“With the expertise of ABB’s Integrated Operations team, it was easier to identify problems early and to solve them permanently,” adds Røsdal.

Optimizing the process plant

Improved profitability with rapid commissioning

ABB's Integrated Operations team minimized the time needed for commissioning, enabling the facility to start earning revenue earlier. Just by shortening the time to start-up by four to five days, the cost of the contract could be recouped many times over.

The team also provided continuity by helping to manage the transition from start-up to the operational phase. The performance level that has been established will now be maintained – there is a service agreement in place to maintain and if possible improve on this level.

“Correct tuning can prevent many problems. Issues associated with overload are reduced. With less fluctuations and more stable operation, we can increase the throughput. The workload for staff is also reduced, as they otherwise have to go out to the plant and investigate problems. In addition, there is less need to shut down, as the ABB team has the expertise to make adjustments while the process is running,” says Røsdal.

“Focusing systematically on the tuning, ABB helps to free up the Shell staff for other duties,” says Røsdal.

“The tuning of the controllers was a deciding factor enabling us to start the plant rapidly. During operation, the trouble-shooting carried out by the team has been particularly useful,” says Reidar Haugsgjerd, startup advisor for Ormen Lange at Norske Shell.

The optimization has helped Shell maximize revenues through improved up-time, less equipment wear, reduced energy use and higher condensate production.

Increased profit, safe operation and lower costs

The optimization has resulted in improved plant up-time, less wear of equipment, increased condensate production and reduced energy use. This means maximized profit with safe and robust operation, while maintaining quality constraints and export requirements. It has also minimized time for duty change due to varying demand from the customer and enabled the plant to achieve the quickest possible resumption of production following downtime. The result has been increased uptime by four to five days per year.

“We have also introduced several improvements to the process. For instance, condensate production has increased. Condensate is a more valuable product than gas, so this helps increase revenues. The process is now optimized to produce the highest proportion of condensate possible. The ABB team has also helped reduce the amount of heat transfer medium in the cooling processes,” says Røsdal.

On top of this, the ABB team has identified opportunities for energy savings of more than 3 MW. Significant energy savings were achieved by, for instance, optimizing control of the export compressor by reducing the cooler temperature, making more power available to increase the export rate.

“All energy efficiency improvements are of interest. Electricity is a large part of the running costs for the plant and Ormen Lange also pays for the CO₂ emissions. In addition, we have to work within the maximum capacity of the electrical plant. If 1 MW is saved, the freed-up capacity can be used



somewhere else, for instance to increase the export rate, which will boost revenues. The effort invested in improving energy efficiency gives rapid payback,” says Røsdal.

Gain for engineering contractor

The early start-up has also been a benefit for the engineering contractor, Aker Solutions.

“The quick commissioning benefited Aker directly. It is a distinctive advantage to the engineering contractor to finish its part of the project as early as possible, both to save its own costs and to earn any bonuses stipulated in the contract. Rapid completion is also a competitive advantage and an important reference for future contracts,” says Romar Ekbraaten, responsible for integration of the automation system on behalf of the engineering contractor, Aker Solutions. Ekbraaten monitored the overall reliability of Ormen Lange during the first year of operations.

“Tuning of the controllers has given an important contribution to the high reliability, together with robust design and small fluctuations. Compared to other similar projects, Ormen Lange showed outstanding reliability from day one,” says Ekbraaten.

“Tuning the controllers during start-up turned out to be much better than the traditional alternative, which is to start up with theoretical design values and values obtained during simulation. A substantial part of this data is normally modified during commissioning, as it becomes part of the complete system and no longer works in isolation. During this stage, equipment failures are common if equipment is forced to work with parameters it was not designed for. While starting up Ormen Lange, this could be prevented by parallel verification,” says Ekbraaten.

Further benefits with earlier involvement

“In hindsight, it would also have made sense to have the ABB tuning team involved at an earlier stage, during mechanical completion. In many projects, this stage includes all tests up to full loop test and handover to commissioning. It would have been useful to verify the systems implemented on a running basis,” says Ekbraaten.

“ABB can assist the engineering contractor by ensuring the dynamic behavior is the way the customer wants it when the system is commissioned. These process control engineering services are based on thousands of hours of control room experience. The services enable the contractor to optimize the engineering for the control tasks ahead and will reduce the commissioning and start-up time,” says Nummedal.



The engineering contractor, Aker Solutions, also benefited from the rapid start-up of the process plant.

Continuing and sustaining the improvement

“There is no doubt about the enormous usefulness of ABB’s tuning team when starting up the plant. They were one of the keys to the success,” says Per Sælevik, startup leader of Ormen Lange at Norske Shell.

“We have learned a lot both about the automation system and about the process in general. The work with the tuning team has given us an invaluable overview of which parameters are important, based on actual operation of the plant. We can tackle bottlenecks and remove these systematically,” says Røsdal.

“The tuning team gives us important information on a continuous basis,” Røsdal concludes.

Process fingerprint service

A service to identify possible process control improvements is also available to operators of brown-field sites. For reasons like tail production, process changes, equipment changes, or changes in reservoir or fluid characteristics, a production plant may no longer operate as it was intended in the design phase. ABB’s Process Fingerprint Service will identify how production can be increased and operational expenses reduced while ensuring safe operation.

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