

# 800xA Simulator

## Overcoming the challenges of Peregrino



**Two System 800xA Simulators have helped Statoil overcome the challenges of recovering and processing some of the heaviest and most challenging crude oil on the planet.**

### One of the world's largest production vessels

Peregrino is Statoil's largest oil project outside of Norway. The field lies about 85 km off the coast of Rio de Janeiro, Brazil, and around 2,300 meters below the seabed. It is one of the largest producing oil fields in the region.

At the heart of the field's production system is the Peregrino floating production, storage and offloading (FPSO) vessel. It is one of the biggest and most technologically advanced ships ever built.

FPSO Peregrino has a daily production capacity of 100,000 barrels of oil and considerable quantities of water and gas. It has a storage capacity of 1.6 million barrels of oil, equivalent to 16 days of round-the-clock production. The topside consists of two identical production trains, as well as 15 modules for various processes like crude oil separation, water treatment and power generation.

By far the biggest production challenge at Peregrino is the high viscosity of the oil and the complex recovery and processing that it requires. Each of the 30 production wells is equipped with an electric submersible pump to artificially lift the oil from the reservoir to the two wellhead platforms, a distance of almost 2.5 km. To enable the oil to flow between the platforms and the FPSO, the wellstream is heated to a very high temperature.

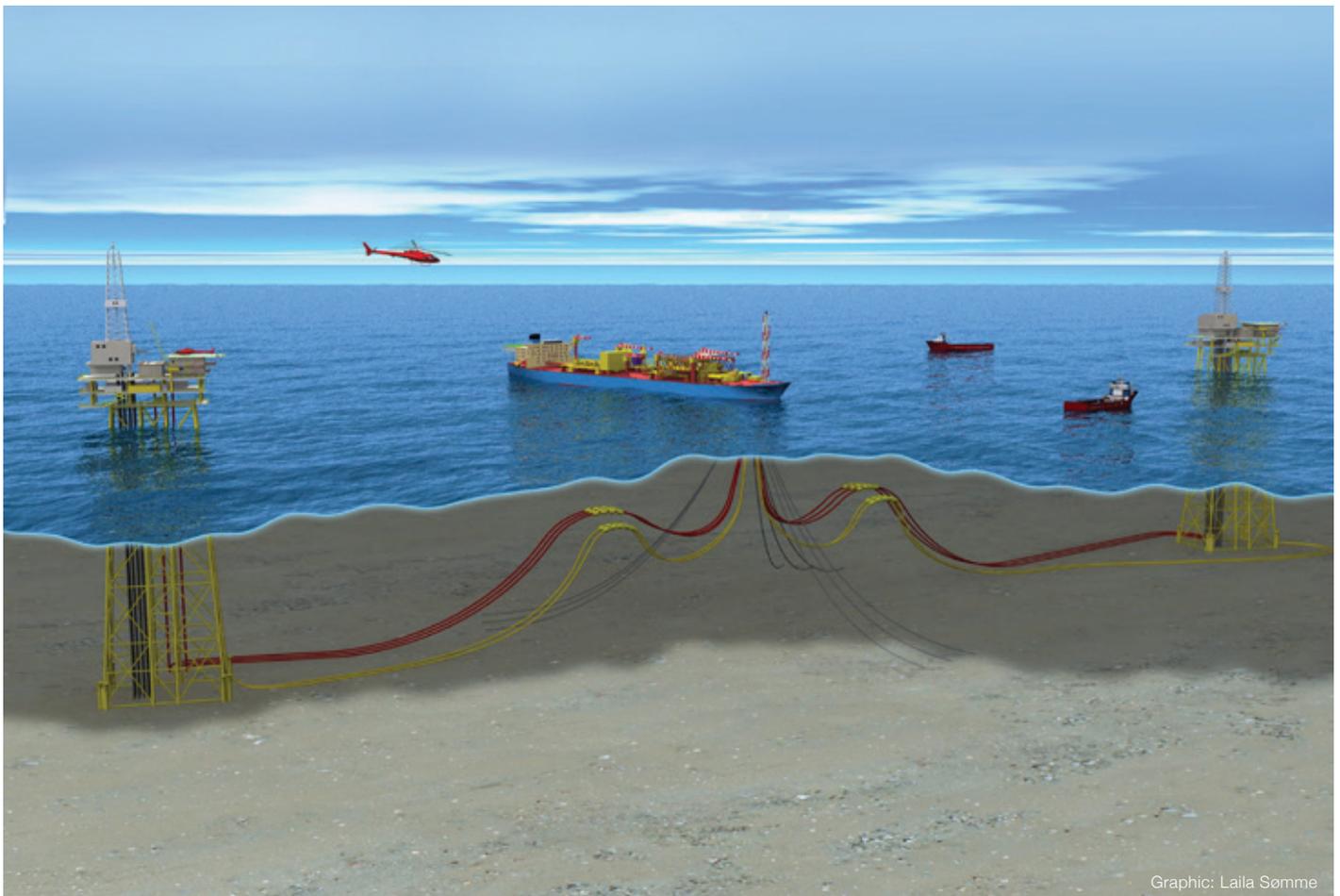
The wellstream is a mixture of oil, gas, water and sand. When it reaches the ship it has to be separated, cleaned and coalesced. Once stabilized the oil is stored ready for offloading onto tankers, while the cleaned water is injected into the production wells to help lift the heavy oil through the reservoir. Production at Peregrino began in 2011.

