SIEMENS
Ingenuity for life

Kongsberg Develops Dynamic Simulator for Oil & Gas

Siemens' SIMIT software enables the testing, training, and virtual commissioning of a floating production, storage and offloading offshore vessel.

By David Greenfield
Editor-in-Chief, Automation World

Off the coast of South America—in water depths of 1,500 to 2,000 meters, a major oil and gas company has nearly completed the development of a floating production, storage, and offloading (FPSO) vessel designed to produce more than 100,000 barrels of oil per day. The vessel, which is on schedule to produce oil in 2020, has multiple drill centers with subsea well systems, including production wells, water injection wells, and gas injection wells.

The massive FPSO is being developed and integrated in a shipyard right now. As part of a multibillion-dollar project, it's important that all engineering and control systems are fully tested to reduce schedule, quality, and integration risks. In addition, the operators and the local workers involved in the project must be trained and assessed for competency before heading offshore to the floating production facility.

For the testing and training, the oil company turned to Kongsberg, a global technology firm based in Norway that focuses on the maritime, aerospace and defense industries, energy, and oil and gas industries.

Kongsberg uses two in-house high-fidelity process modeling engineering software, including LedaFlow for well performance/multi-phase flow assurance and K-Spice, a process simulation tool for topsides unit operations. These technologies work seamlessly together to provide a multi-purpose dynamic simulators (MPDS) for design, verification, operator training, and real-time decision support throughout the well-to-expert process.

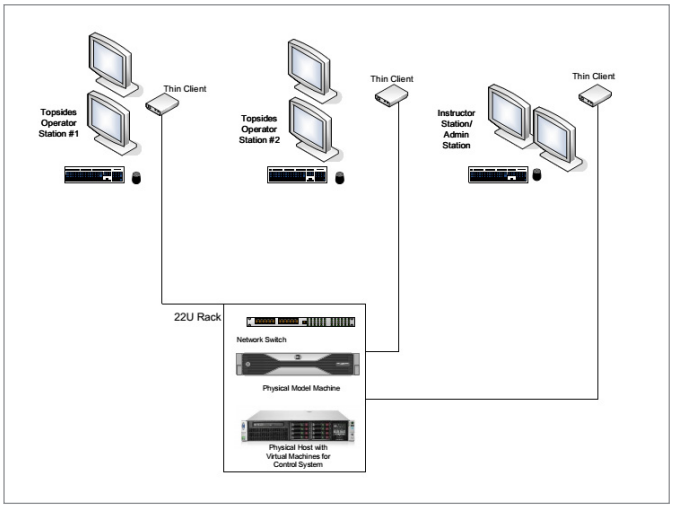
The high-fidelity process model built in K-Spice includes everything used in the project, from the topside receiving to the export oil and gas systems. Utilities such as heating medium, cooling medium, sea water lift, produced water systems, seawater treatment system and chemical injection systems are also included.

"These are the highest fidelity models in the industry right now," said Ankur Rastogi, operations manager for the Americas at Kongsberg Digital, during a presentation at the Siemens Automation Summit 2019. "These are offline applications, but the next step is to connect to the facility control system in real-time...[so] these models can represent the live plant as it is running and support future Digital Twin applications for planning, optimization, and surveillance."

