Commercial Working Boat to Minelayer Conversion

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A growing threat to U.S. Naval supremacy requires a new emphasis on the role of mine warfare. In contrast with the advancement of military technology, mine warfare continues to be a highly asymmetric threat with considerable strategic and tactical advantages. In addition to denial of access or delaying enemy combatant movements, mines are an effective, low cost and low risk means of sinking or damaging enemy vessels and restricting merchant shipping to an enemy state. Currently, the U.S. Navy surface fleet has no capability to lay mines, with all minelaying conducted by aviation or submarine assets. The objective for this project was to design a conversion concept that could quickly and inexpensively convert a commercially available working boat into a minelayer for use by the U.S. Navy surface fleet.

This study focuses on vessel type selection and mine storage, transfer and launching system concept development with a focus on affordability, scalability and modularity. The final design presents a highly modular "bolt-on" mine storage and launching system. The entire mine storage and transfer system is designed to be fabricated inside International Standard Organization (ISO) shipping containers, which can be quickly installed on a conversion vessel. In an effort to increase modularity, commercially available equipment was used as much as possible, with very few components requiring custom fabrication.

The Platform Supply Vessel (PSV) ship class was chosen as a baseline for this ship conversion due to the working deck area and strength, load capacity, range, speed and crew accommodations inherent to the class. Additionally, this vessel class is ubiquitous and available for acquisition. In cooperation with Jensen Maritime Naval Architecture Firm based out of Seattle, Washington, the Jensen 3000 PSV was chosen for the study. An optimized loadout was designed and analyzed using this vessel. Although this study was conducted on a specific PSV, the design concept is flexible enough to implement on any working boat with sufficient deck space, weight margin, and deck strength. Due to this modularity, the design can be implemented with pre-fabricated "plug and play" pieces based on the space and weight capacity available or desired payload capabilities.

The mine storage and launch systems consist of 20' or 40' shipping containers. Storage containers use warehouse pallet racking systems to store palletized mines which can be used to reload the transfer and launch rails within the launching containers. The launch containers are connected in rows spanning the length of the deck and transport the mines on powered rollers to ramps at the stern of the ship as shown in Fig. 1 and Fig. 2. Ramps, consisting of gravity fed free roller sections, are supported by pinned connections to the conveyor roller sections and may be stowed when not in use to permit clandestine transit to and from a minefield location. The subsystems of the conversion are shown in Fig. 3. Final design parameters are shown in Table 1.

A key insight gained from this study was the density of payload capacity to cost compared to what was expected at the outset of the project. Ultimately, the payload capability in the final design exceeded the objective by over 500%, while coming in 69% under budget. Table 2 shows a breakdown of modular cost and performance. These are significant margins that grant the sponsor ample flexibility to meet strategic minelaying objectives with a surface asset such as the one examined in this study. The project team concluded that a conversion of a commercially available working vessel to an asset capable of laying mines is cost-effective, feasible and can provide significant capability to fill a strategic gap in the current U.S. Navy surface fleet.

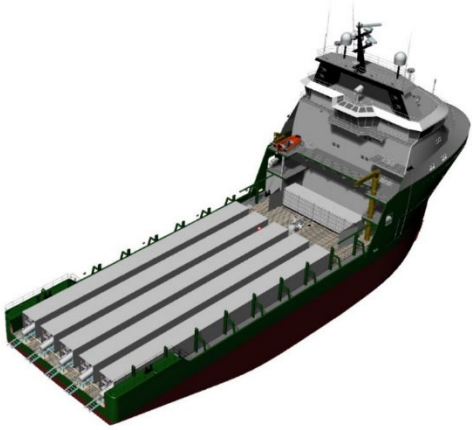

Fig 1. Final Conversion Design with Full Loadout

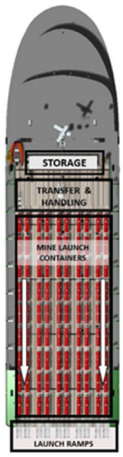

Fig 2. Deck Layout for Final Design

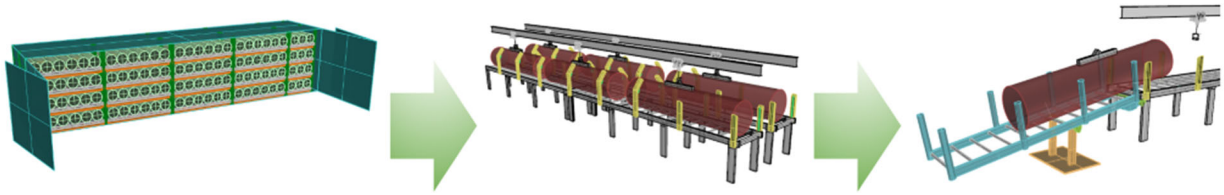

Fig. 3. Mine Storage, Transport and Launching Systems

Maximum Speed	17 kts
Endurance Speed	12 kts
Range	10,472 nm
Accommodations	20 people
Endurance	36.3 Days
Payload Capacity	108 Quickstrike Mk 65 **OR** 258 Quickstrike Mk 62
Cost	$622,125.41
Minefield Density	100 yds at 15 kts

Table 1: Final Conversion Design Parameters

Container	**Payload**	**Launching System**			**Storage System**	
		Capacity	Max Launch Rate	Cost	Capacity	Cost
40'	Mk 62	10	7.5 sec	$34,511.40	108	$9,159.26
	Mk 65	6	11 sec	$34,511.40	18	$8,133.18
20'	Mk 62	4	7.5 sec	$17,309.69	48	$4,970.76
	Mk 65	2	11 sec	$17,309.69	N/A	N/A

Table 2: Per Container Material Cost and Performance