Freedom (LCS 1) Class Ship Propulsion Plant Conversion

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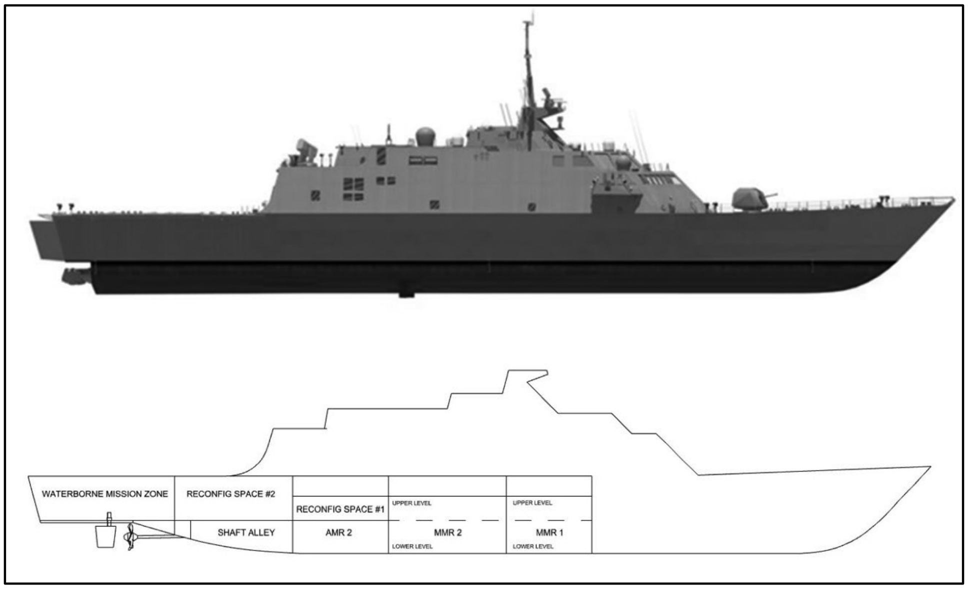
This conversion project developed a concept design for an engineering plant revision of FREEDOM (LCS 1) Class ships from waterjet propulsion to a propellers. Design metrics for the FREEDOM Class were utilized as a benchmark to perform an analysis of alternatives, aimed at designing a replacement propulsion plant that aligned with the proposed speed and endurance profile of the Frigate (FFG(X)) program while also improving engineering plant efficiency, simplicity and fleet commonality. The converted FREEDOM Class ship was expected to complete similar missions to its predecessor but with a reduced speed profile. These missions include littoral surface, mine and anti-submarine warfare. Maintaining the small size, agility, light weight and shallow draft were key characteristics for performing these littoral missions.

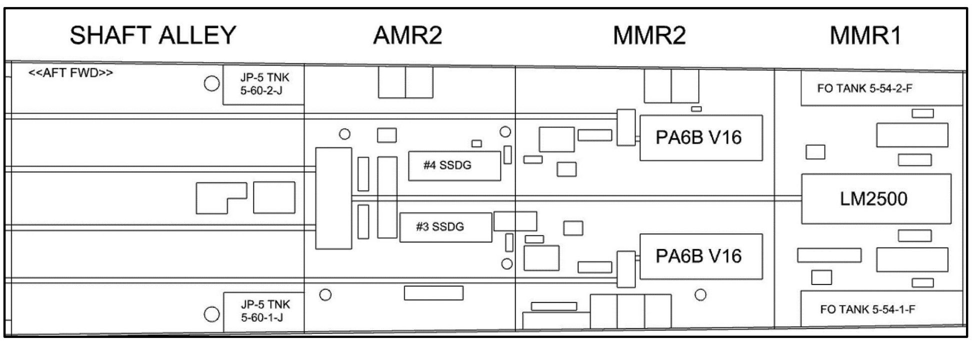
The starting point for the study was a FREEDOM Class match model containing the baseline load list and spatial arrangement. This model was utilized as the project benchmark in order to minimize the impact of the conversion to ship structure and existing ship systems outside of the engineering plant. Alterations to crew habitability and mission support spaces were also minimized during the engineering plant conversion.

The design philosophy for this project was to provide an updated engineering plant that better fit the restructured speed and range profile requirements without affecting the ships littoral capabilities. Additionally, the conversion team aimed to provide a design that increased efficiency, decreased acquisition costs, decreased complexity, and increased fleet commonality.

The design space for this conversion project focused on mechanical propulsion configurations. The updated hull design removed the waterjet housing step and faired that portion of the hull in order to provide sufficient inflow for the propellers. The waterjet propulsion system was replaced with controllable pitch propellers and rudders. The final engineering plant layout was selected by first determining the number of shafts based on propeller size and then developing potential plant configurations. The optimal engineering plant layout was selected using an overall measure of effectiveness analysis based upon the design philosophy.

The existing two diesel, two gas turbine and waterjet configuration was replaced with a more moderately powered engineering plant consisting of two diesel, one gas turbine, and four controllable pitch propellers. This plant configuration provided sufficient power to achieve the 28 knot sustained speed requirement as well as exceed the 3500 nm endurance objective. The transition from waterjets to a propeller driven engineering plant, in conjunction with the revised speed profile, assisted in providing a design with increased endurance range, operating efficiencies, and fleet commonality as well as a decreased displacement, complexity and acquisition cost.


WATERBORNE MISSION ZONE
RECONFIG SPACE #2
RECONFIG SPACE #1
UPPER LEVEL
UPPER LEVEL
SHAFT ALLEY
AMR 2
MMR 2
MMR 1
LOWER LEVEL
LOWER LEVEL


SHAFT ALLEY
AMR2
MMR2
MMR1
<<AFT FWD>>
JP-5 TNK 5-60-2-J
FO TANK 5-54-2-F
PA6B V16
#4 SSDG
LM2500
#3 SSDG
PA6B V16
JP-5 TNK 5-60-1-J
FO TANK 5-54-1-F