



# **TECHNICAL AND OPERATIONAL GUIDANCE (TECHOP)**

## **TECHOP\_GEN\_02 (WHITE PAPER ON CONTINUOUS TRIALS FOR DP MODUS)**

**AUGUST 2015**

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# 1 INTRODUCTION - TECHOP (TECHNICAL AND OPERATIONAL GUIDANCE)

## 1.1 PREAMBLE

1.1.1 Guidance documents on DP, Design and Operations, were published by the MTS DP Technical Committee in 2011 and 2010, subsequent engagement has occurred with:

- Classification Societies (DNV, ABS).
- United States Coast Guard (USCG).
- Marine Safety Forum (MSF).

1.1.2 Feedback has also been received through the comments section provided in the MTS DP Technical Committee Web Site.

1.1.3 It became apparent that a mechanism needed to be developed and implemented to address the following in a pragmatic manner.

- Feedback provided by the various stakeholders.
- Additional information and guidance that the MTS DP Technical Committee wished to provide.
- Means to facilitate revisions to the documents and communication of the same to the various stakeholders.

1.1.4 The use of Technical and Operations Guidance Notes (TECHOP) was deemed to be a suitable vehicle to address the above. These TECHOP Notes will be in two categories.

- TECHOP\_ODP.
- TECHOP\_GEN.

## 1.2 TECHOP\_ODP

1.2.1 Technical Guidance Notes provided to address guidance contained within the Operations, Design or People (Future development planned by the MTS DP Technical Committee) documents will be contained within this category.

1.2.2 The TECHOP will be identified by the following:

TECHOP\_ODP\_SNO\_CATEGORY (DESIGN (D), OPERATIONS (O), PEOPLE (P))

- EG 1 TECHOP\_ODP\_01\_(O)\_(HIGH LEVEL PHILOSOPHY).
- EG 2 TECHOP\_ODP\_02\_(D)\_(BLACKOUT RECOVERY).

## 1.3 TECHOP\_GEN

1.3.1 MTS DP TECHNICAL COMMITTEE intends to publish topical white papers. These topical white papers will be identified by the following:

TECHOP\_GEN\_SNO\_DESCRIPTION.

- EG 1 TECHOP\_GEN\_01-WHITE PAPER ON DP INCIDENTS.

## **1.4 MTS DP GUIDANCE REVISION METHODOLOGY**

- 1.4.1 TECHOPs as described above will be published as relevant and appropriate. These TECHOPs will be written in a manner that will facilitate them to be used as standalone documents.
- 1.4.2 Subsequent revisions of the MTS Guidance documents will review the published TECHOPs and incorporate as appropriate.
- 1.4.3 Communications with stakeholders will be established as appropriate to ensure that they are notified of intended revisions. Stakeholders will be provided with the opportunity to participate in the review process and invited to be part of the review team as appropriate.

## **2 SCOPE AND IMPACT OF THIS TECHOP**

### **2.1 SCOPE**

- 2.1.1 TECHOP\_GEN\_02 discusses the guidance on annual DP trials for MODUs provided in IMCA M191 and TECHOP\_ODP\_08\_(O)\_(ANNUAL\_DP\_TRIALS\_AND\_GAP\_ANALYSIS). The discussion includes an explanation of how the operational concepts of Critical Activity Mode (CAM) and Task Appropriate Mode (TAM) can influence the development of an annual trials program for MODUs based on IMCA M191 which allows the trials program to be spread over a year.
- 2.1.2 Nothing in this TECHOP is intended to override requirements imposed by the classification societies to maintain DP equipment class notation. Where suggestions for test intervals exceeding one year are made in this Techop it is to be understood that this only applies when there is no conflict with classification society or other statutory requirements.
- 2.1.3 This Techop may be used to supplement class annual surveys and trials prepared in line with the guidance in IMCA M191

### **2.2 IMPACT ON PUBLISHED GUIDANCE**

- 2.2.1 None.

