

FMEA – Five Yearly Review

1 BACKGROUND

The IMCA Marine DP committee promotes the practice of maintaining an up-to-date DP system FMEA/FMECA. Opportunities to benefit from new guidance and lessons learned may be missed if the FMEA/FMECA document is not periodically refreshed. A neglected DP system FMEA/FMECA may lead to a reduction in robustness, resilience, and single fault tolerance if it is only updated after deficiencies have been identified by a vessel DP Assurance process or after major upgrades are carried out to the vessel's DP system.

IMO MSC.1/Circ.1580, Guidelines for Vessels and Units with Dynamic Positioning Systems, Chapter 5.1.2 states:

For equipment classes 2 and 3, an FMEA should be carried out. This is a systematic analysis of the systems to the level of detail required to demonstrate that no single failure will cause a loss of position or heading and should verify worst-case failure design intent. This analysis should then be confirmed by FMEA proving trials. The FMEA and FMEA proving trials result should be kept on board and the FMEA should be kept updated so that it remains current.

IMCA M 166, Guidance on Failure Mode Effects Analysis Guidance, Chapter 2.7 Updating of an FMEA states:

*The FMEA will become out of date if it is not maintained regularly and systematically, due to changes in operating procedures, modifications to DP hardware and software, to confirm compliance with the latest industry guidance, etc., over the life cycle of the vessel. If this happens, it is likely that another FMEA revision will be incurred later. A systematic FMEA review through the vessel's life cycle should be an ongoing process which should be formally completed at least once every **five** years.*

2 OBJECTIVE

The objective of this information note is to remind FMEA/FMECA owners to treat the FMEA as a living document that can be leveraged to:

- Ensure the DP system remains robust, resilient, and single fault tolerant.
- Remains in step with current and evolving industry guidance.
- Demonstrate the vessel owner's commitment to a process of continuous improvement through the adoption of current industry good practice.

Any DP modifications to the vessel or systems may require specifically targeted testing to verify and validate those modifications, for example, but not limited to, where PRSs have been upgraded or added, hardware required for power generation, distribution and/or propulsion is modified or added.

Note that in most cases, these changes may also necessitate update of related documentation, for example, DP Annual Trial Programmes, DP Operations Manuals and Decision Support Tools such as ASOG.

IMO MSC.1/Circ.1580, Guidelines for Vessels and Units with Dynamic Positioning Systems, Chapter 5.1.1.4 states:

A survey, either general or partial according to circumstances, should be carried out every time a defect is discovered and corrected, or an accident occurs which affects the safety of the DP vessel, or whenever any significant repairs

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or alterations are made. After such a survey, necessary tests should be carried out to demonstrate full compliance with the applicable provisions of the Guidelines.

3 GENERAL

Key DP personnel should be conversant with their vessel's FMEA/FMECA document and the associated DP Proving Trials. These documents hold a wealth of information and underpin the DP Operations manual and the ASOG. The ASOG is a decision support tool that relies heavily on the FMEA/FMECA and DP Proving Trials to correctly identify post failure DP capability and failures that require suspension of DP operations. It is therefore essential that the FMEA/FMECA remains accurate if the ASOG is to be effective in managing DP station keeping risk.

Company procedures must be put in place for document changes (e.g., in compliance with ISM Code procedures), including a Management of Change procedure to aid traceability and accountability of the FMEA/FMECA system updates.

4 REVIEW

A DP system FMEA/FMECA has a very wide readership and a review of the FMEA/FMECA document can have participation by anyone who can assist to ensure it remains relevant, these persons include but are not limited to:

- Vessel Staff
 - DPO's.
 - Engineers.
 - Electro Techs.
 - Mission specialists.
- Vessel Management
- 3rd Party IMCA DP Accredited Practitioners
- DP class surveyor

The person responsible for the final overall review must be suitably qualified to conduct such a review, preferably an [IMCA DP Accredited Practitioner](#).

Further guidance is detailed in IMCA M166, chapter 2.7

Review Process

It is recognised that updating the FMEA/FMECA every time a minor modification/alteration is applied to the DP system may not be practical or cost effective. Any changes to the vessel systems should be assessed to determine the effect on the DP system's redundancy concept and documented within the DP FMEA/FMECA. Updates must ensure the document contains the correct information in order to confirm fault tolerance is maintained. A record of the changes should be recorded within the updated document. A process should be established to ensure verification and validation is completed.

