Tasneef
هيئة الإمارات للتصنيف
Emirates Classification Society

Rules for the Classification of Floating Offshore Units at Fixed Locations and Mobile Offshore Drilling Units

Effective from 1 January 2024

Part F

Additional Class Notations

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GENERAL CONDITIONS

Definitions:

"*Administration*" means the Government of the State whose flag the Ship is entitled to fly or under whose authority the Ship is authorised to operate in the specific case.

"IACS" means the International Association of Classification Societies.

"*Interested Party*" means the party, other than the Society, having an interest in or responsibility for the Ship, product, plant or system subject to classification or certification (such as the owner of the Ship and his representatives, the ship builder, the engine builder or the supplier of parts to be tested) who requests the Services or on whose behalf the Services are requested.

"*Owner*" means the registered owner, the ship owner, the manager or any other party with the responsibility, legally or contractually, to keep the ship seaworthy or in service, having particular regard to the provisions relating to the maintenance of class laid down in Part A, Chapter 2 of the Rules for the Classification of Ships or in the corresponding rules indicated in the specific Rules.

"Rules" in these General Conditions means the documents below issued by the Society:

(i) Rules for the Classification of Ships or other special units;
(ii) Complementary Rules containing the requirements for product, plant, system and other certification or containing the requirements for the assignment of additional class notations;
(iii) Rules for the application of statutory rules, containing the rules to perform the duties delegated by Administrations;
(iv) Guides to carry out particular activities connected with Services;
(v) Any other technical document, as for example rule variations or interpretations.

"*Services*" means the activities described in Article 1 below, rendered by the Society upon request made by or on behalf of the Interested Party.

"Ship" means ships, boats, craft and other special units, as for example offshore structures, floating units and underwater craft.

"*Society*" or *"TASNEEF"* means Tasneef and/or all the companies in the Tasneef Group which provide the Services.

"*Surveyor*" means technical staff acting on behalf of the Society in performing the Services.

Article 1

1.1. The purpose of the Society is, among others, the classification and certification of ships and the certification of their parts and components. In particular, the Society:
(i) sets forth and develops Rules;
(ii) publishes the Register of Ships;
(iii) issues certificates, statements and reports based on its survey activities.

1.2. The Society also takes part in the implementation of national and international rules and standards as delegated by various G overnments.

1.3. The Society carries out technical assistance activities on request and provides special services outside the scope of classification, which are regulated by these general conditions, unless expressly excluded in the particular contract.

Article 2

2.1. The Rules developed by the Society reflect the level of its technical knowledge at the time they are published. Therefore, the Society, although committed also through its research and development services to continuous updating of the Rules, does not guarantee the Rules meet state-of-the-art science and technology at the time of publication or that they meet the Society's or others' subsequent technical developments.

2.2. The Interested Party is required to know the Rules on the basis of which the Services are provided. With particular reference to Classification Services, special attention is to be given to the Rules concerning class suspension, withdrawal and reinstatemen t. In case of doubt or inaccuracy, the Interested Party is to promptly contact the Society for clarification.
The Rules for Classification of Ships are published on the Society's website: www.tasneef.ae.

2.3. The Society exercises due care and skill:
(i) in the selection of its Surveyors
(ii) in the performance of its Services, taking into account the level of its technical knowledge at the time the Services are performed.

2.4. Surveys conducted by the Society include, but are not limited to, visual inspection and non-destructive testing. Unless otherwise required, surveys are conducted through sampling techniques and do not consist of comprehensive verification or monitoring of the Ship or of the items subject to certification. The surveys and checks made by the Society on board ship do not necessarily require the constant and continuous presence of the Surveyor. The Society may also commission laboratory testing, underwater inspection and other checks carried out by and under the responsibility of qualified service suppliers. Survey practices and procedures are selected by the Society based on its experience and knowledge and according to generally accepted technical standards in the sector.

Article 3

3.1. The class assigned to a Ship, like the reports, statements, certificates or any other document or information issued by the Society, reflects the opinion of the Society concerning compliance, at the time the Service is provided, of the Ship or product subject to certification, with the applicable Rules (given the intended use and within the relevant time frame).
The Society is under no obligation to make statements or provide information about elements or facts which are not part of th e specific scope of the Service requested by the Interested Party or on its behalf.

