Propulsion Selection

An Engineering Quandary

by Tracey O' Keefe

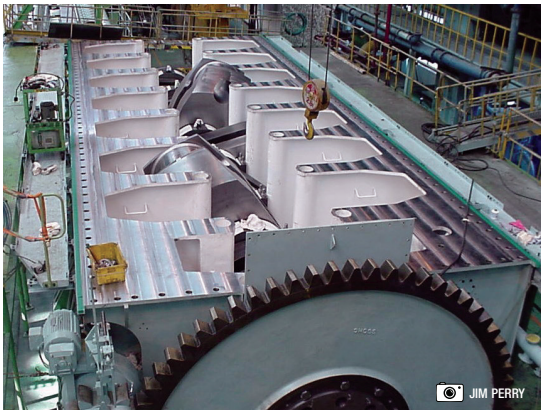
Designing of today's marine ships can entail some very complex systems and equipment. In designing a ship's propulsion plant, there are many choices of equipment. Significant new technologies are now available that are vastly different from the traditional set that ships have utilized in the past few decades. Today's propulsion plant design requires the interconnections of multiple ship considerations, such as operational safety, client requirements, and expected high levels of efficiency.

The development of the propulsion plant design is generally a result of the ship's operation profile which outlines the intended missions of the ship such as the voyage type, speed distribution, draft distribution, and the expected power to complete the required operations. It is important to note that the choice of propulsion plant will have great influences on tanks, structure, machinery placement, regulations, and operational requirements. The choice of propulsion package must also consider infrastructure that is port side to support the ships. Providing shore side charging capabilities, available fuel sources, and mechanical support to ships in their ports of call is also critical to the design.

Designing towards a 25-year lifespan for a purpose-built ship that is capable of efficiently completing numerous tasks requires a versatile propulsion plant. Attempting to meet the requirements for diverse operating profiles, specifics from the ship owners, and environmental compliance can cause quite the dilemma for those designing the propulsion plant for next-generation ships.

The typical performance criteria that the propulsion plant designer must address include the fuel consumption requirements; emissions; manoeuvrability; radiated noise; propulsion availability; noise and vibration limitations – all within the construct of cost for a low cost, low maintenance system. Within the varied operational profile requirements and the pressure to reduce fuel consumption and emissions, the designer must also attempt to optimize the power and propulsion plant for a specific operating objective using the most advanced technical options. Blending the power and propulsion requirements into an integrated system as well as implementing safety into the design also requires applying redundancy as part of the propulsion plant.

The increase in demands on the propulsion plant requires the designer to not only be cognizant of the design requirements of performance and the regulatory restrictions but to also be informed of what technologies and equipment are in place to assist in optimizing the propulsion plant design. The blending of knowledge in different engineering



Building of the MV *Vinland* in Korea in 2005.

disciplines is also essential to the designer. Understanding the mechanical equipment, electrical aspects, and electronics of operation and how they work in unison with power and energy management systems is now essential for the power plant designer as well as comprehending the plant and its auxiliaries.

The evolution of the ship propulsion plant design was traditionally categorized as mechanical or electrical. The traditional choice of prime mover was either the gas turbine, diesel engine, or steam turbine with the majority of the world's fleet today utilizing the diesel engine. The options for the prime mover and fuel type in today's energy efficient engines are vaster now than ever before. Diesel fuel alternatives such as methanol, ethanol, LNG, hydrogen, and ammonia as well as choices of injection into diesel burning engines are all viable options for today's propulsion plant.

Other alternatives to the traditional diesel engine set up are fuel cells, energy storage (batteries), and hybrid set ups utilizing both mechanical and electrical configurations. Emerging technologies in advanced variable drives, solar power, hydro-pneumatic energy storage, Flettner rotors, and many others are all concepts that may be viable options for integration into the propulsion plant of today.

Adding to the complexity of the propulsion plant design are the ever-changing environmental restrictions that significantly influence the design. Pollutants to the atmosphere and greenhouse gases have been a paramount consideration in new ship design. According to the International Maritime Organization's Third IMO greenhouse gas study in 2014, shipping contributes 15% of the global NOx emissions. As a response to such studies, stakeholders are now calling for stricter regulations to force the shipping industry to cut carbon emissions and make the switch to greener fuels, putting greater pressures on designers. The concept of decarbonizing shipping with alternative fuels and technology is changing rapidly. Today's regulations are setting carbon-emission targets that were unthinkable even half a decade ago.

As a part of the propulsion plant design, implementing exhaust abatement technologies such as exhaust gas recirculation systems and other exhaust treatments are also considered to be integral parts of the propulsion system, thus adding further considerations to the designer's dilemma.

The selection of engines and new methods of powering ships now for long-term competitiveness is evidently no easy task. Keeping up with the technology, its regulations, and its successes is, in itself, a full time job but most designers are up to the challenge. The goal to produce clean, efficient ships with operational cost savings and safety is one that keeps the mind of the propulsion plant designer well charged.

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