The Foss Hybrid Tug

From Innovation to Implementation

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Abstract

Harbour tugs need enormous power and bollard pull capabilities, relative to displacement. In conventional tugboats, high power diesel propulsion engines afford all the power and thrust required to arrest the momentum of a large ship. In actual operations, however, full power is needed only occasionally, even during ship assist jobs because the majority of a tug's time is spent awaiting a job, transiting to catch a ship, or providing substantially less than full resistance to a ship's way. Although the main diesel engines are sized to satisfy the tug's maximum thrust requirement, they operate at substantially lower loads most of the time - empirical data collected from conventional Dolphin-class tugs show that these boats spend fully 95% of their time at less than 67% power and up to 60% of their time at less than 20% power.

Tug operations require that the boats be able to move at any moment without the delay of starting a main engine. They must also always have electrical power available to meet 'hotel', navigation and miscellaneous electronics loads. Accordingly, both main engines plus at least one diesel generator, run constantly (usually, at idle) when a boat is on the job. Because main engines are designed for high output, that's where their specific fuel consumption and emissions controls are most efficient. Off-design operations reduce emissions control effectiveness and overall engine efficiency. The result, from a fuel and emissions efficiency point of view, is that the engines run well off their peak performance most of the time.

Foss' new 5,080 hp hybrid tug, achieves significant reduction in emissions and fuel consumption while maintaining the same high performance standards as her conventional Dolphin-class sisters. The hybrid system combines electrical and mechanical power sources, with batteries playing a vital role in energy storage. The key to the design was finding the right combination of motor generators, batteries, diesel engines and control systems to provide the horsepower required by customers and pilots and which fit within the compact platform and weight constraints of a tugboat.

This paper presents the impetus behind the innovation, the evolution of the idea into a workable concept, and its implementation on a new hybrid Dolphin-class tug.

xero point hybrid clean and simple.

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