CAL MARITIME ALTERNATE FUEL TESTING PLATFORM

PROJECT BACKGROUND

The environmental impact of maritime emissions has become a more prominent issue. These issues relate to the types of fuel used by vessels, mainly diesel and heavy fuels. There has not been much progress in the United States testing and switching over to alternate sources such as battery power, Hydrogen, or LNG.

Cal Maritime desires to build a platform that would allow testing of alternate power sources/fuels in the maritime environment. The test platform would be a vessel that is be equipped with electric propulsion only. Power generation would be provided by a standardized modular package that would be craned onto the vessel and could be exchanged easily. Power packages could be batteries, hydrogen fuel cell, hybrid, LNG, diesel electric with after-treatment, etc.

FACULTY AND STUDENT INVOLVEMENT

This project provides opportunities for multi-disciplinary involvement at Cal Maritime. All areas of study can be involved in the testing and implementation of the new fuels and power systems. Examples are:

- Engineering Technology (Marine and Facilities) – Responsible for installation and operation of the power plant, automation programming, and stability calculations.
- Mechanical Engineering – Responsible for equipment packaging design.
- Marine Transportation – Responsible for operation of the vessel.
- Maritime Policy and Management – Responsible for the economic analysis and regulatory compliance.

INDUSTRY AND REGULATORY INVOLVEMENT

Vessel Owners – This is a platform where vessel owners can develop and test new technologies to reduce their carbon footprint. Implementing new technologies on a vessel has been financially difficult for owners because of the capital cost of the vessel and the need for the vessel to be in revenue service. Our platform provides a risk free test bed to perfect a new technology before implementation on a revenue generating asset.

USCG MSC – This will provide a platform for the USCG to develop regulations relating to fuel cells, cryogenic fuels, compressed fuels, and batteries.

USCG OCMI – This will provide a platform for the USCG to train local inspectors on the proper installation, testing, and operation of fuel cells, cryogenic fuel and compressed fuel handling, and batteries.

For more information, contact: Keir Moorhead, kmoorhead@csum.edu

POTENTIAL VESSELS

The M/V Tuna is a 46' vessel currently owned by Cal Maritime. It is equipped with (2) Detroit 8V71 diesel engines for main propulsion. These engines (to be removed during the project) are not emissions rated and are only allowed to be operated 300 hours a year to maintain emissions compliance. The Tuna is available now and is a suitable platform for testing.

Alternate vessels will be considered for this project. Preference will be given to vessels that are less than 100gt, have large weight handling capability, and do not require major structural/hull repair.

Regardless of vessel, the following work would have to be funded and completed prior to testing.

Vessel Modification Requirements

1. System removal
    a. Remove diesel engines
    b. Remove existing gearboxes
    c. Remove existing throttle/direction controls
    d. Remove existing interior in crew area
2. Install electric motors for propulsion.
    a. Induction motor with gearbox – This motor would be 1800RPM with a gearbox that has had the clutches removed. Reversal would done by reversing motor direction. This is the lowest cost, least advanced option.
    b. Permanent magnet without gearbox – This motor would be a 600RPM motor and would require an external thrust bearing. This is a mid-cost, lightweight option.
    c. Azipod – This would be a pair of electric pods mounted on the hull of the vessel. This is a high cost, but the highest technology option for all parties involved in the project.
3. Install support systems
    a. Power Converter Package – The vessel will require dual DC-AC converters to power the electric propulsion motors. Due to size and weight constraints, liquid cooled inverters are preferred. Inverters must be able to accept CANbus, Modbus, or alternate digital communication based system. There must also be backup analog inputs for emergency control. Inverters should be capable of 300-400HP at a voltage between 600-850Volts
    b. Interconnection - The vessel will not have any built in power generation. An interconnection system will be required to tie together the onboard propulsion inverters to the power generating module.
    c. Control System - A Programmable Logic Controller (PLC) based control system will be required to operate the vessel. Due to Coast Guard regulations, redundant PLCs are required. Options for PLCs are: Siemens, Allen Bradley, Danfoss, Opto22
    d. Wheelhouse Controls - Fully electronic controls will be required to interface with the new propulsion control system. Options for controls are: Twin-Disc, ZF and Glendenning.
    e. Research Center – Crew cabin will be converted to a research lab. Multiple desks and computers to be installed to allow a lab class to conduct experiments while the vessel is being operated
    f. Data Acquisition System – The PLC system will be required to interface with a PI server located shoreside.

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