

MSC Guidelines for Design Verification Test Procedures

Procedure Number: E2-05

Revision Date: 11/09/2011


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Purpose: To establish a review procedure for the Design Verification Test Procedures of various shipboard automation systems in accordance with the references below.

- References:**
- a. Title 46 CFR Subchapter F, Marine Engineering
 - b. Title 46 CFR Subchapter J, Electrical Engineering
 - c. Navigation and Inspection Circular (NVIC) 2-89, "Guide for Electrical Installations on Merchant Vessels and Mobile Offshore Drilling Units," can be found at: <http://www.uscg.mil/hq/cg5/nvic/pdf/1989/n2-89.pdf>
 - d. Safety of Life at Sea (SOLAS), Consolidated Edition 2009, Chapter II-1, Part D
 - e. MSC Plan Review Guidelines E2-17 (Periodic Safety test Procedure) and E2-18 (Qualitative Failure Analysis)
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Contact Information: If you have any question or comments concerning this document, please contact the Marine Safety Center by e-mail or phone. Please refer to the Procedure Number: **E2-05**

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Responsibilities: Using applicable portions of references (a) through (e), the submitter shall provide sufficient documentation and plans to indicate compliance with the applicable requirements. To facilitate plan review and project management, all plans and information specified in these guidelines should be submitted as one complete package through a single point of contact for the project. All submissions shall be made in triplicate if a stamped copy is desired.

General Guidance: The submitter shall include this document as part of Vital System Automation plan submittal per reference (a), 46 CFR Part 62, and reference (b), through a single point of contact for the project. The submissions should be made in triplicate if stamped copies are desired. The overall design philosophy should be discussed with MSC at early stages of the design process.

- Per 46 CFR 62.01-5(a), a Design Verification Test Procedure (DVTP) is applicable to self-propelled vessels 500 gross tons or over certificated under 46

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General Guidance (continued):

CFR Subchapters D, I, U and self-propelled vessels 100 gross tons or over, certificated under 46 CFR Subchapter H, and in the judgment of Commandant any other automation that may potentially constitute safety hazard to the vessel or personal. Vessels equipped with a Dynamic Positioning (DP) system should refer to MSC Plan Review Guidance # E2-24 for assistance.

- ❑ Using the DVTP, tests must be performed immediately after installation of automated equipment or before the issuance of an initial Certificate of Inspection (COI). The final approval of this document is contingent upon satisfactory completion of onboard tests in the presence of the Coast Guard inspector. The MSC, or an Authorized Class Society acting on behalf of the CG, will return DVTP plans recommended for approval after the completion of testing. Final approval is reserved until the resubmittal of the DVTP after satisfactory testing. Please see reference (a) part 61.40-1(c) and 61.40-3(b).
- ❑ The DVTP is used to verify that automated vital system installations are designed, constructed and operate in accordance with all applicable requirements in references (a) and (b). The DVTP must be based on a Qualitative Failure Analysis (QFA) or a qualitative Failure Mode Effects Analysis (FMEA), and Periodic Safety Test Procedure (PSTP). Please see 46 CFR 61.40-3(a) and part 62.20-3.
- ❑ The DVTP may be incorporated with the QFA.
- ❑ The DVTP must be a separate document from the PSTP. The final approved documents by the Coast Guard must be retained aboard the vessel. Please see 46 CFR 61.40-1(c).
- ❑ The DVTP document should be in a step by step spread sheet or check off list instruction format that specifies the following per 46 CFR 61.40-10(a):
 - a) Equipment status.
 - b) Apparatus (test equipment) needed to perform the test.
 - c) Safety precautions.
 - d) Safety control and alarm set points.
 - e) Procedure to be followed.
 - f) Expected test results.

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General Guidance (continued):

- g) See Attachment 1 for a sample DVTP format.
- Examine the test instruction to ensure that it closely simulates design failure of only a failed component of the test considered in the QFA. For example, simulation of a cabinet component failure by loss of power to the entire cabinet would not be acceptable. However, a programmable logic controller (PLC) power supply module failure could be tested by removing the fuse to the power supply module. A central processor unit (CPU) and PLC failure from the same power supply module; however, should not be tested using the same power supply fuse removal procedure since the power supply module should remain energized with only a CPU failing.
- Test instructions should be prepared assuming that the vessel is underway in pilothouse automatic control, with the required machinery automation set for normal underway mode of operation. The engineroom should be at the normal manning level required of the machinery plant.
- Although components may be supplied by various manufacturers, design verification testing using failures considered in the QFA along with vital system automation installations should function as an integrated system. For example, automated systems supplied by separate manufacturers may be used to monitor the operational integrity of other systems and provide failure alarms.
- Per CFR 62.25-25(a), programmable control or alarm system logic must not be altered after satisfactory completion of the DVTP without the approval of the cognizant Officer in Charge, Marine Inspection (OCMI). This comment will be included in the MSC letter recommending approval of the DVTP to ensure that both the OCMI and the ship's owner are aware of the requirement. Please refer to 46 CFR 61.40-3(b).
- Based on the automated machinery normally tested in the DVTP, the following applicable Plan Review Guidance might be useful during the development and submittal of the DVTP:
 - a) E2-04: Overcurrent Protection Coordination
 - b) E2-06: Load Analysis
 - c) E2-07: One-line Electrical Diagrams
 - d) E2-20: Steering Gear Control and Alarm Circuits

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Attachments:

1. Sample DVTP Format
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Disclaimer:

This guidance is not a substitute for applicable legal requirements, nor is it itself a rule. It is not intended to nor does it impose legally-binding requirements on any party. It represents the Coast Guard's current thinking on this topic and may assist industry, mariners, the general public, and the Coast Guard, as well as other federal and state regulators, in applying statutory and regulatory requirements. You can use an alternative approach for complying with these requirements if the approach satisfies the requirements of the applicable statutes and regulations. If you want to discuss an alternative, you may contact the Marine Safety Center, the unit responsible for implementing this guidance.

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Loss of Control Interface Slave Module

Testing the failure effects on the starboard boiler combustion control process.

WARNING: Removal of the IMC-IS02 in Step 1 below will cause the starboard boiler to go to low fire due to the fuel oil control valve failing.

STEP	COMPONENT(S)	ACTION	RESULT	ALTERNATE ACTION/CONTROL	ALARM	VERIFIED
1	IMC-IS02 PCU 1 Module 2 Slave 1	In PCU Cabinet #1, remove the IMCIS02 module with the address Module 2 Slave 1.	Analog inputs to the INFI 90 System from this module show last known value as bad quality. Analog outputs from the module go to 0 mA.		System alarm, Bad Quality indicated for inputs to this module	
			The starboard boiler goes to low fire due to the fuel oil control valve failing to minimum due to loss of control signal.	If the starboard boiler must be operated, manual control can be maintained from the IISAC in the bypass mode. Also manually control the valve via the valve hand wheel.	Starboard Boiler Trip Alarm	
			The starboard boiler steam flow signal is lost. The steam drum level should not be controlled in automatic without the signal	If the starboard boiler must be operated, drum level must be controlled by the IISAC in the bypass mode.		
			The starboard superheat temperature control valve falls open due to loss of control signal.	If the starboard boiler is operated, the super heater control valve must be operated by the IISAC in the bypass mode or in Local Manual Control.		
2		In PCU #1 insert the IMSIS02 module which was removed in Step 1 above with address Module 2 Slave 1.	Functions and control lost in Step 1 above are restored. System is normal.			

Table 1: Sample DVTP Format