

Podded Propulsion Test and Demonstration Ship (PPTDS)

Conversion of an *Oliver Hazard Perry* Class Frigate

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Several international navies, including those of the Australians, French, and Spanish, use podded propulsion systems, due to their increased efficiency and control as well as several other observed benefits. However, the U.S. Navy has made only small, initial steps towards pursuing their implementation and has yet to fully investigate the employment of these underwater devices on its naval vessels, for which a significant number of unknowns and uncodified risks remain. To fully understand the feasibility considerations associated with podded propulsion, this project analyzed the conversion of an Oliver Hazard Perry (FFG-7) class frigate to a Podded Propulsion Test and Demonstration Ship (PPTDS). The baseline decommissioned FFG-7 hull was chosen due to the remaining U.S. inventory and its proven seaworthiness, which would result in a cheaper (and, hence, more feasible) demonstration ship than a new vessel built solely for testing.

Utilizing modeling and simulation tools with a traditional FFG-7 model, the team conducted an in-depth analysis of the podded propulsion asset, including ship arrangements, electrical power requirements, weight and space requirements, hydrostatics, stability, seakeeping, speed, and maneuvering. While the sponsor requested these specific analyses to assist with the conversion's feasibility determination, allowance for significant latitude in decision-making and design space exploration was provided, with conversion cost minimization as a driving constraint. The resultant analysis led to two feasible variants: (i) removal of the rudder and replacement with one contra-rotating pod (CRP variant) and (ii) full replacement of the current propeller and rudder with two pods, placed transversely symmetric under the hull (twin-pod variant). For each of these final variants, the team evaluated two powering methods: (i) conversion of the ship's electrical system to power both the vessel and the pods and (ii) powering the pods with one temporary generator in each hangar, while powering the ship with existing in-hull generators.

A review of all available pod and powering options led to the team's determination that the CRP variant (ABB's 4.8-MW, 62-ton Azipod® DO 1250) with two temporary electric diesel generators (MTU's V3200M, 26.5 tons each – or similar modules) that can be loaded into FFG-7's hangar bay is the most cost-effective option for initial testing. With the PPTDS designed for one purpose, subsequent design refinements would be limited to specific models of Azipod® and temporary diesel generators that are available on the market at the time of construction. The team's PPTDS design has a significant margin in all major naval architectural areas, facilitating future design alteration efforts to minimize cost and increase feasibility of execution.

Using FFG-7 weight reports, Azipod® specifications, and open-source generator specifications, the weight analysis revealed that the conversion's required modifications are well within the trim system's compensation capabilities (102 tons removed + 115 tons added = +13 tons added total). The selected CRP variant is capable of 25-knot sustained speed and within the STANAG 4154 limits up to sea-state 7, considerably above a test and demonstration ship's projected needs. This proposed single-pod design is a cost-affordable option (\$80M-\$120M, based on ABB's previous conversion work and nominal man-day rates at public shipyards), with a large dependence on FFG-7's current condition and the work required to restore the vessel to a sea-going status.

With benefits of enhanced maneuverability and minimal acoustic and magnetic signatures, the CRP variant is a feasible option for the U.S. Navy, who could refine the team's cost and weight estimates and conduct a more extensive evaluation of FFG-7's conversion for PPTDS service.

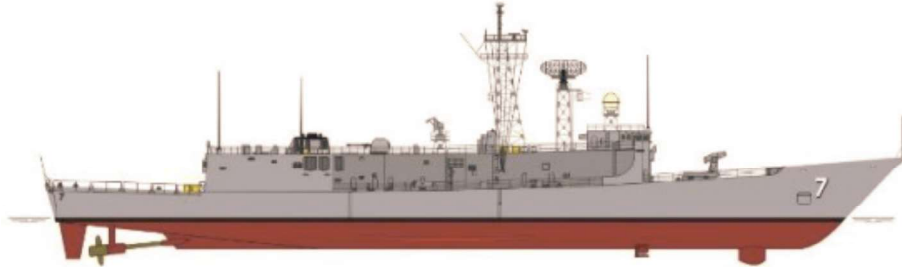


Figure 2: Oliver Hazard Perry Class Frigate

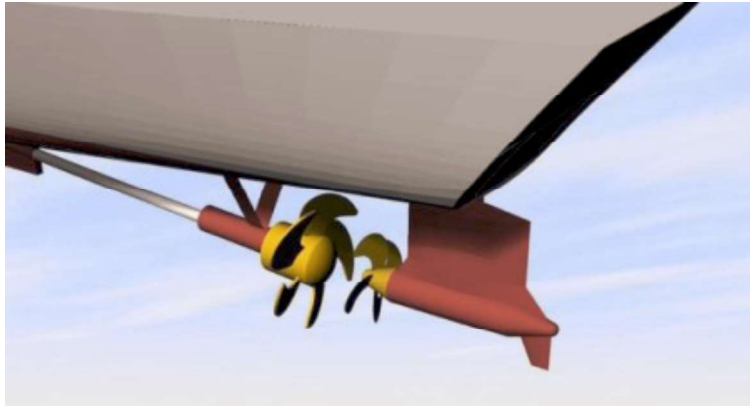


Figure 3: Contra-rotating Pod Variant

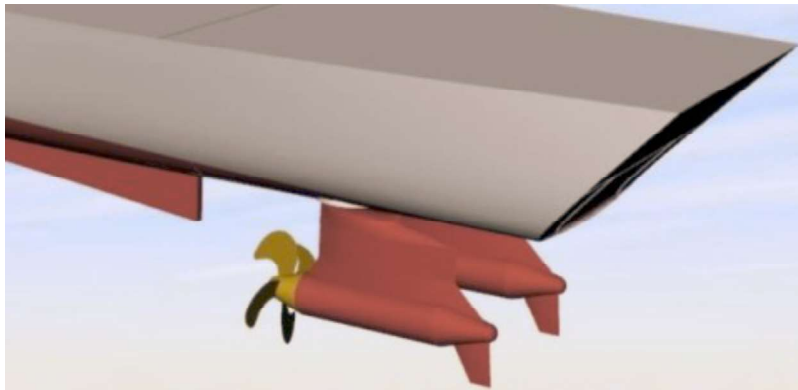


Figure 4: Twin-Pod Variant