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AMENDMENTS TO THE GUIDELINES FOR VESSELS WITH DYNAMIC POSITIONING (DP) SYSTEMS (MSC/CIRC.645)

Proposed amendments to the Guidelines

Submitted by Antigua and Barbuda, Australia, Liberia, the United States, Vanuatu, the International Association of Drilling Contractors (IADC), the International Marine Contractors Association (IMCA) and the Superyacht Builders Association (SYBAss)

SUMMARY

Executive summary:	This document proposes amendments to the *Guidelines for vessels with dynamic positioning (DP) systems* (MSC/Circ.645) in order to reflect advances in technology and operations since the publication of the circular in 1994
Strategic direction:	5.2
High-level action:	5.2.1
Planned output:	5.2.1.33
Action to be taken:	Paragraph 30
Related documents:	MSC/Circ.645; resolution A.1023(26); MSC 90/25/17 and MSC 90/28, paragraph 25.34

Introduction

1 This document is submitted in accordance with the provisions of paragraph 6.12.3 of the *Guidelines on the organization and method of work of the Martime Safety Committee and the Marine Environment Protection Commitee and their subsidiary bodies* (MSC-MEPC.1/Circ.4/Rev.3) and proposes amendments to the *Guidelines for vessels with dynamic positioning systems* (MSC/Circ.645) in order to reflect advances in technology and operations since the publication of the circular in 1994.

Background

2 The Maritime Safety Committee, at its sixty-third session, approved the *Guidelines for vessels with dynamic positioning systems*, as set out in the annex to MSC/Circ.645, which were prepared by the Sub-Committee on Ship Design and Equipment at its thirty-seventh session. The guidelines were developed to provide an international standard for dynamic positioning systems on all types of new vessels.

3 The Maritime Safety Committee, at its ninetieth session, considered document MSC 90/25/17 (United States, IADC and IMCA), proposing to amend and update the *Guidelines for vessels with dynamic positioning systems* (MSC/Circ.645) to address the current technology employed on modern vessels of growing size and operating in deeper waters, and agreed to include in the post-biennial agenda of the Committee an output on "Development of amendments to the Guidelines for vessels with dynamic positioning (DP) systems (MSC/Circ.645)", with two sessions needed to complete the item, assigning the DE Sub-Committee as the coordinating organ. Following the re-structuring of the Organization's technical sub-committees, this item was included in the 2014-2015 biennial agenda for the newly formed Sub-Committee on Ship Systems and Equipment.

4 The co-sponsors have reviewed the existing guidelines against the latest industry guidance and lessons learned to identify areas in need of revision. A draft revised circular identifying the proposed changes is provided in the annex for the Sub-committee's consideration. To assist the Sub-committee's deliberations, the proposed amendments are discussed below.

Discussion

5 The existing guidelines are widely accepted as the international standard for the acceptance of dynamic positioning systems. The guidelines have provided the framework on which national regulations and classification society rules are based, and which are supplemented by a growing body of more detailed industry guidance.

6 Over the decades, dynamic positioning has evolved from being a tool primarily for mobile offshore drilling units (MODUs) maintaining position over offshore wells, to being employed for a wide range of position keeping operations, with systems being fitted on much larger numbers of new vessels and on an increasingly diverse set of vessels, from offshore units to shuttle tankers and passenger vessels.

7 The core elements of dynamic positioning systems and the principles of operation, however, have remained the same and the existing guidelines have largely stood the test of time. Even the original definition of dynamic positioning (DP) is largely still fit for purpose. Even though DP has evolved from simple position keeping to more complex operations such as weather vaning, the different operational modes were already anticipated in the original definition, which includes both mainitaining position at a fixed location and on a pre-determined track.

8 Nevertheless, the co-sponsors have identified areas that would benefit from clarification or updating to take account of improved industry guidance and changes in technology and best practice.

Scope and application

9 The guidelines were originally developed to provide an international standard for DP systems on all types of new vessels (i.e. vessels whose keel was laid or which was at a similar stage of construction on or after 1 July 1994). Taking into account that dynamically positioned vessels are moved and operated internationally, and that the design and operating criteria require special consideration, the guidelines were developed to facilitate international operation without having to document the DP system in detail for every new area of operation.

10 This approach is even more relevant today, particularly for the offshore sector. DP systems are now fitted on the vast majority of new drill ships and offshore support vessels. Modern offshore support vessels are increasingly multipurpose, offering a range of specialist offshore support functions, many of which are DP assisted, and are capable of being deployed in all the main offshore oil and gas arenas. MODUs are also large, specialized assets that need to be able to be utilized all over the world.

11 Although DP may be used for different types of operations, depending on the type of vessel, the general principles of equipment requirements and operation are the same. DP systems on passenger ships, for example, tend not to be classed, but the existing guidelines still provide the baseline requirements.

12 The co-sponsors therefore consider that the general principles of the existing guidelines, to provide an international standard for DP systems on all types of vessels, should be maintained.

13 In addition, although the guidelines do need updating to reflect some specific operational and technological changes, it is important to avoid overcomplicating the existing framework or diluting the focus of the original document.