IMCA recommends that a general review cycle is undertaken at the least every 5 years in line with the 5 yearly periodical trials as further detailed in IMCA M166, chapter 3.4.

Items to consider:

- Guidance Changes – Guidance is always evolving, often reflecting the lessons learnt across the industry. For example, IMCA's DP Station Keeping Event Reporting scheme provides a direct input to all IMCA's guidance. Guidance may recommend improved analysis and testing methods.

- Class Rule Changes – Class rules at the time of vessel build will typically only apply, however major changes may require adoption of new rules, (for example, retrofitting a Hybrid System).
- New Knowledge – Knowledge recently acquired or currently being acquired through observation, learning, thinking and experience, which can be found in DP event reports, safety bulletins, information notes or shared knowledge.
- Lessons learnt – Methodology in analysis do change over time, and if it has been noted that certain items are causing DP incidents across the industry it would then necessitate the need to re-visit the vessel’s FMEA and check if that issue has been effectively analysed in the current FMEA/FMECA. Examples include, but are not limited to the following:
 - The risks of fault propagation through cross connections and common points which are not effectively mitigated by protective functions.
 - Networks storms.
 - Cyber security.
- Re-validation & Re-verification – Any hardware and software changes will require validation and verification, usually in the form of specific proving trials, this will then be required to be translated back into the DP Annual Trials Programme and any other relevant documents.
- Improved Presentation – The FMEA documentation should be intuitive and facilitate the reader to arrive at the same conclusion as the author. An improved presentation format may therefore be warranted during the review process.
- Mission Equipment – Has mission equipment been considered with regards to its impact on DP Systems and the redundancy concept of the vessel. If the vessel’s industrial mission changes from contract to contract are these changes reflected within the analysis.

Recommended Review Process

IMCA recommends that the following items are checked as part of the 5 yearly review of the vessel’s FMEA/FMECA:

- Redundancy Concept – Is the vessel’s redundancy concept clear and accurate?
- Worst Case Failure Design Intent (WCFDI) – Is this clearly stated and still relevant? Does the FMEA/FMECA verify that the WCFDI has been met?
- Worst Case Failure (WCF) – Is this clearly stated and still relevant? – Is the $WCF \leq WCFDI$?
- System Configuration – Are all the vessel’s technical system configurations included to the vessel and its industrial mission?
- System Illustrations – Are all systems and sub-systems clearly represented in simple easily understandable sketches that communicate the redundancy concept?
- Common Points/Cross Connections – Have all common points been identified and analysed with single failure effects being tolerable or mitigated? These can include but are not limited to:
 - Dual power supplies.
 - Automatic changeovers.
 - Network highways.
 - Closed Bus Ties.
 - Cross-over valves in fluid auxiliary system.
 - Common cooling, air, fuel, HVAC systems etc.
 - Location of equipment (IMO DP Class 3 considerations).

- Hidden Failures – Have all predictable hidden failures been identified and analysed with single failure effects being tolerable or mitigated? These can include but are not limited to:
 - Protection devices.
 - Breakers failing to open/close.
 - UPS capacity.
 - Generator/Thruster 100% capability.
 - HVAC – Sensitive electronic equipment cooling.
- Configuration errors – Have all configuration errors been identified and analysed with single failure effects being tolerable or mitigated? These can include but are not limited to:
 - Cross over valves open.
 - PRS/Sensor selection.
 - Close bus power systems AC & DC.
- Acts of Maloperation – Have acts of maloperation been identified and analysed with single failure effects being tolerable or mitigated? These can include but are not limited to:
 - Tripping of QCV;
 - Generator E-stop activated during checks.
 - Deselection of wrong faulted sensors/PRS.
 - UPS being switched into by-pass.
- Guidance and Rules – Are the quoted guidance and rules still relevant? – A vessel is built to Class rules dated at the time of the build; these remain relevant. The guidance is relevant at the time the vessel was originally built; however, this guidance may have been through several updates since it was first applied.

For more information, please contact Richard.Purser@imca-int.com.