### 3 CASE FOR ACTION

#### 3.1 THE NEED TO UNDERSTAND AND MAINTAIN A DP REDUNDANCY CONCEPT

3.1.1 There is significant variation in the interpretation and implementation of Annual DP trials for MODUs.

3.1.2 Guidance has been produced by IMCA and MTS on the subject of annual DP trials for DP MODUs and other DP vessels including:

- IMCA M190 Guidance for developing and conducting annual DP trials programmes for DP vessels.
- IMCA M190A Guidance for Developing Annual DP Trials Programmes for DP Vessels: Executive Summary.
- IMCA M191 Guidelines for annual DP trials for DP mobile offshore drilling units.
- TECHOP\_ODP\_08\_(O)\_(ANNUAL\_DP\_TRIALS\_AND\_GAP\_ANALYSIS).

3.1.3 This guidance note attempts to highlight the important points in this wealth of guidance with particular reference to DP MODUs. This note also comments upon the influence of the concepts of critical activity mode (CAM) and task appropriate mode (TAM) on trials development which leverages and supplements the trials program intended to prove fitness to conduct operations in a particular DP equipment class and associated approved configuration.

#### 3.2 ORIGIN OF ANNUAL DP TRIALS REQUIREMENTS

3.2.1 The requirement for an annual survey originates in IMO MSC645 but it is essentially driven by the fundamental principles that fault tolerant systems based on redundant elements must be monitored and maintained to ensure that there is a high degree of confidence that each redundant equipment group is available at full capacity when required.

3.2.2 The requirements for initial, five-yearly and annual survey in IMO MSC645 are given below and interpreted as follows in present day practice.

- .1 Initial survey which should include a complete survey of the DP-system to ensure full compliance with the applicable parts of the guidelines. Further it includes a complete test of all systems and components and the ability to keep position after single failures associated with the assigned equipment class. The type of test carried out and results should be documented in the Flag State Verification and Acceptance Document (FSVAD), see 5.2.
- .2 Periodical survey at intervals not exceeding five years to ensure full compliance with the applicable parts of the guidelines. A complete test should be carried out as required in 5.1.1.1. The type of test carried out and the results should be documented in the FSVAD, see 5.2.
- .3 Annual survey should be carried out within three months before or after each anniversary date of the initial survey. The annual survey should ensure that the DP-system has been maintained in accordance with applicable parts of the guidelines and is in good working order. Further an annual test of all important systems and components should be carried out to document the ability of the DP-vessel to keep position after single failures associated with the assigned equipment class. The type of test carried out and results should be documented in the FSVAD, see 5.2.

**Extract 3-1 (Courtesy IMCA – 113IMO)**

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- 3.2.3 The requirements of Extract 3-1 Paragraph 1 are satisfied by the sea trials and DP FMEA proving trials and all parts of the classification society approval process associated with DP system.
- 3.2.4 The requirements of Extract 3-1 Paragraph 2 recognises that equipment ages and its performance and reliability deteriorates in service. A five-yearly interval aligns with classification society survey requirements. This is not interpreted as a requirement to repeat the original DP FMEA proving trials program. A new survey should be carried out which has the same objective of proving that the DP system is fully fault tolerant in respect of its defined failure criteria. Although the requirements do not change, the ability to confirm compliance with greater confidence improves with passage of time as survey and analysis techniques improve and lessons learned are applied. A well-managed FMEA process as recommended by IMCA M178 'FMEA Management Guide', should ensure that Annual DP trials are periodically updated with new knowledge from the FMEA and such trials may satisfy a significant part of this requirement.
- 3.2.5 The requirements of Extract 3-1 Paragraph 3 are to demonstrate that the redundancy concept is in good order. In DP FMEA proving trials the focus is to prove compliance with redundancy requirements. At annual DP trials it is accepted that the design of the redundancy concept has been proven and the focus is on ensuring all the essential parts of the DP system operate correctly and documenting the ability of the DP system to respond correctly to single failures. A carefully crafted annual DP trials program should be developed following the practical guidance in IMCA M190 and in IMCA M191. The requirement to conduct such trials annually has no known basis in reliability analysis. The best time to carry out a test to reveal potential hidden failures is immediately after an item has failed as this ensures the vessel operates for the minimum amount of time in a non-fault tolerant condition. As this is nearly impossible to predict and is affected by so many variables an arbitrary test interval of one year is accepted by industry as reducing the risk to an acceptable level. Alarms, monitoring and watchkeeping routines supplement this process.