14 The purpose of the guidelines was to recommend design criteria, necessary equipment, operating requirements and a testing and documentation regime for DP systems. The guidelines therefore concentrate on the system requirements, and do not address more detailed operational matters, including navigation and the Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs), or topics such as training and experience of dynamic positioning operators.

15 These issues are covered in detail in the extensive body of industry guidance that has been developed over the years. Trying to incorporate much more detailed guidance would over complicate the guidelines and create duplication with established industry documents. In addition, the revised guidelines will need to be consistent with the existing version, as this will continue to be in place for existing vessels.

16 The proposed revised guidelines, as set out in the annex, therefore retain the essence of the original circular MSC/Circ.645 and continue to be structured around the different classes of system.

Proposed changes

17 The co-sponsors have identified a number of changes needed to reflect key advances in technology and operations.

18 The main changes in industry practice since the guidelines were published has been the wider use of Failure Modes and Effects Analysis (FMEA) for single point of failure analysis for safety critical equipment, and the use of industry developed guidance, such as Activity

Specific Operating Guidelines (ASOG), as one of the key processes in operational activity planning. It is therefore proposed that chapter 4 (Operational Requirements) and section 5.1 (Surveys and Testing Guidance) should be updated to incorporate FMEA and references to such industry guidance, respectively.

19 Amendments are also being proposed to take account of changes in technology, such as new guidance on Uninterruptible Power Supplies (UPS) (paragraph 3.4.2.8) and firewalling the DP system software (paragraph 3.4.2.9).

20 In response to the lessons learned and experience of using the existing guidelines, some editorial amendments are being proposed to improve the clarity of the text.

21 For example, some fine tuning is being suggested to the definition of DP (paragraph 1.3.1) to clarify its application and to take account of some current technology which does not use thruster force exclusively. Some amendments have been proposed to better explain the concept of redundancy (paragraph 1.3.8) and to set out the system requirements for each equipment class more clearly (chapters 2 and 3). Text in chapters 2, 3, 4 and 5 is also being rewritten to both clarify the meaning and reflect modern DP systems and operations.

22 A number of paragraphs in the proposed draft have been put in square brackets, to indicate particular areas that have been identified as either needing further work or on which further discussion is needed, in order to agree on matters of principle.

23 One of these issues is the suggestion that the equipment classes (chapter 2) be expanded to include DP class 0, to take account of the growing number of vessels, including crew transfer vessels and commercial yachts, that are being fitted with dynamic positioning systems which do not quite meet DP class 1. Although some classification societies have introduced additional DP notations, these are more of a commercial notation, indicating additional requirements that are not covered by the international standard, so these are not being proposed for inclusion here. However, it has proved difficult to identify the exact differences between DP class 0 and DP class 1, and there was not unanimous support for including class 0. The proposed references to DP class 0 have therefore been left in square brackets, to indicate that further discussion is needed on this point of principle. If it is decided to include DP class 0, more work will be needed to identify the appropriate technical requirements.

24 Opinions were also divided on whether new guidance should be included on waiving the requirements for cables and piping systems, subject to other protection (proposed new paragraph 3.5.4). Some members were of the view that, as exemptions are being granted, this should be reflected in the Guidance. Others, however, were concerned that this would weaken the existing requirements, and that such waivers should not be formalized.

25 The guidance on the Flag State Verification and Acceptance Document (FSVAD) (section 5.2) has also been placed in square brackets. The FSVAD provides an independent assessment by the flag Administration of the DP system's capabilities, and provides useful confirmation of how the system complies with the existing guidelines, without having to interpret the individual notations and terminology used by different classification societies. However, it appears that in practice few administrations issue FSVADs. There have therefore been suggestions that the references to FSVAD should be replaced by "certification" or similar, and that, even though the FSVAD and Failure Modes and Effects Analysis (FMEA) processes do have slightly different aims, the intended function of the FSVAD could also be fulfilled by an alternative certificate, on the basis of the FMEA (in conjunction with proving trials documents) required by classification societies for equipment classes 2 and 3. However, as FMEAs are not

usually a class requirement for equipment classes 0 and 1, as an alternative to the FSVAD for equipment classes 0 and 1, compliance with the guidelines could be documented by means of the classification society equipment class certificate.

26 Irrespective of the certification to demonstrate compliance with the guidelines, the FMEA along with proving trials is a classification society requirement for DP classification for equipment classes 2 and 3. It is not the co-sponsors intention to suggest that the existing FMEA requirement could be replaced by an FSVAD.

27 The Sub-committee is therefore invited to comment on the extent to which FSVAD is implemented, and possible alternatives for DP certification. It is acknowledged that, if the Sub-committee were to agree to alternative methods of certification to demonstrate compliance with these guidelines, further work would be needed on the draft proposed text to ensure a clear but robust approach.

28 It has also been identified that the examples given in paragraph 3.1.4, regarding redundancy for equipment class 3, do not reflect current technology. However, there has not been sufficent time to develop updated text, so this paragraph has also been left in square brackets.