### Powered and automated by ABB

ABB was appointed the main automation and main electrical contractor (MAC/MEC) when FPSO Peregrino was converted in 2010 from a very large crude carrier (VLLC) into an FPSO by its then owners, A.P. Moller-Maersk Group, the world's largest ship company.

ABB designed, engineered and supplied a complete power distribution solution and a fully integrated safety and automation system for the entire production process.

The safety and automation system is based on ABB's System 800xA Extended Automation platform and is operated from a System 800xA Extended Operator Workplace (EOW-x) control room onboard the FPSO. The solution includes two 800xA Simulators, one for operator training and the other for process studies and engineering support.



Graphic: Laila Sømme

The high-fidelity dynamic simulator has proven to be highly valuable in engineering, commissioning and operation preparation of the Peregrino FPSO project.

“The operator training simulator (OTS) increased our understanding of the operational challenges and reduced the operational risk during the initial phase of production start-up. The result of this training was a success – the start-up of Statoil’s largest international operation was safe and efficient.”

Taale Stette, Lead Engineer Process Control, Statoil.

### Simulators play a vital role

The two System 800xA Simulators, which use a process model developed by process simulation software vendors RSI, have played a vital role in helping Statoil to understand the complex behavior of the oil and the best way to recover and process it in accordance with the field’s challenging properties.

The simulators provide Statoil with an exact replication of the Peregrino safety and automation system. Instead of real process equipment the simulators use high-fidelity dynamic modelling of the entire production process – from the wells and submersible pumps to the wellhead platforms and FPSO production facilities.

One of the simulators is used to train operators how to operate the production process and safety and automation system. This ensures that they are fully trained and knowledgeable before they enter the real control room for the first time.

They also learn how to start up and shut down the process, perform emergency and safety procedures, and react to production anomalies. An instructor station equips the instructor with a comprehensive range of tools to simulate process situations and evaluate trainee performance.

The second simulator is used for process studies and engineering support. It was used extensively by Statoil in the design and pre-startup phases to form a better understanding of the production challenges and to use the knowledge gained to make correct process decisions.

The simulator was also used to verify the safety and automation system prior to commissioning. Any changes made to process parameters are first tested in the simulator to evaluate how they affect production and ensure that they are correct.

## “The OTS increased process availability during the initial phases of production start-up.”

Taale Stette, Lead Engineer Process Control, Statoil.

### The benefits of 800xA simulation

Statoil refers to the 800xA Simulators as ‘life cycle simulators’ for their ability to deliver benefits throughout the life cycle of the field and production process. At Peregrino these benefits began at the initial stages of the project and are still ongoing.

By using the simulators throughout the design phase of the production process, Statoil was able to better understand the challenges of recovering and processing the field’s heavy oil. The simulators made it possible to compare the various process options available and arrive at optimal solutions at each stage of the long recovery and processing chain. The simulators were used to commission the safety and automation system and to develop and refine Statoil’s standard operating procedures for Peregrino.

By training the operators in the simulator prior to start-up Statoil was able to start production with a team of well-trained and knowledgeable operators. The result was a smooth and successful start-up and higher process availability. Within the first two years of operations at Peregrino Statoil has doubled the recovery factor from 10 percent to 20 percent, which is a remarkable achievement.

### Simplifies field expansion

As a result of the increased recovery factor Statoil has decided to proceed with its plans to add a third wellhead to the Peregrino field and to develop its recent discovery of the nearby Peregrino South oil field.

In a recent conference paper, Statoil said: “Thanks to the 800xA simulators and simulation software, the existing simulators and safety and automation system at Peregrino can be easily extended to include future facilities. The impact of the new facilities on the existing production process can be investigated in the simulators before implementation.

ABB has a huge reference list of 800xA Simulators throughout the oil, gas and petrochemical industries. In addition to Statoil, users include BP, ConocoPhillips, Eni, ExxonMobil and Shell. 800xA Simulators are also widely used in process industries like minerals and mining, power generation and pulp and paper.



# Contact us

## **ABB AS**

### **Process Automation Division**

Oslo, Norway

Phone: +47 22 87 20 00

Fax: +47 22 87 29 00

E-mail: [simulator.sales@no.abb.com](mailto:simulator.sales@no.abb.com)

[www.abb.com/controlsystems](http://www.abb.com/controlsystems)

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