## **4 SUGGESTED IMPLEMENTATION METHODOLOGY**

### **4.1 MAINTAINING THE REDUNDANCY CONCEPTS OF DP MODUS USING CONTINUOUS TRIALS**

4.1.1 Although they may be expressed differently, there are no technical differences in the requirements to test the redundancy concepts of DP MODUs or other DP vessels. IMCA M191 simply recognises the difficulty associated with finding a suitable time to do all necessary tests at one time and provides an alternative scheduling and verification process which encourages DP MODU owners to conduct tests of opportunity when it is safe to do so and make good use of planned maintenance to satisfy test requirements on a continuous basis over the period of one year.

### **4.2 DEVELOPING AN ANNUAL TRIALS PROGRAM**

4.2.1 There is large amount of practical advice provided IMCA M190, 190A, 191 and MTS Techop\_ODP\_08. This note is not intended to duplicate that guidance rather the intention is to highlight some of the more important points. DP vessels of equipment classes 2 & 3 must have at least two redundant equipment groups each capable of developing surge, sway and yaw forces. Each redundant group must have sufficient performance to maintain the vessel's position and heading at the limits of its defined post failure environmental capability either alone in the case of two redundant groups or in combination when there are more than two groups.

4.2.2 Each redundant group will also have a range of protective functions designed to prevent fault propagation from one redundant group to the other by way of common points in the design and a range of alarms or other detection methods intended to help reveal hidden failures that could defeat the redundancy concept. Note it is only essential to test those elements of performance, protection and detection that directly contribute to redundancy but vessel owners may elect to test other systems, features and risk mitigation measures, the failure of which could contribute to non-productive time.

4.2.3 The range of protection systems that are considered to be essential may be significantly influenced by the operational configuration of the DP system. For example, a vessel which operates its power plant as two or more independent power systems may rely on far fewer protective functions than one that operates its power plant as a single power system. This could significantly reduce the annual trials test burden.

4.2.4 As a minimum, all essential aspects of the redundancy concept on which the CAM configuration relies should be tested annually.

4.2.5 Elements of performance, protection and detection which are relied upon only in TAM may be tested at other intervals not exceeding five-years. These tests should be included in the annual trials program with a note indicating the test frequency. The same conditions can be applied to non-critical redundancy. A rolling program may prove the most effective method.

4.2.6 The basis of any trials program should be a document which tests the redundancy concept and configurations analysed in the class approved DP system FMEA. Any adaptations to this program intended to accommodate CAM and TAM alternative strategies should be part of that base document and clearly explained within it. However, where the purpose of the annual DP trial is to demonstrate the fitness of the vessel to conduct operations requiring a vessel of a particular DP equipment class and its associated machinery configuration it may be necessary to test all the functions and features which are relied upon in that configuration.



4.2.7 The DP system FMEA is a suitable source of information from which to develop the Annual DP trials program.

4.2.8 A DP FMEA should identify:

- The redundant equipment groups which together form the redundancy concept. These redundant groups will generally be broken down into functional systems such as SW cooling, FW cooling, fuel oil , compressed air power generation, power distribution, safety systems, vessel and power management systems and DP control systems.
- Those elements of performance, protection and detection within each functional system upon which the redundancy concept depends.
- The operational configuration of the DP systems used for critical activity mode (CAM).
- Other configurations such as that used for TAM.