29 The application of the revised guidelines will also need to be decided. Given that the proposed changes include some significant amendments, such as expanding the DP system equipment classes, and the large increase in the DP vessel fleet, it had been suggested that the updated guidelines should apply to new vessels only, and that for vessels constructed before the agreed date of application of the revised guidelines, the existing guidelines should continue to apply. However, one co-sponsor was of the view that Administrations should have the option to expand the applicability of the updated guidelines to existing vessels. The scope of application will therefore need further discussion.

Action requested of the Sub-Committee

30 The Sub-Committee is requested to note the discussion in paragraphs 5 to 29 above, and in particular the co-sponsors' recommendations that the general principles and structure of the existing guidelines should be maintained, and consider the proposed amendments provided in the annex, with a view to updating MSC/Circ.645.

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ANNEX

DRAFT AMENDMENTS TO THE GUIDELINES FOR VESSELS WITH DYNAMIC POSITIONING SYSTEMS

[Additional text is indicated by underlining, deleted text by strikethroughs.]

GUIDELINES FOR VESSELS WITH DYNAMIC POSITIONING SYSTEMS

1 [The Maritime Safety Committee at its ~~sixty-third session (16 to 25 May 1994),~~ […] approved the updated *Guidelines for Vessels with Dynamic Positioning Systems*, set out at annex to the present circular, as prepared by the Sub-Committee on ~~Ship Design and Equipment~~ Ship Systems and Equipment at its ~~thirty-seventh~~ [...] session.

2 Member Governments are invited to bring the guidelines to the attention of all bodies concerned, and apply the guidelines to new vessels with dynamic positioning systems constructed on or after ~~1 July 1994~~[…], in conjunction with implementation of the provisions of paragraph ~~4.12~~ 4.13 of the ~~1989~~ 2009 MODU Code as ~~amended by resolution MSC.38(63)~~ adopted by resolution A.1023(26).

3 [Member Governments are also invited to use the proposed model form of flag State verification and acceptance document set out in the appendix to the guidelines.]]

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ANNEX

GUIDELINES FOR VESSELS WITH DYNAMIC POSITIONING SYSTEMS

CONTENTS

PREAMBLE

1 These guidelines for vessels with dynamic positioning systems have been developed to provide an international standard for dynamic positioning systems on all types of new vessel.

2 Taking into account that dynamically positioned vessels are moved and operated internationally and recognizing that the design and operating criteria require special consideration, the guidelines have been developed to facilitate international operation without having to document the dynamic positioning system in detail for every new area of operation.

3 The guidelines are not intended to prohibit the use of any existing vessel because its dynamic positioning system does not comply with these guidelines. Many existing units have operated successfully and safely for extended periods of time and their operating history should be considered in evaluating their suitability to conduct dynamically positioned operations.

4 Compliance with the guidelines will be documented by [a Flag State Verification and Acceptance Document (FSVAD)] [or other certification] for the dynamic positioning system. The purpose of [a FSVAD] [this certification] is to ensure that the vessel is operated, surveyed and tested according to vessel specific procedures and that the results are properly recorded.

5 A coastal State may permit any vessel whose dynamic positioning system is designed to a different standard than that of these guidelines to engage in operations.

1 GENERAL

1.1 Purpose and responsibility

1.1.1 The purpose of these guidelines is to recommend design criteria, necessary equipment, operating requirements, and a test and documentation ~~system~~regime for dynamic positioning systems to reduce the risk to personnel, the vessel, other vessels or structures, sub-sea installations and the environment while performing operations under dynamic positioning control.

1.1.2 The responsibility for ensuring that the provisions of the guidelines are complied with rests with the owner of the DP-vessel.

1.2 [Application

The guidelines apply to dynamically positioned units or vessels, the keel of which is laid or which is at a similar stage of construction on or after ~~1 July 1994~~[...]. For vessels constructed between 1 July 1994 and [...], the previous version of the guidelines MSC/Circ.645) apply.]

1.3 Definitions

[Editorial note: once this section has been finalized, the definitions will need to be re-ordered, to ensure any new definitions are listed in the order in which they appear in the main text.]

In addition to the definitions in the MODU Code ~~1989~~2009 the following definitions are necessary for the guidelines:

1.3.1 Dynamically positioned vessel (DP-vessel) means a unit or a vessel which automatically maintains its position and heading (fixed location, relative location or predetermined track) ~~exclusively~~ by means of thruster force.

1.3.2 Dynamic positioning systems (DP-system) means the complete installation necessary for dynamically positioning a vessel comprising, but not limited to, the following sub-systems:

.1 power system,
.2 thruster system, and
.3 DP-control system.

1.3.3 Position keeping means maintaining a desired position and heading or track within the normal excursions of the control system and the defined environmental conditions.

1.3.4 Power system means all components and systems necessary to supply the DP-system with power. The power system includes:

.1 prime movers with necessary auxiliary systems including piping, fuel and cooling systems,
.2 generators,
.3 switchboards, and
.4 ~~distributing~~distribution system (cabling and cable routeing).

