rexroth
A Bosch Company

Subsea Electrification Keep it Simple!

NOVEL ELECTRIC ACTUATOR TECHNOLOGY ENABLES SUSTAINABILITY ENERGY TRANSITION USING LOW VOLTAGE TO MOVE HIGH LOADS

A new generation of electric Subsea Valve Actuators developed by Bosch Rexroth needs only low power voltage to move high loads. The new technology reduces both CAPEX and OPEX significantly. The low power demand allows to connect up to 4 units of the Subsea Valve Actuator SVA to a single 96 W power supply line.

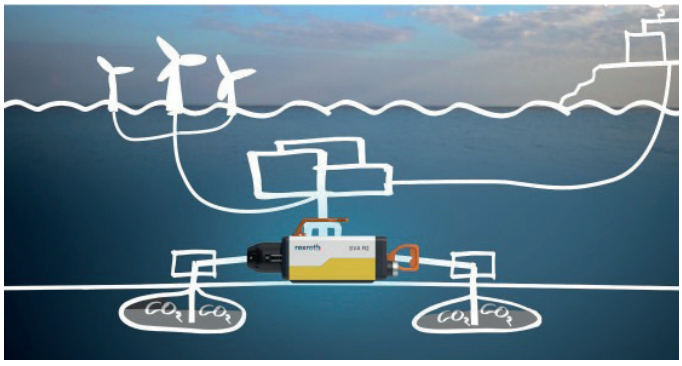
Their low power mode considerably reduces the actuator size and the required installed electric power supply, simplifying the overall subsea power installation and distribution.
The SVA is ready to be installed in greenfield and brown field applications for oil & gas, deep sea mining as well as for new concepts of CCUS and H2 needed for energy transition.

SUBSEA AUTOMATION FOR ENERGY TRANSITION

Novel generation of subsea valve actuators is powering the energy transition.

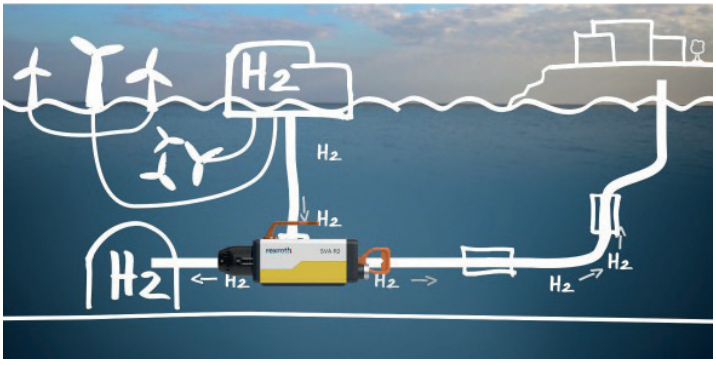
Carbon Storage

Key innovation to enable Carbon Capture and Storage



Green Hydrogen

Future-proof technology for Green Hydrogen production



ELECTRIFICATION OF SUBSEA EQUIPMENT

The novel technology combines the ability to move high forces while being cost effective, safe and reliable. The substitution of conventional hydraulic systems by electric valve actuators provides several advantages, starting from removing all the hydraulic hoses, pipes, filters, control valves, accumulators, sensors and hydraulic power unit.

At subsea, the simplification of the umbilical with all control lines has a huge cost saving effect. The electrification increases the reliability and efficiency of subsea machineries by also reducing the carbon footprint and eliminating the risk of hydraulic fluid leakage into the sensitive subsea environment.

NEW GENERATION OF SUBSEA VALVE ACTUATORS

The Subsea Valve Actuator SVA R2 was designed to electrify the actuation of small-bore rotary subsea valves, replacing conventional hydraulic cylinders with field-proven safety technology and without taking up additional space. Solely an electric interface with 24 V DC power supply and communication over SIIS L2 (Subsea Instrumentation Interface Standardization) with fault-tolerant CANOpen is used to provide the commands for the valve operation.
The safety function is triggered by de-energizing this interface in case command close is not available. Monitoring of the absolute valve position and torque as well as additional sensors are provided for condition monitoring, including the Diagnostic Coverage of the safety function. The SVA R2 is to be mechanically connected via an ROV class 2 or class 4 interface into the infrastructure, in accordance with API 17H. It can be mounted vertically or horizontally.

