

# Technical Article

*The Subsea Valve Actuator combines the best of electromechanics and hydraulics.*

## A Step Forward: The First Hybrid Actuator to complete the All-Subsea Factory!

Together with leading equipment suppliers and operators, Bosch Rexroth has developed a completely new concept for deep sea actuators. The best of electro-mechanics and electro-hydraulics in a compact unit for deep sea applications, the Subsea Valve Actuator (SVA) provides up to SIL3 safety, consumes up to 75 percent less energy and is designed for 25-years of operation.



# Key Insights & Considerations

- **With considerations including overall lifetime and maintenance restrictions, the requirements for subsea production systems are extremely strict**
- **When working with subsea production systems for oil and gas, operational safety is especially important**
- **The Subsea Valve Actuator provides an energy-efficient and safe alternative to commonly used hydraulic or electro-mechanical actuators**

External pressure 300 bar, compatible with a saltwater environment, 24-hour operation 365 days a year, 25-year lifetime, no maintenance if possible: The requirements for subsea production systems are extremely high. Operational safety is especially important for underwater systems that produce oil and gas, to protect people and environments. Additionally, protecting the sea from the pollution that intentional leakage of hydraulic fluid causes is now also a key priority.

For each well, a system is used in underwater plants. Because of its similarity to its namesake plant, this type of system is known as a “Subsea Tree.” Each “tree” controls the oil and gas production of its respective well via multiple process valves. The process valves are actuated by the SVAs, which in turn, receive their electrical control signals from the Actuator Control Modules (ACM). When required, they must safely close the respective process valve in every operating state, even during power failure.

## **| Self-contained axes with a hydrostatic drive**

With the recently developed SVA, Bosch Rexroth provides an energy-efficient and safe alternative to the previously used hydraulic or electro-mechanical actuators. SVAs are self-contained modules with their own closed fluid circuit. A variable-speed motor drives a robust hydraulic pump, which generates flow for the cylinder movements. A safety valve with a mechanical spring ensures the cylinder also changes safely into the fail-safe position if the power fails, without any external power supply. The cylinder, which opens and closes the well valve, can also be actuated externally by an underwater robot via an override. All key components of the drive train are installed redundantly. Altogether, SVAs provide safety on four levels with the redundant controls, the fail-safe spring and the intervention options from outside.

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## ENERGY EFFICIENCY

Subsea Valve Actuators  
consume up to 75  
percent less power at  
its peak performance.

# SAFETY ON BOARD

Condition monitoring  
enables higher safety  
integrity levels from  
SIL 2 to SIL 3.



*Rexroth's Subsea Valve Actuator is helping make the "all subsea factory" a reality.*

The benefits are especially clear when the solution is compared with the current state of technology. The vast majority of underwater actuators used around the world are still based on conventional hydraulics. This common structure has proven its durability and long-term safety over the past 50 years. However, operators still want to reduce the effort needed because conventional hydraulics require big, central hydraulic power units above water. These supply the actuators with fluid via lines, known as umbilicals, that can be kilometers long. At a working depth of 3,000 meters, several hundred liters of fluid accumulate in the lines alone. This is in addition to the demand for additional hydraulic accumulators and directional valves required for a complex subsea control module.

As the first alternative, equipment suppliers tried to set up electromechanical solutions. These only need to be supplied via power cables and connected to the ACM via a data line. However, because they have no external mechanical intervention options for adjustments, electromechanical solutions have safety-related disadvantages. Due to their lower power density, they also require bigger housings and electrical batteries. The design results in high friction, causing mechanical wear on the power transmission and reducing the required 25-year operating period. For these reasons, electromechanical solutions are at a critical disadvantage for subsea applications when a fail-safe emergency closure is needed.

## **Up to 75 percent less energy consumption**

Rexroth's SVA combines the benefits of both hydraulic and electromechanical solutions and eliminates the existing disadvantages. The decentralized fluid circuit means the topside hydraulic power unit (HPU), subsea hydraulic control module and kilometer-long umbilical cords are no longer required for the fluid. The SVAs only require a power supply and a data line, like the electromechanical actuators.

Hydraulic pumps generate the flow rate for the wear-resistant hydraulic gear. As a control principle, Rexroth uses a displacement system here, which regulates the flow rate with low friction from out of the rotation speed. This simplifies the design because proportional valves are not required and significantly increases energy efficiency. Compared with the purely electromechanical actuators, SVAs consume up to 75 percent less power at peak performance. Considering all the actuators used to operate a subsea field properly, a huge cost saver for the electric infrastructure (power cable, transformer, frequency converters...) can be obtained. The motors can then be configured considerably smaller with the same adjustment force of the actuators, which in turn saves installation space and costs.

As part of its condition monitoring capabilities, built-in sensor technology continuously records the operating

states within the actuator and reports them to the higher-level master controller. Trends can then be analyzed, allowing deviations to be identified and solved early.

## Self-contained industrial axes as a standard

Within the SVA, there are two bars of overpressure at every depth because of the redundant pressure compensation system. This prevents the penetration of saltwater and the need for large housings with a pressure-neutral design. Rexroth only uses underwater cables, even within the axis. All electrical components are also encapsulated. Rexroth's deep-sea specialists utilized the principle of self-contained axes for industrial applications when developing the SVAs. Bosch Rexroth produces the individual components in large-scale series. This reduces

costs, creates long-term availability and guarantees production with quality management systems such as ones used in the automotive industry.

Where required, Bosch Rexroth has made modifications to the components for deep sea use. The manufacturer can draw on available concepts here, which are qualified for depths up to 6,000 meters. The system and core components also meet the special requirements of different classification societies for marine, offshore and subsea use.

Working closely with leading equipment suppliers and operators, Bosch Rexroth used the latest simulation technology for the "proof of concept" and built prototypes for field trials. This innovative drive technology combines the best of electromechanics and hydraulics to help ensure safe and reliable conveyance technology on the seafloor and make the vision of an "all subsea factory" a reality sooner.

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