1.3.5 Thruster system means all components and systems necessary to supply the DP-system with thrust force and direction. The thruster system includes:

.1 thrusters with drive units and necessary auxiliary systems including piping and cooling systems,
.2 main propellers and rudders if these are under the control of the DP-system,
.3 thruster control ~~electronics~~system,
.4 manual thruster controls, and
.5 associated cabling and cable routeing.

1.3.6 DP-control system means all control components and systems, hardware and software necessary to dynamically position the vessel. The DP-control system consists of the following:

.1 computer system/joystick system,
.2 sensor ~~system~~systems,
.3 control stations and display system (operator panels),
.4 position reference ~~system~~systems, ~~and~~
.5 associated cabling and cable routeing,
.6 power supplies, including generators, switchboards and uninterruptible power supplies (UPS), and
.7 cooling systems (including air conditioning units).

1.3.7 Computer system means a system consisting of one or several computers including software and their interfaces.

1.3.8 Redundancy means the ability of a component or system to ~~mantain~~maintain or restore its function, without interruption of that function, when a single failure has occurred. Redundancy can be achieved for instance by installation of multiple components, systems or alternative means of performing a function.

1.3.9 [Certification][Flag State Verification and Acceptance Document (FSVAD)] means the document issued by the Administration or Recognized Organization to a DP-vessel complying with these guidelines. (See Appendix for model form.)

1.3.10 Failure Modes and Effects Analysis (FMEA) means a procedure by which potential failure modes are analysed to determine the results and effects.

1.3.11 Activity Specific Operating Guidelines (ASOG) means the operational, environmental and equipment performance limits for the location and specific activity.

1.3.12 Power Management System means a system that ensures continuity of electrical supply under all operating conditions.

1.3.13 Worst Case Failure Design Intent means the minimum amount of propulsion and control equipment remaining operational following the worst case failure.

1.3.14 Undesired thrust means the thrust generated due to a fault within the DP system, or component of the system, resulting in a potential loss of position or heading.

1.4 Exemptions

An Administration may exempt any vessel which embodies features of a novel kind from any provisions of ~~the~~these guidelines the application of which might impede research into the

development of such features. Any such vessels should, however, comply with safety requirements which, in the opinion of the Administration, are adequate for the service intended and are such as to ensure the overall safety of the vessel.

The Administration which allows any such exemptions should list the exemptions on the [certification][Flag State Verification and Acceptance Document (FSVAD)] and communicate to the Organization the particulars, together with the reason therefor, so that the Organization may circulate the same to other Governments for the information of their officers.

1.5 Equivalents

1.5.1 Where the guidelines require that a particular fitting, material, appliance, apparatus, item of equipment or type thereof should be fitted or carried out in a vessel, or that any particular provision should be made, or any procedure or arrangement should be complied with, the Administration may allow other fitting, material, appliance, apparatus, item of equipment or type thereof to be fitted or carried, or any other provision, procedure or arrangement to be made in that vessel, if it is satisfied by trial thereof or otherwise that such fitting, material, appliance, apparatus, item of equipment or type thereof or that any particular provision, procedure or arrangement is at least as effective as that required by the guidelines.

1.5.2 When an Administration so allows any fitting, material, appliance, apparatus, item of equipment or type thereof, or provision, procedure, arrangement, novel design or application to be substituted, it should communicate to the Organization the particulars thereof, together with a report on the evidence submitted, so that the Organization may circulate the same to other Governments for information of their officers.

2 EQUIPMENT CLASSES

2.1 A DP-system consists of components and systems acting together to achieve sufficiently reliable position keeping capability. The necessary reliability is determined by the consequence of a loss of position keeping capability. The larger the consequence, the more reliable the DP-system should be.

To achieve this philosophy the requirements have been grouped into [three]/[four] equipment classes. For each equipment class the associated worst case failure should be defined as in 2.2 below.

The equipment class of the vessel required for a particular operation should be agreed between the owner of the vessel and the customer based on a risk analysis of the consequence of a loss of position or heading. Else, the Administration or coastal State may decide the equipment class for the particular operation.

2.2 The equipment classes are defined by their worst case failure modes as follows:

[.1 For equipment class 0, loss of position or heading may occur in the event of any fault.]

~~.1~~.2 For equipment class 1, loss of position or heading may occur in the event of a single fault. However, such a fault should not result in undesired thrust.

~~.2~~.3 For equipment class 2, a loss of position or heading is not to occur in the event of a single fault in any active component or system. Normally static components will not be considered to fail where adequate protection from damage is demonstrated, and reliability is to the satisfaction of the Administration. Single failure criteria include:

.1 Any active component or system (generators, thrusters, switchboards, communication networks, remote controlled valves, etc.).

.2 Any normally static component (cables, pipes, manual valves, etc.) which is not properly documented with respect to protection and reliability.

~~.3~~.4 For equipment class 3, a loss of position or heading is not to occur in the event of a single failure. A~~a~~ single failure includes:

.1 Items listed above for class 2, and any normally static component is assumed to fail.