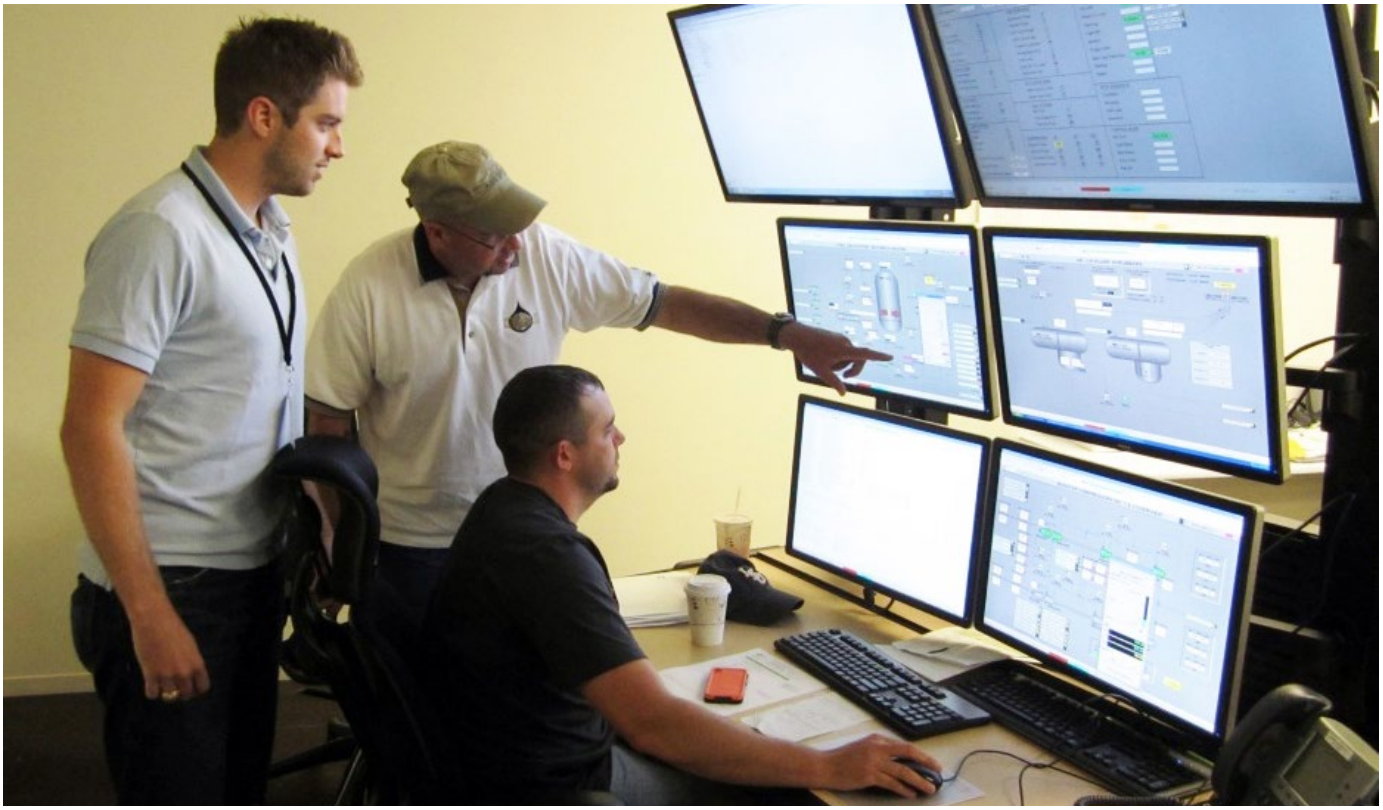
Kongsberg integrated the FPSO's control system, Siemens' SIMATIC PCS 7, with the high-fidelity process models using Siemens' SIMIT real-time simulation platform. The topside process controls were emulated with six SIMIT virtual controllers which eliminated the need for physical controller hardware in the simulation system. Because of the tight integration between SIMIT and PCS 7, Kongsberg was able to download the project control program directly to the virtual controllers without making any changes. SIMIT also provided an interface between the high-fidelity process models and the PCS 7 operator screen, providing a testing and training environment that was as close to the production environment as possible.

Testing and Training Time

The system hardware is designed for two students and one instructor, consisting of two operator workstations and an instructor station, each with two monitors, a thin client, keyboard, and mouse. A half rack server cabinet contains an ESXi Host Server, a network switch, a network-attached storage unit and a model workstation PC.



For the software architecture, one of the virtual machines was used to run SIMIT along with two virtual PCS 7 controllers. The remaining four virtual controllers were distributed over two additional virtual machines. Three HMI servers were included along with historian licenses and dual operator station clients running WinCC HMI; one of these servers were also used as the SIMATIC Manager/Engineering Station.



The Siemens team completed the setup of the hardware and software. After Kongsberg provided the link to the high-fidelity process models, the systems were integrated via OPC, and then used for ICSS testing and operator training.

To start, a complete check out of the integrated control and safety system was performed virtually. By using the simulation system, Kongsberg was able to identify errors and make corrections to the graphics, PID loop tuning, control actions, startup sequences, plant alarms, and trip set-points all from the office, early in the commissioning phase of the project.

"Virtual commissioning is where you really deliver value from the simulation system," Rastogi said. "You are often paying $200 to $300 thousand per day to be onsite for commissioning and you can save money and weeks of commissioning time by shifting this work off site in an office environment." Rastogi added that by virtually commissioning the process from the office, the work became less stressful and it was easier to debug any failures.

After testing was complete, Kongsberg began using the system to bring operators up to speed on FPSO operation. One of the strongest features of K-Spice and SIMIT, Rastogi said, was the ability to pause and backtrack. "You can't do that in the real world, but with the simulator you can go back in time to see that, if you did something in a different way, would you get different results?"

You can also run the process faster than real time with the K-Spice – SIMIT simulator. Kongsberg was able to make more efficient use of their operator training time by speeding up production processes where nothing significant occurs and then returning to real time when the operator needs to take their next action.

In this scenario, Kongsberg was able to deliver several valuable benefits for the FPSO deployment, including validating operator procedures and training the operators on:

- Operation and familiarization with the HMI and control systems;
- Handling all functions of the topside process control system and subsea universal master control station;
- Recognizing and interpreting the interactions between the various process units;
- Start-up and shutdown of various units safely and efficiently;
- Identifying and correcting plant alarms, upsets, and malfunctions;
- Responding correctly and promptly to emergency situations, and plant upsets;
- Validating operating procedures; and
- Assisting in commissioning.

Siemens Industry, Inc.
100 Technology Drive
Alpharetta, GA 30005

1-800-365-8766
info.us@siemens.com

Subject to change without prior notice.
Order No.: BRPA-00295-0819