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Reference

(Source: Robotic Drilling Systems AS)

Oil and gas drilling goes digital

Fully-automated handling robots for oil and gas drilling rigs

The oil and gas industry has finally entered the world of automation and digital process control. Norway-based Robotic Drilling Systems AS and Siemens have teamed up to develop a game changing drill floor solution comprising robotic technology for fully unmanned oil and gas drill floor operations.

Drilling for oil and gas is still one of the most adventurous businesses of our times. But it is a risky business not only in financial terms, but also for the workers operating the drilling equipment on both onshore and offshore platforms. This is clearly reflected in the fact that there were approximately 1,600 injuries and 18 fatalities reported in 2014 alone, according to the White Paper "Digital Transformation Initiative", from the World Economic Forum.

Health, safety, security and environmental (HSSE) concerns are therefore major aspects driving oil and gas drilling companies worldwide. They need to comply with environmental legislation, but they are also completely focused on improving the safety of workers in the field, and at the same time, ensuring reliable platform operation.

Risky operations with high associated costs

As a consequence of global energy markets characterized by increasing demands and at the present time decreasing profits, drilling companies are also challenged with reducing the overall cost structure of their drilling operations. Especially offshore drilling operations require a highly qualified workforce, and are also faced with high operating expenses. Offshore workers need to be especially certified, which translates into substantial labor costs. They frequently need to be transported to and from the platform by helicopter, which results in high transportation costs. Taking all of this into consideration, labor costs represent a high percentage of the overall cost, and must be carefully taken into consideration.

Another factor is the time needed until the first gas or oil is actually pumped. The shorter this time, the more profitable the drilling project will be. This means that companies are very interested in increasing the efficiency of their operations by improving the reliability and availability of the hardware used.

There are also environmental issues that call for efforts to minimize the footprint of the operation, reduce the amount of energy needed and prevent accidents that might have a detrimental effect on the environment.

Reducing manual operations with robotics

As the automotive industry has demonstrated, replacing manual work by handling robots is not only a step towards lower operating costs. It also leads to a significantly higher level of quality and repeatability. Robotic Drilling Systems AS (RDS) is in the process of transferring this knowledge to the worldwide oil and gas industry. The company was founded in 2005, and is located in the greater Stavanger area in Norway. It has developed a revolutionary drill floor solution that allows fully unmanned operation. The system can be called a revolution for the oil and gas industry, and is designed to automate the complete drilling process. It handles the pipes and tools required, and can be integrated into new or existing onshore and offshore installations.

The system basically consists of drill floor robots, robotic roughnecks, multi-size elevators and robotic pipe handlers. It is designed to remove high-risk manual tasks from the drilling platform, while adding a new level of speed, accuracy and reliability to drilling operations. Jimmy Bostrøm, Chief Operating Officer of RDS sums up the key benefits of the system:

"The RDS solution enables oil and gas operators to decrease rig time per well, reduce health, safety and environmental incidents, while reducing operating costs through consistent operations. Additionally, the system offers benefits, such as faster installation, along with lower noise and energy consumption." The company's solution not only reduces the personnel costs associated with the rig, it also redefines the role of the drilling crew. The focus will change from drill floor tasks to the well construction process.



Multi-axis drill floor robot designed for handling pipes and drill heads
(Source: Robotic Drilling Systems AS)

Robots in seamless interaction

Handling robots not only require intelligent motion control. They also need a complex automation system to seamlessly work together in order to handle a complete work process without human intervention. RDS has teamed up with Siemens, tapping the comprehensive know-how of a world leader in industrial automation and industrial communication, and applying this wealth of expertise to the oil and gas industry. As a result, the electronic equipment of the system consists entirely of Siemens products. The same is true for the drives.

Each of the robots is equipped with its own digital control system accommodated in a control cabinet. Here is where SIMATIC IPC's with SIMATIC STEP 7 software interpret sensor signals, translate process commands into motion control sequences and coordinate the interaction of related robots. They provide the digital intelligence required for handling pipes, positioning and attaching tools and the drilling operation itself.

At the machine level, Siemens drives are combined with SINAMICS 120 frequency converters, SIMATIC S7-300 controllers and SIMATIC ET 200 distributed IO systems. They form a decentralized machine control system that links all the mechanical processes on the drill floor to the digital world. In the control room, WinCC Advanced is used to visualize all of the processes via SIMATIC HMI panels, and allows especially trained drilling technicians to monitor and control the ongoing drilling operation without manual intervention.