.2 All components in any one watertight compartment, from fire or flooding.

.3 All components in any one fire sub-division, from fire or flooding (for cables, see also 3.5.1).

2.3 For equipment classes 2 and 3, a single inadvertent act should be considered as a single fault if such an act is reasonably probable.

2.4 Based on the single failure definitions in 2.2 the worst case failure should be determined and used as the criterion for the consequence analysis (see 3.4.2.4).

2.5 The Administration should assign the relevant equipment class to a DP-vessel based on the criteria in 2.2 and state it in the [certification][Flag State Verification and Acceptance Document (FSVAD)] (see 5.2).

2.6 When a DP-vessel is assigned an equipment class this means that the DP-vessel is suitable for all types of DP-operations within the assigned and lower equipment classes.

2.7 It is a provision of the guidelines that the DP-vessel is operated in such a way that the worst case failure, as determined in 2.2, can occur at any time without causing a ~~significant~~ loss of position or heading for equipment class 2 and 3.

2.8 For an [equipment class 0 or]equipment class 1 vessel, except in the event of a blackout, a failure should not disable the vessel so that it is unable to move away to a safe position, nor should it produce undesired thrust.

3 FUNCTIONAL REQUIREMENTS

3.1 General

3.1.1 In so far as is practicable all components in a DP-system should be designed, constructed and tested in accordance with international standards recognized by the Administration.

3.1.2 If external forces from systems such as cable lay, pipelay and moorings are measured, these may be used within the DP system for positioning.

~~3.1.2~~ 3.1.3 In order to meet the single failure criteria given in 2.2, redundancy of components will normally be necessary as follows:

.1 for equipment class 2, redundancy of all active components;

.2 for equipment class 3, redundancy of all components and physical separation of the components.

~~3.1.3~~ 3.1.4 [For equipment class 3, full redundancy may not always be possible (e.g. there may be a need for a single changeover system from the main computer system to the backup computer system). Non-redundant connections between otherwise redundant and separated systems may be accepted provided it is documented to give clear safety advantages, and that their reliability can be demonstrated and documented to the satisfaction of the Administration. Such connections should be kept to the absolute minimum and made to fail to the safest condition. Failure in one system should in no case be transferred to the other redundant system.]

~~3.1.4~~ 3.1.5 Redundant components and systems should be immediately available without manual intervention from the operators and with such capacity that the DP-operation can be continued for such a period that the work in progress can be terminated safely. ~~The transfer to redundant component or system should be automatic as far as possible, and operator intervention should be kept to a minimum.~~ The transfer of position control should be smooth and within acceptable limitations of the DP operation(s) for which the vessel is designed.

~~3.1.5~~ 3.1.6 For equipment classes 2 and 3, consideration should be given to hidden failure monitoring on all devices that provide redundancy.

3.2 Power system

3.2.1 The power system should have an adequate response time to power demand changes.

3.2.2 For equipment class[es 0 and]1 the power system need not be redundant but on restoration of main power the vessel should be able to manoeuvre without restoration of the DP control system.

3.2.3 For equipment class 2, the power system should be divisible into two or more systems such that in the event of failure of one system at least one other system will remain in operation. The power system may be run as one system during operation, but should be arranged by bus-tie breakers to separate the systems automatically upon failures which could be transferred from one system to another, including overloading and short circuits.

3.2.4 For equipment class 3, the power system should be divisible into two or more systems such that in the event of failure of one system, at least one other system will remain in operation. The divided power system should be located in different spaces separated by A.60 class division. Where the power systems are located below the operational waterline, the separation should also be watertight. Bus-tie breakers should be open during equipment class 3 operations unless equivalent integrity of power operation can be accepted according to ~~3.1.3~~3.1.4.

3.2.5 For equipment classes 2 and 3, the power available for position keeping should be sufficient to maintain the vessel in position after worst case failure according to 2.2.

3.2.6 If a power management system is installed, ~~adequate~~ it should have redundancy ~~or~~and reliability to the satisfaction of the Administration ~~should~~ that can be demonstrated during trials.

3.3 Thruster system

3.3.1 Each thruster on a DP vessel should be capable of being individually remotely controlled independently of the DP control system.

~~3.3.1~~ 3.3.2 The thruster system should provide adequate thrust in longitudinal and lateral directions, and provide yawing moment for heading control.

~~3.3.2~~ 3.3.3 For equipment classes 2 and 3, the thruster system should be connected to the power system in such a way that ~~3.3.1~~3.3.2 can be complied with even after failure of one of the constituent power systems and the thrusters connected to that system.

~~3.3.3~~ 3.3.4 The values of thruster force used in the consequence analysis (see 3.4.2.4) should be corrected for interference between thrusters and other effects which would reduce the effective force.

~~3.3.4~~3.3.5 Failure of a thruster system including pitch, azimuth or speed control, should fail safe and not make the thruster ~~rotate or~~ go to an uncontrolled full pitch and/or speed or cause the thruster to impose an undesirable force.

