

# Building a safer and more efficient submarine

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**With the Baltic sea becoming a region with contested borders, submarines that can undertake long missions to patrol the seas and deter altercations are crucial. The hydraulic system currently used in modern day submarines, while reliable, is a potential fire hazard and not necessarily the most energy efficient solution. Recent developments have made electromechanical actuators more energy efficient than their hydraulic counterparts, enabling longer missions. It is therefore of great interest for Swedish submarine giant, Saab Kockums, to investigate the possibility of replacing or scaling down the hydraulic system.**

Due to the high power density and small size of the hydraulic components, they have been the premier choice for actuation in submarines. The goal of the project was to see whether hydraulic components could be replaced by electromechanical counterparts.

Two types of actuators were decided to be investigated: cylinders and rotary valve actuators.

One of the big advantages of electromechanical actuators is their high efficiency due to fewer steps of energy conversion. A drawback to the hydraulic system is that the main pump is always active. This due to the risk of the loud sounds associated with turning off and on the pump spreading out into the water, thus revealing the submarine's position. Therefore, the hydraulic system will continuously draw power even when no control action is needed.

Calculations show that hydraulic cylinders that rarely run are most suitable for

replacement by electric counterparts while rotary valve actuators are even more efficient and would improve the energy efficiency of the submarine wherever implemented. The often running rotary valve actuators would be especially beneficial to implement because the hydraulic pump is always active. By replacing hydraulic valve actuators, the pump can be downsized to draw less power in its idle state.



*Electric valve actuators are beneficial replacements to hydraulic counterparts*

The tests carried out: Electromagnetic compatibility (EMC), sound and vibrations, highlight some of the inherent problems with electromechanical actuators. While all actuators tested passed the sound tests none passed the EMC and vibrations tests.

None of the components tested passed all the necessary requirements. However, the potential energy savings warrants further investigation into similar actuators. Finding these replacements could prove greatly beneficial in increasing the safety of the crew and opening up the possibility for longer missions, highlighting the potential for a fleet of electric submarines safeguarding the Baltic Sea.