Step 1: Decoupling Safety from the Drive system

SVA R2 is designed as a de-energize to trip system which does not use electric energy for the safe motion. Because reliable mechanical springs are used to perform the safety function, even a large valve actuator can be brought to a safe position within few seconds. There is no need for batteries, saving space, cost and maintenance. Another advantage is that the components required solely for a normal function of the actuators can be optimized for the nominal operating point.

Therefore, when the motion during the safety event is decoupled from the commanded operation, the drive system can be optimized to fulfill different communication and power requirements.
This opens up opportunities to optimize the actuator drive system for limited power, such as stated in the SIIS power levels.

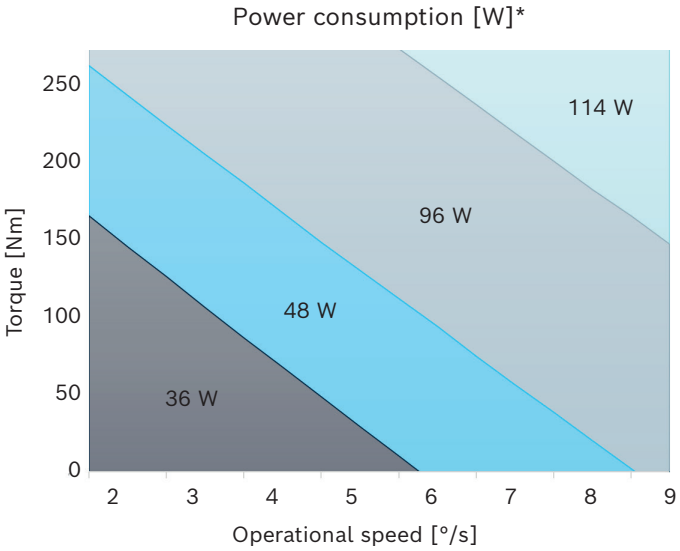
Qualified in Tests: 225 Nm with less than 48 W

During the endurance testing of the actuator, efficiency tests and power measurements were performed for different water depths, including variations of operational speeds and temperatures. Emulating up to 4,700 m water depth the SVA R2 proved to operate quarter-turn valves with crack-to-open torques up to 225 Nm with less than 48 W and to hold position with a stand-by power less than 15 W.
Considering that the small-bore valves typically just require 150 Nm to be actuated, the SVA R2 could move them just using 36 W power, measured for the whole actuator.

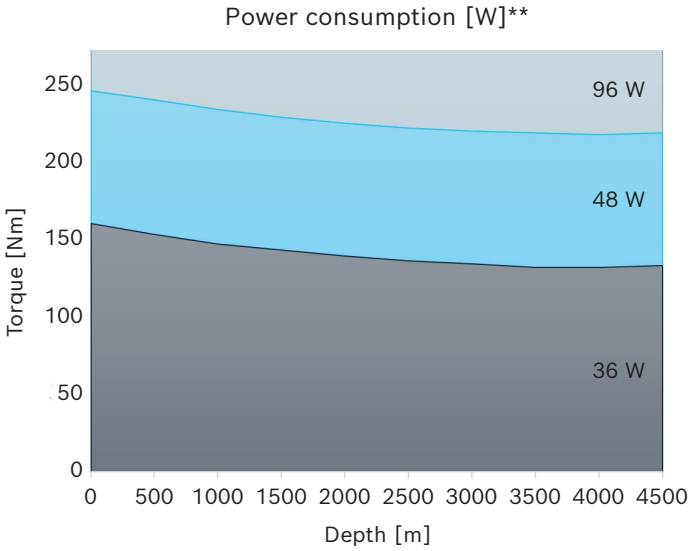
This means, we the power of an instrument, these valves can be reliably and safe actuated.

SVA R2 – TRL4 | LOW POWER TEST

Results of low power testing of SVA R2 in pressure chamber emulating up to 4,700 m water depth.