3.2. No report, statement, notation on a plan, review, Certificate of Classification, document or information issued or given as p art of the Services provided by the Society shall have any legal effect or implication other than a representation that, on the basis of the checks made by the Society, the Ship, structure, materials, equipment, machinery or any other item covered by such document or information meet the Rules. Any such document is issued solely for the use of the Society, its committees and clients or other duly authorised bodies and for no other purpose. Therefore, the Society cannot be held liable for any act made or document issued by other parties on the basis of the statements or information given by the Society. The validity, application, meaning and interpretation of a Certificate of Classification, or any other document or information issued by the Society in connection with its Services, is governed by the Rules of the Society, which is the sole subject entitled to make such interpretation. Any disagreement on technical matters between the Interested Party and the Surveyor in the carrying out of his functions shall be raised in writing as soon as possible with the Society, which will settle any divergence of opinion or dispute.

3.3. The classification of a Ship, or the issuance of a certificate or other document connected with classification or certificati on and in general with the performance of Services by the Society shall have the validity conferred upon it by the Rules of the Society at the time of the assignment of class or issuance of the certificate; in no case shall it amount to a statement or warranty of seaw orthiness,

structural integrity, quality or fitness for a particular purpose or service of any Ship, structur e, material, equipment or machinery inspected or tested by the Society.

3.4. Any document issued by the Society in relation to its activities reflects the condition of the Ship or the subject of certifi cation or other activity at the time of the check.

3.5. The Rules, surveys and activities performed by the Society, reports, certificates and other documents issued by the Society are in no way intended to replace the duties and responsibilities of other parties such as Governments, designers, ship builders, manufacturers, repairers, suppliers, contractors or sub-contractors, Owners, operators, charterers, underwriters, sellers or intended buyers of a Ship or other product or system surveyed.

These documents and activities do not relieve such parties from any fulfilment, warranty, responsibility, duty or obligation (also of a contractual nature) expressed or implied or in any case incumbent on them, nor do they confer on such parties any right, claim or cause of action against the Society. With particular regard to the duties of the ship Owner, the Services undertaken by the Society do not relieve the Owner of his duty to ensure proper maintenance of the Ship and ensure seaworthiness at all times. Likewise, t he Rules, surveys performed, reports, certificates and other documents issued by the Society are intended neither to guarantee the buyers of the Ship, its components or any other surveyed or certified item, nor to relieve the seller of the duties arising out of the law or the contract, regarding the quality, commercial value or characteristics of the item which is the subject of transaction.

In no case, therefore, shall the Society assume the obligations incumbent upon the above-mentioned parties, even when it is consulted in connection with matters not covered by its Rules or other documents.

In consideration of the above, the Interested Party undertakes to relieve and hold harmless the Society from any third party claim, as well as from any liability in relation to the latter concerning the Services rendered.

Insofar as they are not expressly provided for in these General Conditions, the duties and responsibilities of the Owner and Interested Parties with respect to the services rendered by the Society are described in the Rules applicable to the specific Service rendered.

Article 4

4.1. Any request for the Society's Services shall be submitted in writing and signed by or on behalf of the Interested Party. Such a request will be considered irrevocable as soon as received by the Society and shall entail acceptance by the applicant of all relevant requirements of the Rules, including these General Conditions. Upon acceptance of the written request by the Society, a contract between the Society and the Interested Party is entered into, which is regulated by the present General Conditions.

4.2. In consideration of the Services rendered by the Society, the Interested Party and the person requesting the service shall be jointly liable for the payment of the relevant fees, even if the service is not concluded for any cause not pertaining to the Society. In the latter case, the Society shall not be held liable for non-fulfilment or partial fulfilment of the Services requested. In the event of late payment, interest at the legal current rate increased by 1.5% may be demanded.

4.3. The contract for the classification of a Ship or for other Services may be terminated and any certificates revoked at the request of one of the parties, subject to at least 30 days' notice to be given in writing. Failure to pay, even in part, the fees due for Services carried out by the Society will entitle the Society to immediately terminate the contract and suspend the Services.

For every termination of the contract, the fees for the activities performed until the time of the termination shall be owed to the Society as well as the expenses incurred in view of activities already programmed; this is without prejudice to the right to compensation due to the Society as a consequence of the termination.

With particular reference to Ship classification and certification, unless decided otherwise by the Society, termination of the contract implies that the assignment of class to a Ship is withheld or, if already assigned, that it is suspended or withdrawn; any st atutory certificates issued by the Society will be withdrawn in those cases where provided for by agreements between the Society and the flag State.

