Fuel-Efficient Destroyer, DDG(X)

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Leaders at the highest levels, including the President and the Secretary of Defense, stated a need to reduce use and cost of fuels in the Navy. Desired equipment on and mission capabilities of destroyers both grew in the face of emerging threats and shrinking budgets. The existing DDG-51 class was reaching its limit to accept larger radars and mission systems, and it lacked the desired integrated power system (IPS) to enable these systems. The team designed a new destroyer, called DDG(X), to simultaneously meet these requirements.

The size of DDG(X) was driven by the mission systems it needed to fill the numerous roles of a modern destroyer. A ballistic missile defense role demanded the Air and Missile Defense Radar (AMDR) and a 96-cell Mk 57 vertical launch missile system. All combat electronics required an upgrade, particularly the electronic warfare system. The standard deck gun was upgraded to a 40 megajoule railgun, and a laser was added. Both of these advanced systems filled numerous roles; testing on both systems indicated additional capabilities in the future. Support for special operations forces was improved in the new design, and unmanned aerial vehicles were added to its air complement. Deployable sonar systems completely replaced hull-mounted sensors, and the required maximum speed was set at 27 knots, lower than previous classes.

Design of a hull to carry this equipment was completed using Design of Experiments (DOE). A baseline hull was developed from an existing hull design that had been intended for improved efficiency. This hull was scaled up to carry the DDG(X) equipment using a technique of scaling parameters in sets, while maintaining ratios proven through model testing to maintain the best hydrodynamic efficiency. Adaptations to the baseline hull were performed as iterations guided by the DOE until a minimum in resistance was achieved. Even though significantly larger than the DDG-51 hullform, this DDG(X) hullform showed a 14% reduction in drag.

The speed-time profile from a recent destroyer field study, which detailed amount of time at each speed, was combined with anticipated use of electrical loads to develop a power-time profile representing the electrical demands on DDG(X) and its IPS. An optimization code was developed to evaluate the best possible use of a given set of engines to meet the demands of this power-time profile. The team updated the engine database and evaluated all practical options, selecting 5 Wärtsilä 11.6 MW 16V38 diesels to power DDG(X). These engines provided fuel savings of up to 28% over current destroyer engine selections.

DDG(X) was shown to be an effective multi-mission destroyer that greatly reduced fuel consumption. Seakeeping was affected but acceptable to the team, and improvements could be made in future iterations of the design. Expanded use of diesels was recommended by the team for IPS ships.

Ship Characteristics	
Parameter	**Value**
LOA	580 ft
Beam	66 ft
Draft	25.5 ft
Displacement	12,900 MT
Speed	27 knots
Major Features and Systems	
Power	IPS
Engines	5 x Wärtsilä 11.6 MW diesels
Primary Radar	4-faced, 14’ AMDR
Missile System	Mk 57 VLS (96 cells)
Direct Fire	40 MJ Railgun
Multi-mission	Laser