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World's First Hybrid Tug Even Greener Than Initial Estimates

***Independent testing by California clean air agency confirms
Foss Maritimes' hybrid technology significantly reduces pollutants***

LONG BEACH, CA, October 26, 2010 — Technology that powers Foss Maritime's hybrid tug is performing even better than originally hoped, bringing cleaner air to southern California communities and the ports of Long Beach and Los Angeles.

That's a finding of *Evaluating Emission Benefits of a Hybrid Tug Boat* (<http://www.arb.ca.gov/ports/marinevess/harborcraft.htm>), a new report released today by the California Air Resources Board (CARB). It details third-party testing of the *Carolyn Dorothy*, the world's first hybrid tug. The report's conclusion:

*Hybrid technology works
when it comes to reducing
emissions from tug boats.*

"The CARB study is better than we had hoped," said Susan Hayman, Foss Maritime's Vice President of Environmental and Governmental Affairs. "We anticipated that the *Carolyn Dorothy* would show

significant reductions in emissions compared to a conventional tug. The report confirms it and then some."





Hayman pointed to Foss' partnership with the ports of Los Angeles and Long Beach as an example of how innovation can work for the benefit of both the private and public sectors.

"This intensive testing has demonstrated that hybrid technology holds great promise for tug boats and potentially other vessels operating in our ports. Based on what we've seen so far, we're very pleased that the *Carolyn Dorothy* is going to be joined in San Pedro Bay by a second hybrid in mid-2011 that will represent another step forward in the evolution of hybrid technology," said Bob Fletcher, Deputy Executive Officer, California Air Resources Board.

A side-by-side comparison of two Foss Maritime dolphin-class tugs—the *Carolyn Dorothy* and a conventional tug named the *Alta June* — showed significant emissions reductions:

- 73 percent reduction for particulate matter (PM)
- 51 percent reduction for nitrogen oxide (NOx)
- 27 percent for carbon dioxide (CO2)

The testing was performed by a team at the Center for Environmental Research and Technology at the University of California, Riverside (UCR). The testing program was conducted in the Ports of Los Angeles and Long Beach over a seven-month period from January to July, 2010.

"Developing a suitable protocol to accurately establish the benefits of a hybrid technology was challenging," said Dr. Wayne Miller, Adjunct Professor and Associate Director of CE-CERT at University of California, Riverside. "UCR was helped with a broad team of many interested partners, including local, state and federal regulatory agencies; the developer and user of the technology and others listed in the report."

Testing to determine the emission benefits of using a hybrid system on a tug included the following steps:



- Power from the engines and batteries, and vessel location was recorded while the tug boats worked typical assignments. These data were analyzed to produce activity profiles of the fraction of the time that the tugs spent in each operating mode.
- In-use emission measurements were made on the propulsion and auxiliary engines to determine the gaseous (CO CO₂ and NO_x) and particulate matter (PM) emissions across that engine's entire operating range.
- Activity data coupled with emissions data were used to determine the total in-use emissions in g/hr from each tug.
- The total in-use emissions for each tug were compared and allowed UCR to calculate the percentage reduction of the gaseous and particulate matter emissions and benefits of the hybrid technology.

The conventional dolphin tug, *Foss' Alta June*, was powered by four diesel engines, while the hybrid tug, *Foss' Carolyn Dorothy*, operated on four diesel engines and 126 batteries. All engines in both vessels met the EPA Tier 2 marine emission standards..

The *Carolyn Dorothy* was introduced in the ports of Long Beach and Los Angeles in January of 2009 as an innovative approach to reducing air pollution and greenhouse gases. The vessel was designed to retain the power and maneuverability of her conventional Dolphin class sister tugs, while dramatically reducing emissions, noise and fuel consumption.

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Founded in 1889, Seattle-based Foss Maritime offers a complete range of maritime services and project management to customers across the Pacific Rim, Europe, South America and around the globe. The company has harbor services and transportation operations in all major U.S. West Coast ports, including the Columbia and Snake River system. With one of the largest fleets of tugs and barges on the American West Coast, Foss operates two shipyards and offers worldwide marine transportation, emphasizing safety, environmental responsibility and high-quality service. See www.foss.com for more information.