3.4 DP-control system

3.4.1 General

.1 In general, the DP-control system should be arranged in a DP-control station where the operator has a good view of the vessel's exterior limits and the surrounding area.

.2 The DP-control station should display information from the power system, thruster system and DP-control system to ensure that these systems are functioning correctly. Information necessary to operate the DP-system safely should be visible at all times. Other information should be available upon operator request.

.3 Display systems and the DP-control station in particular should be based on sound ~~ergonometric~~ ergonomic principles which promote proper operation of the system. The DP-control system should provide for easy selection of the control mode, i.e. manual, joystick, or ~~computer~~ automatic DP control of thrusters, propellers and rudders:~~, and~~ the active mode should always be clearly displayed.

.4 For equipment classes 2 and 3, operator controls should be designed so that no single inadvertent act on the operator's panel can lead to a ~~critical condition~~ loss of position or heading.

.5 Alarms and warnings for failures in all systems interfaced to and/or controlled by the DP-control system are to be audible and visual. A permanent record of their occurrence and of status changes should be provided together with any necessary explanations.

.6 The DP-control system should prevent failures being transferred from one system to another. The redundant components should be so arranged that ~~a failure of one component should be isolated, and the other component activated~~ any failed component, or components, may be easily isolated so that the other component, or components, can take over smoothly with no loss of position or heading.

.7 It should be possible to control the thrusters manually, by individual joysticks and by a common joystick, in the event of failure of the DP-control system. If an independent joystick is provided with sensor inputs, these should not fail upon failure of the DP system.

.8 The software should be produced and verified in accordance with an appropriate international quality standard recognized by the Administration.

3.4.2 Computers

.1 For equipment class[es 0 and] 1, the DP-control system need not be redundant.

.2 For equipment class 2, the DP-control system should consist of at least two independent computer systems. Common facilities such as self-checking routines, data transfer arrangements and plant interfaces should not be capable of causing the failure of both/all systems.

.3 For equipment class 3, the DP-control system should consist of at least two independent computer systems with self-checking and alignment facilities. Common facilities such as self-checking routines, data transfer arrangements and plant interfaces should not be capable of causing failure at both/all systems. The two or more independent computer systems mentioned do not include the backup computer system; thus, in~~In~~ addition, one backup DP control system should be arranged, see 3.4.2.6. An alarm should be initiated if any computer fails or is not ready to take control.

.4 For equipment classes 2 and 3, the DP-control system should include a software function, normally known as 'consequence analysis', which continuously verifies that the vessel will remain in position even if the worst case failure occurs. This analysis should verify that the thrusters, propellers and rudders remaining in operation after the worst case failure can generate the same resultant thruster force and moment as required before the failure. The consequence analysis should provide an alarm if the occurrence of a worst case failure would lead to a loss of position or heading due to insufficient thrust for the prevailing environmental conditions. For operations which will take a long time to safely terminate, the consequence analysis should include a function which simulates the thrust and power remaining after the ~~worse~~ worst case failure, based on manual input of the weather ~~trend~~ conditions.

.5 Redundant computer systems should be arranged with automatic transfer of control after a detected failure in one of the computer systems. The automatic transfer of control from one computer system to another should be smooth~~, and within the acceptable limitations of the operation~~; with no loss of position or heading.

.6 For equipment class 3, the backup DP-control system should be in a room separated by A.60 class division from the main DP-control station. During DP-operation this backup control system should be continuously updated by input from the sensors, position reference system, thruster feedback, etc., and be ready to take over control. The switchover of control to the backup system should be manual~~,~~ from a switch situated on the backup computer ~~and~~ that should not be affected by any failure of the main DP-control system. Interfaced input/output signals from and to the backup DP-control should be independent of the main DP-system.

.7 For equipment classes 2 and 3, ~~An~~an uninterruptable power supply (UPS) should be provided for each DP-computer system to ensure that any power failure will not affect more than one computer. UPS battery capacity should provide a minimum of 30 minutes operation following a mains supply failure.

.8 An uninterruptable power supply should be considered for other components and systems within the DP system, such as position reference systems and other sensors.

.9 Consideration should be given to isolating each DP computer from other onboard computer systems and communications systems. This isolation may be effected via hardware or software systems to ensure the integrity of the DP system software and the command interface appliances.

3.4.3 Position reference system

.1 Position reference systems should be selected with due consideration to operational requirements, both with regard to restrictions caused by the manner of deployment and expected performance in working situation.

.2 For equipment classes 2 and 3, at least three independent position reference systems should be installed and simultaneously available to the DP-control system during operation.

.3 When two or more position reference systems are required, they should not all be of the same type, but based on different principles and suitable for the operating conditions.

.4 The position reference systems should produce data with adequate accuracy for the intended DP-operation.

.5 The performance of position reference systems should be monitored and warnings provided when the signals from the position reference systems are either incorrect or substantially degraded.

.6 For equipment class 3, at least one of the position reference systems should be connected directly to the backup control system and separated by A.60 class division from the other position reference systems.

3.4.4 Vessel sensors

.1 Vessel sensors should at least measure vessel heading, vessel motions and wind speed and direction.

