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15. Supplementary Notes

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16. Abstract (MAXIMUM 200 WORDS)

This report summarizes four energy audit reports conducted aboard the Reliance (210'), Juniper (225'), Famous (270') and Hamilton (378') classes of U.S. Coast Guard Cutters. Operational profiles and recent fuel consumption data for these classes in various Coast Guard Districts are presented. The report gives suggestions for reducing fuel consumption, and projects associated fuel savings for each class. Strategies common to all audited classes include use of most efficient machinery alignments, optimum transit speeds, improved pitch schedules, and reduced speed operations when feasible. Possible machinery retrofits, including lube oil heaters and reverse osmosis water-makers were also identified. Finally, the report recommends installation of permanent fuel meters, at least aboard a lead cutter in each class, and initiation of an incentive program to promote fuel efficiency and reward vessels which reduce their present fuel consumption. Realistic fuel savings of $3,334,100 per year (19%) are projected for the three WMEC and WHEC classes combined. The available operating data are too limited to project total savings for the WLB Class, but it appears that the present fuel consumption could be reduced by about 20 percent.

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EXECUTIVE SUMMARY

Results and Conclusions:

Energy audits were conducted aboard a representative vessel from each of four classes of Coast Guard (CG) cutters: Reliance (WMEC 210'), Juniper (WLB 225'), Famous (WMEC 270') and Hamilton (WHEC 378'). The purpose of these audits was to establish historical baseline fuel consumption rates, and to identify strategies for future reductions. These audits included review of historical operating data, crew interviews, and onboard measurement of fuel consumption rates in various operating conditions. All audits were accomplished during routine transits, and each vessel was provided with an exit briefing, and a report summarizing key findings.

Based on the results of the underway audits, three major categories of energy saving options were identified. The first category includes operational changes which do not affect speed. The second category assumes modest speed reductions. The final category requires initial capital investments, either for retrofits or increased maintenance, but offers short payback periods and subsequent savings. While these results are specific to the classes audited, there is reason to expect that similar savings can be realized among other Coast Guard classes.

It is also recommended that a CG incentive program be established to promote energy efficiency awareness, and to reward individual vessels which realize a fuel consumption reduction from their historic average. Installation of permanent onboard fuel meters would greatly facilitate this effort. In a related project, possible retrofits to reduce cutter fuel consumption have been identified, and are being prioritized. Installation and testing of the leading candidates are anticipated.

Operational Changes While Maintaining Present Speeds:

Several instances were found where changing the machinery alignment (e.g. from dual engine operations to single engine trail shaft mode, or vice versa) could achieve the same vessel speed while reducing fuel consumption.

Pitch settings, both in single and multiple engine operations, are generally controlled by automated pitch schedules which depend on throttle position. The audits showed that some of the existing pitch schedules could be adjusted to reduce fuel consumption. The selected pitch schedule must also avoid excessive cavitation, resonant vibration, and engine torque, while maintaining sufficient revolutions per minute (rpm) to provide adequate maneuverability at low vessel speeds. However, it appeared during the audits that fuel consumption could be improved without compromising these qualities. The audits did not allow sufficient time to develop new pitch schedules for all engine alignments. Optimum pitch also depends on draft, trim, underwater surface roughness, and ambient wind and wave conditions. Thus, it is recommended that fuel meters be placed on **at least** one vessel of each class to allow underway fine-tuning of selected pitch settings. Torsion meters and a portable diesel engine analyzer would also provide useful feedback to engineering watchstanders.

Total fuel saving for the three WMEC and WHEC classes resulting from implementing these recommended operational measures 50 percent of the time without speed changes is estimated at 13.8 percent of their fuel budget, or $2,374,000 per year.

Speed Reductions:

It is well known that power requirements increase roughly as the cube of speed through the water. Thus, substantial fuel savings can be realized from relatively small reductions in operating speed. It is recognized that speed reductions would reduce the distance that could be covered in the present number of underway hours, or require increased underway hours to cover the same distances. Thus, this option is not appropriate for time-critical missions. As an example, however, a one-knot reduction in all operating speeds 50 percent of the time is considered.

Total fuel saving for the three WMEC and WHEC classes resulting from a one-knot speed reduction is estimated at 5.7 percent of their fuel budget, or $ 970,000 per year.

Upgrades/Retrofits:

Various equipment retrofits were identified, primarily the use of jacket heaters to maintain lube oil temperature when an engine is in stand-by mode, and the use of more efficient equipment for producing steam and potable water. Other retrofits are being evaluated and will form the basis of a future report. Maintenance measures such as washing of turbocharger blades, and more frequent cleanings of hull and propeller, were also identified.

Total fuel savings for all four classes resulting from retrofits and improved maintenance was estimated at three percent of their fuel budget, or $500,000.

Total Savings:

Realistic fuel savings of $3,334,100 per year (19%) are projected for the three WMEC and WHEC classes combined. The available operating data are too limited to project total savings for the WLB Class, but it appears that the present fuel consumption could be reduced by about 20 percent.