The communication between the control room and the robots and between the robots themselves is established using best-in-class industrial communication products from the SCALANCE S and SCALANCE X range. The SCALANCE Industrial Ethernet switches ensure that data is reliably transmitted between the various automation, drives and visualization components. These switches are designed to be deployed in extremely harsh environments and support critical applications such as drilling operations.

Siemens experience both in the oil and gas industry and in industrial communication networks is reflected in the comprehensive portfolio of SCALANCE switches, which comply with a broad spectrum of approvals required in the oil and gas industry. Examples of these standards include ATEX, FM, IECEx and UL HazLoc approvals for use in hazardous areas – as well as ABS, BV, DNV-GL, LR for marine applications. The SCALANCE X-200IRT managed Industrial Ethernet switches, operating in isochronous realtime, have been specifically designed for stringent realtime applications. They can be used for high-performance machine-level applications all the way up to networked plant sections in Profinet environments.

The security modules of the SCALANCE S family have been specifically designed for use in automation environments, yet connect seamlessly with the security structures of the office and IT world. They ensure security, and meet the special requirements of automation engineering. For instance, existing systems can be simply upgraded, installation is straightforward and downtime is minimized in the event of a fault. Various security measures can be combined depending on the security requirements.



Product family – SCALANCE X-200: Managed SCALANCE X switches for seamless communication between robots and the control room

This clearly explains why industrial communication is a key enabler of digitalization in the oil and gas industry, as it is necessary to ensure a reliable, secure and continuous data transmission along the complete drilling value chain in the oil and gas industry.

Interaction between experts

The cooperation between RDS and Siemens dates back to when the company was founded, which is approximately 10 years ago. Since then, Siemens has supported the project, not only with a wide range of drives and the complete automation and communication system, but also with ongoing consulting and technical support. In addition to a local competent contact person in Norway, the innovative drilling system developed by RDS was also considered to be a priority project, and enjoyed direct support from the Siemens headquarters in Germany. In the meantime, the system is no longer in the development stage, and has stood the test under real conditions in the field. "The very first system was delivered to a North American oil and gas drilling company," explained Jimmy Boström and adds: "We have also installed a system not far from here in the North Sea, just off the Norwegian coast."

One aspect for RDS to choose Siemens as a technology partner is because Siemens is truly a global company, and can provide technical support for the installed base of robotic drilling systems just about anywhere around the world.

Stepping into the digital future

With its robotic drilling system, RDS has catapulted oil and gas drilling operations into the digital age. Its innovative systems replace labor-intensive, costly and potentially dangerous manual processes using handling robots that seamlessly interact with one another. This not only reduces costs while improving reliability, equipment availability and environment protection, it also paves the way for oil and gas operations to evolve.

Robot-based drilling operations will generate a wealth of process data that can be used to streamline processes and get a better insight into the factors determining a successful drilling operation. "At RDS, we anticipate an industry-wide convergence of automation and robotics by 2020," concludes Boström: "Automatic drilling and drill floor handling will be combined with downhole data acquisition to optimize all of the key parameters from crown block to downhole."

From automation to big data

Drilling for oil and gas is still a process requiring extensive manual work on onshore and offshore drilling platforms. In the vicinity of Stavanger, Norway, Robotic Drilling Systems AS has developed a fully automatic drilling system for largely unmanned drilling operations. The combination of four handling robots helps the industry to save costs while greatly improving reliability and availability of the drilling equipment. This innovative technology is the first step towards more efficient, less risky and more profitable drill floor operations based on digital industrial communication, control and automation. It will also provide a wealth of process data to better understand and optimize the drilling process.

Seamlessly interacting robots

The hardware of the RDS drilling system consists of four components for pipe handling and drilling:

- Drill Floor Robot for tool operations
- Robotic Iron Roughneck to handle make-up/break-up operations
- Multi-size Elevator for pipe positioning
- Robotic Pipe Handler to handle the drilling pipes

In addition to the drives, Siemens also provided the complete communication and automation system of the drilling system, as well as consulting and engineering services. The electronic hardware includes the following components:

- SCALANCE X
- SCALANCE S
- SIMATIC S7-300 CPU319F-3
- SIMATIC ET 200
- SINAMICS S120
- SIMATIC IPC
- SIMATIC WinCC Advanced
- SIMATIC STEP 7

Security information

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions only form one element of such a concept. For more information about industrial security, please visit <http://www.siemens.com/industrialsecurity>

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