Article 5

5.1. In providing the Services, as well as other correlated information or advice, the Society, its Surveyors, servants or agents operate with due diligence for the proper execution of the activity. However, considering the nature of the activities performed (see art. 2.4), it is not possible to guarantee absolute accuracy, correctness and completeness of any information or advice supplied. Express and implied warranties are specifically disclaimed.

Therefore, except as provided for in paragraph 5.2 below, and also in the case of activities carried out by delegation of Governments, neither the Society nor any of its Surveyors will be liable for any loss, damage or expense of whatever nature sustained by any person, in tort or in contract, derived from carrying out the Services.

5.2. Notwithstanding the provisions in paragraph 5.1 above, should any user of the Society's Services prove that he has suffered a loss or damage due to any negligent act or omission of the Society, its Surveyors, servants or agents, then the Society will pay compensation to such person for his proved loss, up to, but not exceeding, five times the amount of the fees charged for the specific services, information or opinions from which the loss or damage derives or, if no fee has been charged, a maximum of AED5,000 (Arab Emirates Dirhams Five Thousand only). Where the fees charged are related to a number of Services, the amount of the fees will be apportioned for the purpose of the calculation of the maximum compensation, by reference to the estimated time involved in the performance of the Service from which the damage or loss derives. Any liability for indirect or consequential loss, damage or expense is specifically excluded. In any case, irrespective of the amount of the fees charged, the maximum damages payable by the Society will not be more than AED5,000,000 (Arab Emirates Dirhams Five Millions only). Payment of compensation under this paragraph will not entail any admission of responsibility and/or liability by the Society and will be made without prejudice to the disclaimer clause contained in paragraph 5.1 above.

5.3. Any claim for loss or damage of whatever nature by virtue of the provisions set forth herein shall be made to the Society in writing, within the shorter of the following periods: (i) THREE (3) MONTHS from the date on which the Services were performed, or (ii) THREE (3) MONTHS from the date on which the damage was discovered. Failure to comply with the above deadline will constitute an absolute bar to the pursuit of such a claim against the Society.

Article 6

6.1. These General Conditions shall be governed by and construed in accordance with United Arab Emirates (UAE) law, and any dispute arising from or in connection with the Rules or with the Services of the Society, including any issues concerning responsibility, liability or limitations of liability of the Society, shall be determined in accordance with UAE law. The courts of the Dubai International Financial Centre (DIFC) shall have exclusive jurisdiction in relation to any claim or dispute which may arise out of or in connection with the Rules or with the Services of the Society.

6.2. However,

(i) In cases where neither the claim nor any counterclaim exceeds the sum of AED300,000 (Arab Emirates Dirhams Three Hundred Thousand) the dispute shall be referred to the jurisdiction of the DIFC Small Claims Tribunal; and

(ii) for disputes concerning non-payment of the fees and/or expenses due to the Society for services, the Society shall have the

right to submit any claim to the jurisdiction of the Courts of the place where the registered or operating office of the Interested Party or of the applicant who requested the Service is located.

In the case of actions taken against the Society by a third party before a public Court, the Society shall also have the right to summon the Interested Party or the subject who requested the Service before that Court, in order to be relieved and held harmless according to art. 3.5 above.

Article 7

7.1. All plans, specifications, documents and information provided by, issued by, or made known to the Society, in connection with the performance of its Services, will be treated as confidential and will not be made available to any other party other than the Owner without authorisation of the Interested Party, except as provided for or required by any applicable international, European or domestic legislation, Charter or other IACS resolutions, or order from a competent authority. Information about the status and validity of class and statutory certificates, including transfers, changes, suspensions, withdrawals of class, recommendations/conditions of class, operating conditions or restrictions issued against classed ships and other related information, as may be required, may be published on the website or released by other means, without the prior consent of the Interested Party.

Information about the status and validity of other certificates and statements may also be published on the website or released by other means, without the prior consent of the Interested Party.

7.2. Notwithstanding the general duty of confidentiality owed by the Society to its clients in clause 7.1 above, the Society's clients hereby accept that the Society may participate in the IACS Early Warning System which requires each Classification Society to provide other involved Classification Societies with relevant technical information on serious hull structural and engineering systems failures, as defined in the IACS Early Warning System (but not including any drawings relating to the ship which may be the specific property of another party), to enable such useful information to be shared and used to facilitate the proper working of the IACS Early Warning System. The Society will provide its clients with written details of such information sent to the involved Classification Societies.

