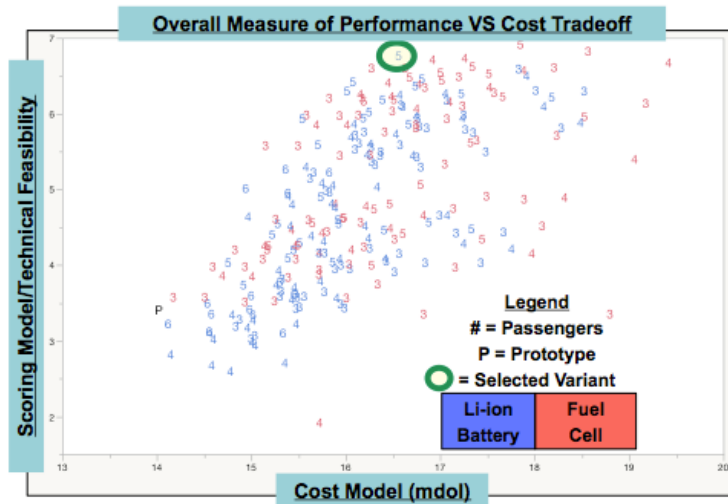


# Submerged Long Endurance Transport (SUBLET)

CDR Nate Mills, USN; LCDR Jim Colgary, USN; LT Justin Stepanchick, USN

This study developed a concept design for a Submerged Long Endurance Transport (SUBLET), a manned, lock in lock out (LIO) capable, dry submersible. (SUBLET) designed for launch and recovery from a modified Dry Deck Shelter (mod-DDS) hosted onboard a submarine. In support of the concept design, the study also sought to quantitatively evaluate the trade space defined by strict limits on volume and weight imposed by the mod-DDS.

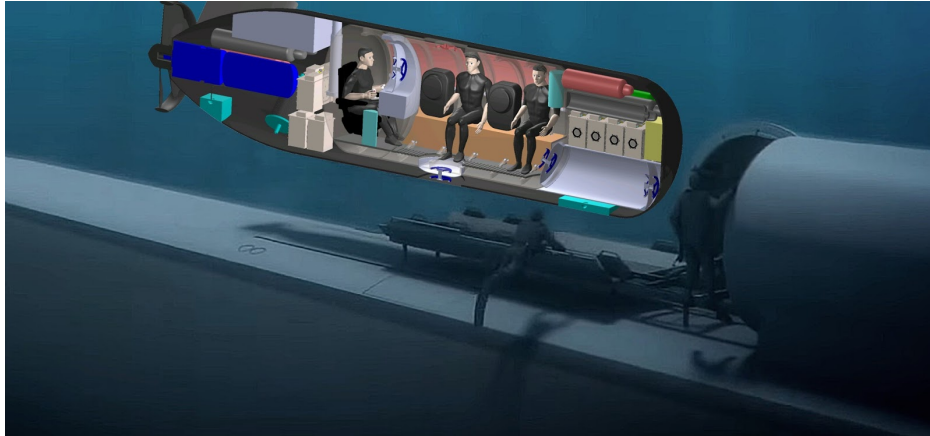


The trade space for the SUBLET was objectively evaluated using progressively layered, custom-built, Excel-based mathematical models. A full factorial Design of Experiments focused on critical design variables, with each variant’s feasibility checked by the volume and weight models. The power model then estimated speed and range based on the feasibility model outputs and the variant power plant

specifics. These three models supported the next layer of modeling, i.e., a weight-based parametric cost model and an operator-approved scoring model. Analysis of the full design space using the cost and scoring models allowed a cost-performance comparison and revealed Pareto optimal feasible designs. Linking these models provided a robust framework for trade space analysis, and the linked set was delivered to the project sponsor after completion. A dynamic design review using live-updating models and data visualization assisted the project sponsor in choosing the following design variables: a single propeller, 300 ft maximum depth, 120 ft mid-water column LIO depth, and 50 cubic ft of cargo volume. After further analysis of arrangements and balance, the final selection to a 5-person, battery-powered variant was made.

Design Variable	Value
Passengers	5
Propulsion	Li-ion Battery 220 kW-hr
Cargo Volume	50 cubic ft
Propulsor	Single Prop
Max Operating Depth	300 ft
Max LIO Depth	120 ft
LIO Type	Mid-water column

Once the trade study was completed, Computer Aided Design illustrated and validated the SUBLET arrangement. The SUBLET passengers and payload enter through a Variable Ballast and Access Trunk (VBAT) and remain in the Command & Control (C&C) and LIO compartments while in transit. Combining the function of access and ballast control in the VBAT simplified SUBLET challenges in arrangement, volume allocation, and trim. When ready for LIO, the SUBLET deploys anchors forward and aft and partially floods the LIO compartment while equalizing pressure with the sea. LIO is primarily conducted through the bottom hatch and is controlled by one operator in the C&C space.



In satisfying the original goals, this project delivered detailed trade study feasibility and performance models, vetted scoring and cost models, and a review of decision criteria for selecting a battery or fuel cell for propulsion power. Overall, this technologically feasible SUBLET concept design provides a significant increase in operational utility over current submarine-launched assets at a reasonable cost.