*@ atmospheric pressure and ambient temperature of 10 °C



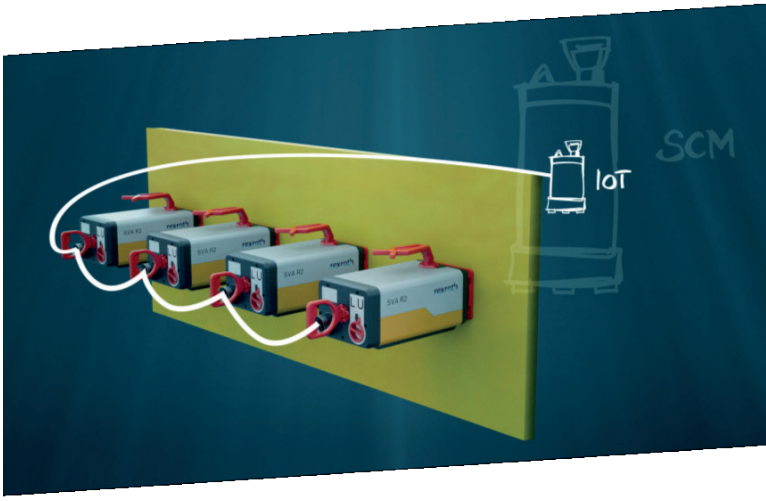
**@ nominal speed of 2 °/s and ambient temperature of 20 °C

REDUCED COMPLEXITY

One SVA R2 can operate a small-bore valve and another SVA R2 can remain in standby requiring less than 15 W. This requirement enables up to 4 units of the SVA R2 to be connected to one single power supply line of 96 W following the SIIS Level 2. The decoupling of the safety system in combination with the low power mode, can also dramatically reduce the complexity of the Subsea Control Module (SCM), which is now reduced to a simple subsea gateway (IoT) only responsible for the connectivity with the top side Master Control System.
When it comes to sharing electric power supplies between actuators, cross-communication between the actuators can easily be integrated into the products, exchanging process information. A distributed control system architecture also simplifies the design of the entire subsea installation. Any function required by different machine designs can be implemented with a minimum variance of electric components, decreasing also the overall subsea equipment dimension and weight.
The result: lower CAPEX.

THE SVA R2 ...

- **reduces size and weight without compromising safety**
- **removes hydraulic lines without extra electric supply**
- **improves productivity & environment by reducing CAPEX & OPEX**



SIMPLER POWER SUPPLY FOR THE WHOLE SUBSEA PRODUCTION SYSTEM

The novel approach energizes an entire subsea production system with the power provided by simple subsea electric cables, such as a single DC/FO cable. Such connections, consisting of high voltage direct current power supply and a fiber optic communication cable, can carry up to 10 kW. A traditional hydraulic subsea tree requires, for example, approximately 385 W electric power just to control the hydraulic valves. A simulation verified that a subsea tree can be electrified using less than 385 W without demanding an complex subsea electric storage.

This is based on the assumption of at least twelve electric actuators, one local subsea control module and a set of up to eight subsea instruments. To evaluate the overall power required, a possible start-up operation sequence was simulated, showing that even the two largest valves can be reliably actuated while keeping all other valves open with their associated standby power without using any battery.

UNLOCKING ELECTRIFICATION POTENTIAL

Subsea production and processing systems play a vital role for the energy supply of mankind and the journey to climate neutrality by Carbon Capture Utilization & Storage (CCUS) and by offshore production of Green Hydrogen (H2).
The substitution of conventional hydraulic systems with electric subsea valve actuators provides numerous advantages.
The simplification of the umbilical with all its control lines has a huge cost saving effect. The electrification increases the reliability and efficiency of subsea machinery by also reducing the carbon footprint and eliminating the risk of hydraulic fluid leakage into the sensitive subsea environment. As an outlook, this drive technology is now used in the development of a new generation of subsea electric actuators for larger rotative and linear valves, with and without safety functions, all using the low power demand.

This novel electric actuator approach is an excellent solution to scale up the energy transition because it is environmentally friendly, safe, reliable, and compact being cost effective at the same time. For CO_2 storage, it enables an all-electric subsea tree, comparable in CAPEX to a traditional hydraulic tree but with much lower OPEX.
In applications requiring long control distances, such as offshore energy fields with long subsea tiebacks or deep sea mining, it allows safe and reliable operation with minimal electric power consumption, capable of precisely handling even high loads

MAIN CONCLUSIONS

- Remove all hydraulics (hoses, pipes, valves, accumulators, sensors and power unit)
- Minimize power supply (simplifying your umbilical)
- Protect the environment, save energy and reduce emissions
- No need for expensive batteries (higher availability)
- Field-proven safety by springs (SIL 3)

Reference:
[1] ORTH, A.; KUBACKI, M; HENDRIX, G.; DUARTE DA SILVA, J. P.: “Moving high loads with low power subsea - How a novel electric actuator technology enables a sustainable energy transition”. Paper presented at the Offshore Technology Conference, Houston, Texas, USA, May 1st – 4th, 2023, in Houston, Texas, USA (OTC-32346-MS).

For further information, please contact us

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