.2 ~~When~~As an equipment class 2 or 3 DP-control system is fully dependent on correct signals from vessel sensors, ~~then~~ these signals should be based on three systems serving the same purpose (~~i.e.~~e.g. this will result in at least three ~~gyro compasses~~ heading reference sensors being installed).

.3 Sensors for the same purpose, connected to redundant systems should be arranged independently so that failure of one will not affect the others.

.4 For equipment class 3, one of each type of ~~sensors~~sensor should be connected directly to the backup DP control system~~ and~~, separated by A.60 class division from the other sensors with galvanic isolation if also used by the main DP control system. This should include power supplies and internal cable routeing.

3.5 Cables and piping systems

3.5.1 For equipment class 3, cables for redundant equipment or systems should not be routed together through the same compartments. Where this is unavoidable such cables could run together in cable ducts of A-60 class, the termination of the ducts included, which are effectively protected from all fire hazards, except that represented by the cables themselves. Cable connection boxes are not allowed in such ducts.

3.5.2 For equipment class 2, piping systems for fuel, lubrication, hydraulic oil, cooling water and cables should be located with due regard to fire hazards and mechanical damage.

3.5.3 For equipment class 3, redundant piping ~~system~~systems (i.e. piping for fuel, cooling water, lubrication oil, hydraulic oil, etc.) should not be routed together through the same compartments. Where this is unavoidable, such pipes could run together in ducts of A-60 class, the termination of the ducts included, which are effectively protected from all fire hazards, except that represented by the pipes themselves.

[3.5.4 The Administration may waive the requirements of 3.5.1 and 3.5.3 if alternative fire and flood detection systems are installed that can adequately protect the power system integrity by disconnecting individual power supplies. However, these should not reduce the vessel below its worst case failure design intent.]

3.6 Requirements for essential non-DP systems

For equipment classes 2 and 3, systems not directly part of the DP-system but which in the event of failure could cause failure of the DP-system~~,~~ (e.g. common fire ~~supression~~suppression systems, ~~engine ventilation~~ heating, ventilation and air conditioning (HVAC) systems, safety shutdown systems, etc.) should also comply with relevant requirements of these guidelines.

4 OPERATIONAL REQUIREMENTS

4.1 Before every DP-operation, the DP-system should be checked according to a vessel specific ~~"location"~~location check list to make sure that the DP-system is functioning correctly and that the system has been set up for the appropriate equipment class.

4.2 During DP-operations, the system should be checked at regular intervals according to a vessel specific watchkeeping checklist.

4.3 DP operations necessitating equipment class 2 or 3 should be terminated when the environmental conditions are such that the DP-vessel will no longer be able to keep position if the single failure criterion applicable to the equipment class should occur. In this context deterioration of environmental conditions and the necessary time to safely terminate the operation should also be taken into consideration. This should be checked by way of environmental envelopes if operating in equipment class 1 and by way of an automatic consequence analysis if operating in equipment class 2 or 3. The necessary operating instructions~~, etc.,~~ should be on board.

4.4 The following checklists, test procedures, trials and instructions should be incorporated into the vessel specific DP ~~operating~~ operations manuals ~~for the vessel~~:

.1 Location checklist (see 4.1).

.2 Watchkeeping checklist (see 4.2).

.3 DP-operating instructions (see 4.3).

.4 Annual tests and procedures (see 5.1.1.3).

.5 Initial and periodical (5-year) tests and procedures (see 5.1.1.1 and 5.1.1.2).

.6 Example of tests and procedures after modifications and non-conformities (see 5.1.1.4).

4.5 Other checklists contained in industry guidance, such as Activity Specific Operating Guidelines (ASOG), should be made available.

5 SURVEYS, TESTING AND [CERTIFICATION][THE FLAG STATE VERIFICATION AND ACCEPTANCE DOCUMENT (FSVAD)]

5.1 Surveys, ~~and~~ testing and analysis

5.1.1 Each DP-vessel which is required to comply with the guidelines is subject to the surveys and testing specified below:

.1 An i~~I~~nitial survey which should include a complete survey of the DP-system to ensure full compliance with the applicable parts of the guidelines. Further it should include~~s~~ 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 [certification] [Flag State Verification and Acceptance Document (FSVAD)], see 5.2.

.2 Periodical ~~survey~~testing 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 [certification][FSVAD], see 5.2.

.3 Annual ~~survey~~testing should be carried out within three months before or after each anniversary date of the initial survey or, where an FMEA is produced, the anniversary date of the FMEA proving trials, see 5.1.2 . The annual ~~survey~~testing 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~~ The 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 [certification][FSVAD], see 5.2.

.4 A survey either general or partial according to circumstances should be made 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 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. The type of tests carried out and results should be recorded and kept on board.

5.1.2 For equipment classes 2 and 3, a Failure Modes and Effects Analysis (FMEA) should be produced. 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 should be updated so that it remains current.

