

Ship Reliability Growth – Mature Ship Example

Program Managers are responsible to provide fully capable Government Furnished Equipment (GFE) for installation aboard the ship. The GFE systems are Programs of Record and have completed OT. Upon shipboard installation, the ship program performs production and post-delivery testing to ensure the equipment and systems are properly integrated to support mission requirements.

A Reliability, Maintainability, and Availability (RM&A) analysis conducted on Propulsion and Electrical Distribution systems predicated that the ship will attain the ship Capability Development Document (CDD) A_0 requirements. The analysis was conducted with the NAVSEA TIGER Computer Simulation Program. TIGER program is a Monte Carlo simulation technique used to provide the analyst with a generalized capability for determining system reliability, readiness, and availability estimates. The result of the analysis is provided in the Ship Hull, Mechanical & Electrical (HM&E) Systems RM&A Analysis, Naval Surface Warfare Center – Carderock Division (NSWC-CD) Report. The TIGER Model used a 180-day Design Reference Mission (DRM) developed by the Ship Program Office based on program documentation (CDD, CONOPs, etc.).

The TIGER Model identified four critical systems to achieve the Propulsion and Electrical Distribution A_0 requirements of 0.85 (Threshold) and 0.95 (Objective):

- Main Propulsion System
- Auxiliary Propulsion System
- Ship Service Diesel Generators
- Machinery Control System

The Program Office will track the reliability of the four critical systems and three additional mission essential systems:

- Heating, Ventilation, and Air Conditioning (HVAC) system
- Refrigeration system
- Cargo and aircraft elevators

Comprehensive production testing is conducted on the Ship to confirm shipbuilder compliance with the contract reliability provisions and specifications. Additionally, the production testing will test for proper installation and integration of Government Furnished Equipment (GFE). Production testing during pre-acceptance test and evaluation will be conducted at the shipbuilder facility and witnessed by the government test team. Sea trials provide the first opportunity to observe full system operation for a sufficient length of time or number of cycles and will be used for the evaluation of the reliability metrics.

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At sea testing will occur prior to the Navy accepting delivery and will continue through the post-delivery test and trial period. The accumulative hours at sea will not be sufficient to statistically validate Mean Time between Failures (MTBF). The shipbuilder is required to analyze and correct all premature failures during the warranty period. System and equipment discrepancies identified during the warranty period are entered and tracked via trial cards in the Technical Support Management (TSM) tool. After completion of acceptance trials conducted by the Navy Board of Inspection and Survey (INSURV) prior to ship delivery and upon correction of deficiencies, the Navy accepts delivery of the ship and assumes maintenance responsibility.

Upon delivery, all system and equipment discrepancies will continue to be entered and tracked via trial cards in TSM during the warranty period. Maintenance data is also entered into the Navy 3M maintenance system. Final Contract Trials (FCT) will be conducted by INSURV prior to the end of warranty period to confirm material readiness to support operational missions.

The ship is a modified variant of an existing ship and, as such, incorporates: (1) the existing hull design / electric plant modifications, and (2) fact of life modifications to Command, Control, Communications, Computers, and Intelligence (C4I) and Warfare Systems (each with an approved Program of Record). The ship program will track the reliability of select common (between the new ship class and the existing ship class) components and equipment via the OPNAV Material Readiness Database (MRDB,) maintained by Naval Surface Warfare Center Corona, and via data through the Open Architecture Retrieval System (OARS).

Design or equipment deficiencies identified on existing ship class are (and continue to be) evaluated; and where practical, design modifications are implemented on the new ship class. Upon delivery, the ship reliability will be similarly tracked. The data collection effort for the identification and evaluation of deficiencies will continue similarly for follow-on ships.

Reliability data will be collected and posted after each trial event in the Common T&E Data Repository on the Naval Sea Systems Command Corporate Document Management System (CDMS).

Data analysis working groups (scoring committees of subject matter experts (SME)) will convene, as required, to adjudicate and analyze reliability data to ensure a common set of data and mutual rules for data evaluation. SMEs will be nominated by the Program Office, PEO IWS, DOT&E, and COMOPTEVFOR.