7.3. In the event of transfer of class, addition of a second class or withdrawal from a double/dual class, the Interested Party undertakes to provide or to permit the Society to provide the other Classification Society with all building plans and drawings, certificates, documents and information relevant to the classed unit, including its history file, as the other Classification Society may require for the purpose of classification in compliance with the applicable legislation and relative IACS Procedure. It is the Owner's duty to ensure that, whenever required, the consent of the builder is obtained with regard to the provision of plans and drawings to the new Society, either by way of appropriate stipulation in the building contract or by other agreement.

In the event that the ownership of the ship, product or system subject to certification is transferred to a new subject, the latter shall have the right to access all pertinent drawings, specifications, documents or information issued by the Society or which has come to the knowledge of the Society while carrying out its Services, even if related to a period prior to transfer of ownership.

Article 8

8.1. Should any part of these General Conditions be declared invalid, this will not affect the validity of the remaining provisions.

EXPLANATORY NOTE TO PART F

1. Reference edition

The reference edition of these Rules is the edition effective from 01 January 2015.

2. Effective date of the requirements

2.1 All requirements in which new or amended provisions with respect to those contained in the reference edition have been introduced are followed by a date shown in brackets.

The date shown in brackets is the effective date of entry into force of the requirements as amended by the last updating. The effective date of all those requirements not followed by any date shown in brackets is that of the reference edition.

2.2 Item 5 below provides a summary of the technical changes from the preceding edition. In general, this list does not include those items to which only editorial changes have been made not affecting the effective date of the requirements contained therein.

3. Rule Variations and Corrigenda

Until the next edition of the Rules is published, Rule Variations and/or corrigenda, as necessary, will be pub-lished on the Tasneef web site (www.Tasneef.ae). Except in particular cases, paper copies of Rule Variations or cor-rigenda are not issued.

4. Rule subdivision and cross-references

4.1 Rule subdivision

The Rules are subdivided into six parts, from A to F.

Part A: Classification and Surveys

Part B: Hull and Stability

Part C: Machinery, Systems and Fire Protection

Part D: Materials and Welding

Part E: Service Notations

Part F: Additional Class Notations

Each Part consists of:

- Chapters
- Sections and possible Appendices
- Articles
- Sub-articles
- Requirements

Figures (abbr. Fig) and Tables (abbr. Tab) are numbered in ascending order within each Section or Appendix.

5.2 Cross-references

Examples: Pt A, Ch 1, Sec 1, [3.2.1]or Pt A, Ch 1, App 1, [3.2.1]

- Pt A means Part A

The part is indicated when it is different from the part in which the cross-reference appears. Otherwise, it is not indicated.

- Ch 1 means Chapter 1

The Chapter is indicated when it is different from the chapter in which the cross-reference appears. Otherwise, it is not indicated.

- Sec 1 means Section 1 (or App 1 means Appendix 1)

The Section (or Appendix) is indicated when it is different from the Section (or Appendix) in which the cross-reference appears. Otherwise, it is not indicated.

- [3.2.1] refers to requirement 1, within sub-article 2 of article 3.

Cross-references to an entire Part or Chapter are not abbreviated as indicated in the following examples:

- Part A for a cross-reference to Part A
- Part A, Chapter 1 for a cross-reference to Chapter 1 of Part A.

5. Summary of amendments

Foreword

The date of entry into force of each new or amended item is shown in brackets after the number of the item concerned.

RULES FOR THE CLASSIFICATION OF FLOATING OFFSHORE UNITS AT FIXED LOCATIONS AND MOBILE OFFSHORE DRILLING UNITS

Part F
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Part F
Additional Class Notations

Chapter 1
PLANNED MAINTENANCE SCHEME AND CONDITION BASED MAINTENANCE (PMS/CBM)

SECTION 1 PLANNED MAINTENANCE SCHEME (PMS) AND CONDITION BASED MAINTENANCE (CBM)

SECTION 1 PLANNED MAINTENANCE SCHEME (PMS) AND CONDITION BASED MAINTENANCE (CBM)

1 General

1.1 Application

1.1.1 *(1/1/2022)*

The additional class notation PMS is assigned in accordance with Pt A, Ch 1, Sec 2, [6.9.2] to units with an approved Planned Maintenance Scheme complying with the requirements of this Section.