~~5.1.2~~ 5.1.3 These surveys and tests should be witnessed by officers of the Administration. The Administration may, however, entrust the surveys and testing either to surveyors nominated for the purpose or to organizations recognized by it. In every case the Administration concerned should ~~fully~~ guarantee the completeness and efficiency of the surveys and testing. The Administration may entrust the owner of the vessel to carry out annual and minor repair surveys according to a test programme accepted by the Administration.

~~5.1.3~~ 5.1.4 After any survey and testing has been completed, no significant change should be made to the DP-system without the sanction of the Administration, except the direct replacement of equipment and fittings for the purpose of repair or maintenance.

5.2 [Certification] [Flag State Verification and Acceptance Document (FSVAD)]

[5.2.1 Compliance with the guidelines will be documented by a Flag State Verification and Acceptance Document (FSVAD) or alternative certification issued by or on behalf of the Administration. Where alternative certification is issued, this would be on the basis of a Failure Modes and Effects Analysis (FMEA) together with proving trials documents for the dynamic positioning system. However, where the Administration does not issue an FSVAD, but deems that an FMEA is not required for the vessel, compliance with the guidelines will be documented by means of equipment class certificate.]

~~5.2.1~~5.2.2 [A Flag State Verification and Acceptance Document (FSVAD)][Certification] should be issued, after survey and testing in accordance with these guidelines, either by officers of the Administration or by an organization duly authorized by it. ~~In every case the Administration assumes full responsibility for the FSVAD.~~

~~5.2.2~~ 5.2.3 The [Certification][FSVAD] should be drawn up in the official language of the issuing country and ~~be~~ reflect that of the model given in the appendix to the guidelines. If the language used is neither English nor French, the text should include a translation into one of these languages.

~~5.2.3~~ 5.2.4 The [Certification][FSVAD] is issued for an unlimited period, or for a period specified by the Administration.

~~5.2.4~~ 5.2.5 [The Certification][An FSVAD] should cease to be valid if significant alterations have been made in the DP-system equipment, fittings, arrangements, etc., specified in the guidelines without the sanction of the Administration, except the direct replacement of such equipment or fittings for the purpose of repair or maintenance.

~~5.2.5~~ 5.2.6 [The Certification][An FSVAD] issued to a DP-vessel should cease to be valid upon transfer of such a vessel to the flag of another country.

~~5.2.6~~ 5.2.7 The privileges of the [Certification][FSVAD] may not be claimed in favour of any DP-vessel unless the [Certification][FSVAD] is valid.

~~5.2.7~~ 5.2.8 Control of a DP-vessel holding a valid [Certification][FSVAD] should be carried out according to the principles of 1.7 in the MODU Code ~~1989~~2009.

~~5.2.8~~ 5.2.9 Results of the [Certification][FSVAD] tests should be readily available on board for reference.

APPENDIX

Model Form of [Flag state Verification and Acceptance Document][Certification]

FLAG STATE VERIFICATION AND ACCEPTANCE DOCUMENT / CERTIFICATION

(Official seal) *(State)*

Issued under the provisions of the

GUIDELINES FOR VESSELS WITH
DYNAMIC POSITIONING SYSTEMS
(MSC/Circ.~~645~~-XXX)

under the authority of the Government of

_____
(full designation of the State)

by _____
(full official designation of the competent person or organization authorized by the Administration)

Distinctive identification (Name or number)	Type	Port of registry	Official IMO-number

Date on which keel was laid or vessel was at similar stage of construction or on which major conversion was commenced .....

THIS IS TO CERTIFY that the above-mentioned vessel has been duly documented, surveyed and tested in accordance with the Guidelines for Vessels with Dynamic Positioning Systems (MSC/Circ.~~645~~XXX) and found to comply with the guidelines.

The vessel is allowed to operate in DP Equipment Class .....
and in lower equipment classes.

This document remains valid until .....
unless terminated by the Administration, provided that the vessel is operated, tested and surveyed according to the requirements in the guidelines and the results are properly recorded.

Issued at .....
(Place of issue of document)

…….. ……..
(Date of issue) *(Signature of authorized official issuing the certificate)*

…….
(Seal or stamp of the issuing authority, as appropriate)

LIST OF EXEMPTIONS AND EQUIVALENTS

(ref. items 1.4 and 1.5 of the guidelines

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LIST OF MAIN SYSTEMS AND COMPONENTS COVERED BY FSVAD*

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* [All main systems and components included in the dynamic positioning system are to be listed in a systematic way. As an alternative reference can be made to drawings, etc. It is important that it is possible by this list to identify all systems and components covered by FSVAD. Software versions should also be identified. Equipment installed after date of issuing FSVAD should only be included in the list after control and testing has been completed and modifications and non-conformities report signed.]

Record of annual survey reports, and special (5 years) survey reports

Date	Test type	Remarks	Report Reference Date/Number *	Sign. of appointed surveyor (IR)	Sign. of Master/ Platform Manager

* [All reports should be filed together with this FSVAD for use during later testing and inspections by nominated surveyors, flag State surveyors, etc.]

IR = if required, ref. item ~~5.1.2~~5.1.3