rexroth
A Bosch Company

Rexroth eSEA Push
Lean All-Electric Linear Subsea Actuators

DESIGNED TO ACCELERATE THE ENERGY TRANSITION

Stopping climate change is the most important challenge of our time. It is our generation's decision to pass our planet on to our children and grandchildren in a way that is worth living on. The overriding goal is climate neutrality. The Intergovernmental Panel on Climate Change (IPCC) from the United Nations (UN) is therefore also calling for the introduction of green hydrogen production offshore and Carbon Capture Utilization & Storage (CCUS).
When working in a consortium on a commercial, large-scale carbon storage project, Bosch Rexroth developed a disruptive and innovative solution to drive linear actuation with the easy-to-use eSEA Push. The all-electric linear actuators automate subsea gate valves without hydraulic control lines. Covering a wide range of forces and strokes. eSEA Push is designed in accordance with current offshore requirements while focusing on standardization to allow for a reduction in the overall costs, exchangeability, easy engineering and fast delivery in combination with high quality, safety and efficiency – in a nutshell: eSEA Push is designed to accelerate the energy transition.

LEAN, ALL-ELECTRIC, LIGHTWEIGHT AND COMPACT DESIGN

Up to now linear valves and actuators in subsea systems were driven mainly by hydraulics. This infrastructure requires a CAPEX and OPEX intensive topside Hydraulics Power Unit and the installation of kilometers of umbilical. Lean, all-electric subsea actuators from the eSEA portfolio do not need a hydraulic infrastructure and enable de-energize to trip safety functions up to SIL 3 with field-proven springs. eSEA Push needs only a voltage of 24 V DC, allowing entire actuators to run on the same power as a subsea sensor, which makes it very easy to connect new actuators to existing subsea control modules (SCM).

SIMPLE, PROVEN AND COST EFFECTIVE: FAIL-SAFE BY SPRINGS

All eSEA actuators use the concept of field-proven hydraulically compressed mechanical springs for fail-safe. The safety function is triggered by de-energizing, allowing a fast-acting Emergency Shutdown (ESD) when needed. There is no need for expensive safety-related redundant batteries, which might need regular maintenance to fulfill safety requirements. By using the standardized API 17H push tool type A interface as a mechanical coupling, the safety package is decoupled from the actuator.

A permanent connection between the subsea valve and spring package is used to achieve a reliable and compact design. This allows the electric actuator, to be retrievable and exchangeable while not compromising the mechanical safety function of the valve and connected safety control system. Even better, with its direct position encoder, eSEA actuators offer a continuous monitoring of the safety function with partial-stroke movements, increasing the overall Diagnostic Coverage up to SIL 3 rating.

READY FOR LONG STEP-OUT DISTANCES

There is a continuous trend of increasing step-out distances in the offshore industry to avoid safety hazards and costly offshore facilities. Especially in cost sensitive applications, such as the carbon storage (CCUS) industry, where the price of installations plays a critical role in making business models feasible, remote operation over long step-out distances becomes highly relevant. In such cases, the hydraulic power supply is not an option. Therefore, it is necessary to supply power in form of electricity. To minimize the material used and therefore the cost, high voltage is currently used in the subsea industry to cover long distances while minimizing the overall power consumption. High voltage does not mean high power for eSEA Push even in long step-outs, consuming from 96 W to 480 W, it offers considerable savings in energy and costs.

