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MEMORANDUM

From: T. M. Howard, CDR
COMDT (CG-ENG-3)

Reply to Mr. Thane Gilman
attn of: (202) 372-1383

To: CG Marine Safety Center (MSC-2)

Subj: MICROPROCESSOR AND COMPUTER BASED PROPULSION ENGINE
CONTROL SYSTEMS ON SUBCHAPTER K AND SUBCHAPTER T BOATS

Ref: (a) 46 CFR 121.620 Propulsion Engine Control Systems
(b) 46 CFR 184.620 Propulsion Engine Control Systems
(c) CG MSC Memo Serial E2-1200382 of 13 February 2012

1. PURPOSE. This memorandum provides technical plan review guidance for microprocessor or computer based propulsion engine control systems installed on small passenger vessels (SPVs) regulated under Title 46 Code of Federal Regulations (CFR) Subchapters K and T (K boats and T boats).
2. BACKGROUND. Propulsion engine control systems that rely on microprocessors or computers to control the direction and speed of a SPV must be carefully reviewed to ensure they provide a level of safety at least equivalent to control systems that have typically been installed on these vessels. On SPVs, the propulsion engine control system is typically the throttle and associate components that connect to the engine and reduction gear. Review of mechanical, pneumatic, or hydraulic control systems is relatively straightforward. The review of modern microprocessor or computer based systems can be more challenging. For K boats, 46 CFR 121.620 requires that these systems meet the requirements of 46 CFR 62. For T-boats, 46 CFR 184.620 addresses propulsion engine control systems but does not specifically address microprocessor or computer based systems.

The Coast Guard has received numerous requests for further guidance on 46 CFR 121.620 and 184.620, including Ref. (c). Propulsion engine control systems on all small passenger vessels regulated under Subchapters K or T must provide a level of safety comparable to or greater than the performance standards contained in 46 CFR 121.620 (a) – (c) or 184.620(a) – (c), respectively.

4. PLAN REVIEW GUIDANCE.

- a. K-boats, 46 CFR 121.620. In 46 CFR 121.620(d), propulsion engine control systems (throttles) that are microprocessor or computer based (the "processor") are required to meet 46 CFR 62. 46 CFR 62 was published many years before Subchapter K, at a time when processors were practically non-existent on SPVs. It is also not specifically applicable to

Subchapter K (46 CFR 62.01-5). Therefore, it is reasonable to limit the application of 46 CFR 62 to the following requirements for processor controls that enable the MSC and USCG inspectors to verify that the control system is equivalent to the requirements of the governing Subchapter K:

- (1) 46 CFR 62.20-3(b)(2). A qualitative failure analysis (QFA) of the vessel's propulsion engine control system (throttle) should be submitted. The QFA should specifically address the failure of the microprocessor based control system hardware and those inputs to the control system whose failure could affect the propulsion system's ability to default to the required conditions in 46 CFR 121.620(c). The QFA must indicate continued compliance with Ref. (a), so that power failure to the processor or processor failure will not result in an increase of shaft speed or propeller pitch. The QFA should be based on single, non-concurrent system failures (including loss of power).
- (2) 46 CFR 62.20-5. The processor controls must be suitable in type and design for the service intended. Standards specified in 46 CFR 62.25-30 are equivalent but not mandatory.
- (3) 46 CFR 62.25-25. Processor programming or system logic shall not be altered after Design Verification Tests (DVT) without approval of the OCMI. Processor settings that are field customizable by the owner/operator do not require notification or approval of the OCMI if they do not require factory or manufacturer approval and do not affect the results of the QFA/DVT.
- (4) 46 CFR 61.40-3 (Per 62.20-1). A DVT Procedure (DVTP) document that incorporates all failure modes identified on the QFA should be submitted for review. Onboard DVTs shall be witnessed by the Coast Guard and should be performed immediately after installation, or before the issuance of the initial Certificate of Inspection of the vessel. The DVTP should enable the inspector to verify compliance with Ref. (a) based on failure of the processor control system. Onboard DVTPs should include verification of status of the propulsion plant upon loss of power to the processor.

Compliance with any other specific requirement from 46 CFR 62, including 62.35-5, is not mandatory. Section 115.804 of Subchapter K includes USCG inspection requirements for propulsion machinery and controls. These requirements should be considered acceptable as periodic verification of proper operation of processor-controlled propulsion.

b. T-Boats, 46 CFR 184.620.

- (1) A limited QFA of the vessel's propulsion engine control system (throttle) should be provided, documenting system compliance to Ref. (b). The limited QFA should only consider loss of power to the control system.
- (2) A propulsion control drawing should be submitted with an installation/operational test protocol. This test protocol is an abridged document intended to show compliance with 46 CFR.184.620.
- (3) Section 176.804 of Subchapter T includes USCG inspection requirements for propulsion machinery and controls. These requirements should be considered acceptable as verification of proper operation of the propulsion control system.