4.2.9 The Annual DP trials program developed for the same vessel should:

- Describe the operational configuration of the DP system required for each test.
- Ensure the test configuration reflects and proves fault tolerance in the operational configurations in the approved DP system FMEA. Any adaptations for CAM and TAM strategies should be part of that document and clearly explained within it.
- Contain tests that taken together confirms that each redundant group has the performance to maintain position and heading at the limits of the vessel's post worst case failure DP capability. As it is unlikely that the environmental conditions necessary to prove this will be present during the trials execution, the necessary level of confidence can be achieved by testing the individual performance of equipment.
- Include the test method, expected results and space to record the actual results
- Contain tests of the measures used to detect hidden failures.
- Test those protective functions upon which redundancy depends.
- Tests may be created to test several essential features at the same time provided they don't conflict with each other (example group redundancy tests).
- A cross reference to a planned maintenance activity for those test to be completed by PM.
- A cross reference to the part of the DP system FMEA that discusses the system to be tested.
- Purpose and justification for the test.

4.2.10 While all reasonable measure should be taken to make testing as realistic as practical.

### **4.3 MAINTENANCE RECORDS**

4.3.1 The requirement to demonstrate that the DP system has been well maintained can be satisfied by reference to appropriate planned maintenance records from which key dates for main machinery and DP control system service intervals can be extracted. Reference is made the relevant IMCA and MTS documents for further guidance on this.

## **4.4 CHARTERERS BATCH TRIALS**

4.4.1 Although the purpose of developing IMCA M191 was to provide guidance on the development of a continuous trials programme to be executed on a continuous basis with no requirement for 3rd party verification, most charterers expect to witness a limited form of an annual DP trials program on a 'batch' basis to satisfy their own requirements. Tests typically carried out at this time may include:

- Generator full power tests.
- Thruster full thruster tests.
- Group redundancy test – Demonstrate maximum effect of single failures.
- Power management protective functions – thruster and drilling power limitation and reduction.
- Blackout recovery from realistic failure conditions.
- DP network communication - test of redundancy and protective functions.
- Recovery from ESD (Note: HEMP process to be used to identify and manage risks. Consequences of delayed recovery from ESD to be clearly identified and mitigated. Additional support requirements may be necessary (example standby tug / vessel)).

4.4.2 Such tests would normally take no more than 36 hours to complete when properly planned and executed.

## **4.5 SUMMARY**

4.5.1 An effective annual DP trials program for a DP MODU should:

- Be a comprehensive test of the redundancy concept.
- Ensure the elements of performance, protection and detection are present where required.
- Make full use of planned maintenance activities to support tests of opportunity.
- Have clear links to the FMEA that demonstrate how the trials test and confirm the essential features identified in the FMEA.
- Test non-critical redundancy and other features intended to reduce non-productive time.
- Demonstrate by test record and other documentation that the DP system has been well maintained and is in good order.
- Include tests of blackout recovery and emergency shutdown functions and recovery.

## 5 MISCELLANEOUS

Stakeholders	Impacted	Remarks
MTS DP Committee	✓	To track and incorporate in next rev of MTS DP Operations Guidance Document Part 2 Appendix 1. Communicate to DNV, USCG, Upload in MTS website part.
USCG	✓	MTS to communicate- FR notice impacted when Rev is available.
DNV	✓	MTS to Communicate- DNV RP E307 impacted.
Equipment vendor community	X	MTS to engage with suppliers.
Consultant community	✓	MTS members to cascade/ promulgate.
Training institutions	✓	MTS members to cascade/ promulgate.
Vessel Owners/Operators	✓	Establish effective means to disseminate information to Vessel Management and Vessel Operational Teams.
Vessel Management/Operational teams	✓	Establish effective means to disseminate information to Vessel Operational Teams.