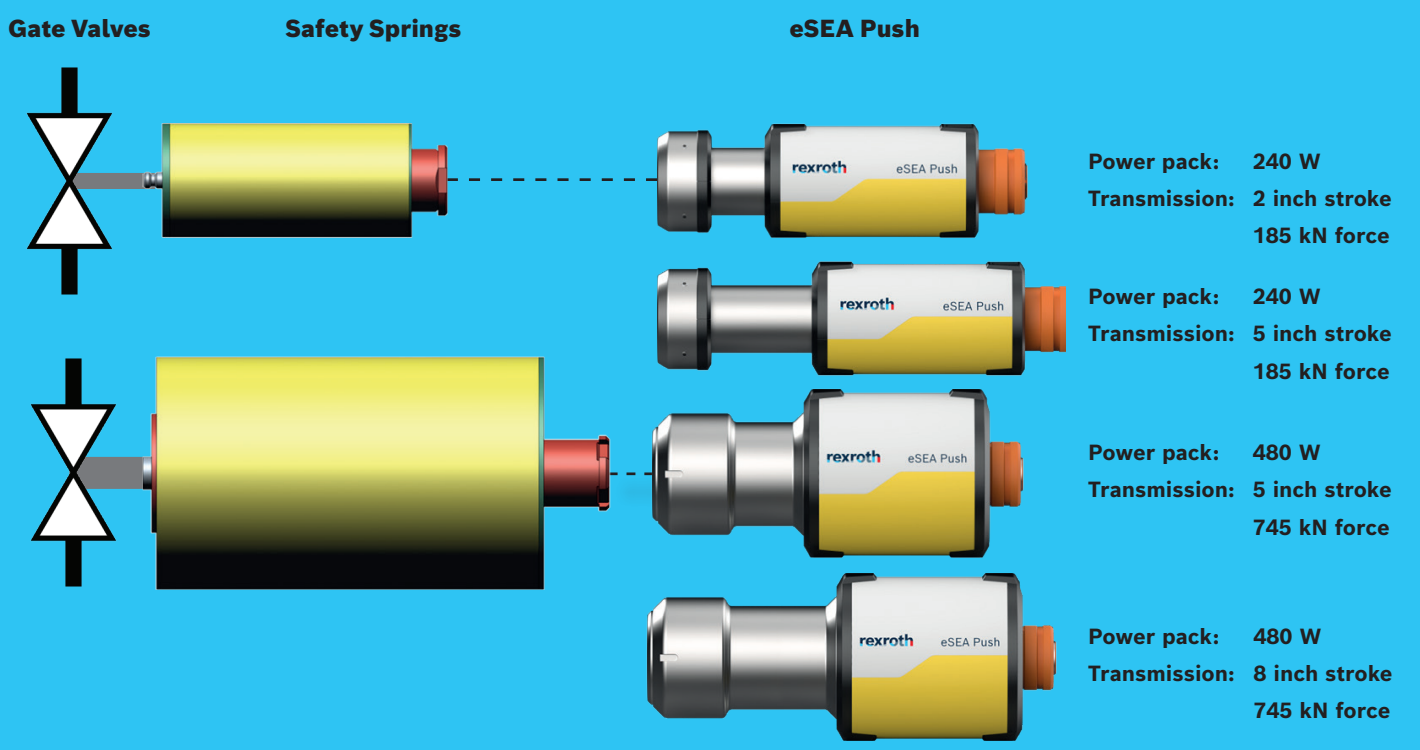
DIGITAL TWIN FOR INCREASED AVAILABILITY

The eSEA Push linear actuators are comprised of an automotive electronics control unit and an electric interface with 24 V DC power supply and communication over SIIS L2 (Subsea Instrumentation Interface Standardization) with fault-tolerant CANopen. Digital models of the actuator and sensors are included in the embedded digital twin, which is continuously improved during the deployment of the system in the field. If a physical sensor loses its accuracy during its lifetime, the digital sensor will automatically take over and keep the system running while sending a message to the SCM, allowing for an increase in availability and productivity.

The digital twin simplifies engineering and commissioning. Installing the communication with master controls is a matter of just a few minutes. The actuators measure the piston position and collect data from additional sensors for condition monitoring, including the Diagnostic Coverage of the safety function, thus increasing the safety up to SIL 3.
Regular data acquisition throughout the lifetime of the system can also help to identify wear and corrosion of process valves and their seals. This information is shared with the master control system (MCS), allowing predictive maintenance and flow assurance.

ONE SOLUTION TO AUTOMATE ALL LINEAR VALVES

eSEA actuators are highly standardized and designed for lean manufacturing using large series components in industrial or automotive applications. eSEA Push offers several power packs, which allow easy parametrization to operate from 96 W up to 480 W. These power packs are matched with linear transmissions ranging from 185 kN force with 2-inch stroke up to 745 kN with 8-inch stroke. At the same time, the modules have standardized interfaces to make it possible to match the best actuation solution and be able to extend the power range and displacement stroke with minimal re-qualification efforts. A special focus was put on the reliability of critical mechanical components, such as seals and the electric drive module. The drive module was tested under full load conditions over 200,000 process valve cycles and regularly checked for wear of the mechanical parts – without any degradation during that test.



LOOKING FOR ENERGY-EFFICIENT AND COST-EFFECTIVE SOLUTIONS?

The technical and application features result in economic benefits for scalable solutions:

- **Safety first** with easy implementation of safety functions with field-proven springs, increasing the Diagnostic Coverage to reach up to Safety Integrity Level SIL 3.
- **Low CAPEX** by removing the hydraulic power supply and control lines from top side down to the seabed, simplifying the umbilical for low power electric supply, scalable in forces and strokes reducing qualification effort.
- **Low OPEX** by minimizing electric power consumption, removing control fluids, and avoiding service time of expensive Offshore Support Vessels with robotic tools.
- **Simple Installation** by utilizing a standardized mechanical interface API 17H push tool type A and standardized electrical interface SIIS (Subsea Instrumentation Interface Standardization) L2 for easy integration within few minutes.
- **Higher Uptime** due to intelligent condition monitoring with a fault-tolerant control by using an embedded digital twin, made from highly reliable industrial and automotive technologies.

THE eSEA PORTFOLIO

The Rexroth easy-to-use Subsea Electric Actuators eSEA portfolio covers all applications for subsea systems: Torque, Push and Drive for smaller and higher loads. This lean all-electric subsea technology replaces the entire hydraulic system for valve actuation, simplifies design and installation, speeding up engineering and commissioning. The actuators are based on standard components, qualified for depths of up to 4,000 meters and designed for permanent use subsea for over 25 years.

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 eSEA portfolio is ready to be installed in greenfield and brownfield applications for offshore energy, water treatment facilities as well as for new building blocks needed to accelerate the energy transition such as carbon storage (CCUS) and green hydrogen (H2) production offshore.

Break Even for the Climate? YOU DECIDE!

Reference:
[1] KUBACKI, M.; PFEIFROTH, E.; HENDRIX, G.; DUARTE DA SILVA, J. P.; ORTH, A. from Bosch Rexroth AG: “Lean Subsea Electric Actuators for Linear Gate Valves”. Paper presented at the Offshore Technology Conference, May 6th – 09th, 2024, in Houston, Texas, USA (OTC-35116-MS).

For further information, please contact us

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