1.1.2 A Planned Maintenance Scheme (hereafter referred to as PMS) is a survey system for machinery items which may be considered as an alternative to the Continuous Machinery Survey system (hereafter referred to as CMS), as described in Pt A, Ch 2, Sec 2, [4.3].

1.1.3 Surveys are to be carried out on the basis of intervals between overhauls recommended by Manufacturers, documented operator's experience and a condition monitoring system, where fitted.

1.1.4 This scheme is limited to components and systems covered by CMS.

1.1.5 Any items not covered by the PMS are to be surveyed and credited in the usual way.

1.1.6 This survey scheme is to be approved by the Society before being implemented.

1.1.7 When the PMS is applied, the scope and periodicity of the class renewal survey are tailored for each individual item of machinery and determined on the basis of recommended overhauls stipulated by the manufacturers, documented experience of the operators and, where applicable and fitted, condition based maintenance (CBM). For instance, within the scope of a PMS the following cases may occur:

- switchboard A is surveyed based on the regular expiry date of the class renewal survey
- lubricating oil pump B is surveyed based on CMS
- diesel engine C is surveyed based on running hours
- turbo pump D is surveyed based on CBM results.

1.2 Maintenance intervals

1.2.1 In general, the intervals for the PMS are not to exceed those specified for CMS. However, for components where the maintenance is based on running hours longer intervals may be accepted as long as the intervals are based on the Manufacturer's recommendations.

1.2.2 However, if an approved CBM is in effect, the machinery survey intervals based on the CMS cycle period may be extended.

1.2.3 When the CBM of machinery and components included in the approved PMS shows that their condition and performance are within the allowable limits, no overhaul is necessary, unless specified by the Manufacturer.

1.3 On board responsibility

1.3.1 On board the unit there is to be a person responsible for the management of the PMS for the purpose of which he is to possess the appropriate professional qualifications. This person is usually the Chief Engineer; however, another person designated by the Owner may be accepted by the Society provided that his qualifications are considered equivalent to those of the Chief Engineer.

The surveys of machinery items and components covered by the PMS may be carried out by personnel on board who have been issued a statement of authorisation, under the conditions and limits given in Pt A, Ch 2, App 1, [2].

Items surveyed by the authorised person will be subject to the confirmatory survey as detailed in Pt A, Ch 2, App 1, [5].

1.3.2 Documentation on overhauls of items covered by the PMS is to be recorded and signed by the person responsible for the management of the PMS.

1.3.3 Access to computerised systems for updating of the maintenance documentation and maintenance program is only to be permitted by the Chief Engineer or another authorized person.

2 Conditions and procedures for the approval of the system

2.1 General

2.1.1 The PMS is to be approved by the Society. To this end the Owner is to make a formal request to the Society and provide the documentation and information specified in [2.3], combined in a manual describing the proposed scheme and including sample copies of the different documents to be used during the implementation of the scheme.

2.2 System requirements

2.2.1 The PMS is to be programmed and maintained by a computerised system. However, this may not be applied to the current already approved schemes.

2.2.2 Computerised systems are to include back-up devices, which are to be updated at regular intervals.

2.3 Documentation and information

2.3.1 The documentation to be submitted is the manual mentioned above, which is to include:

a) a description of the scheme and its application on board, including documentation completion procedures, as well as the proposed organisation chart identifying the areas of responsibility and the people responsible for the PMS on board

b) the list of items of machinery and components to be considered for classification in the PMS, distinguishing for each the principle of survey periodicity used as indicated in [1.1.7]

c) the procedure for the identification of the items listed in b), which is to be compatible with the identification system adopted by the Society

d) the scope and time schedule of the maintenance procedures for each item listed in b), including acceptable limit conditions of the parameters to be monitored based on the manufacturers' recommendations or recognised standards and laid down in appropriate preventive maintenance sheets

e) the original baseline data, obtained on board, for machinery undergoing maintenance based on CBM

f) the list and specifications of the CBM equipment, including the maintenance and CBM methods to be used, the time intervals for maintenance and monitoring of each item and acceptable limit conditions

g) the baseline data of the machinery checked through CBM

h) the document flow and pertinent filing procedure.

2.3.2 As an alternative to the hard copy version of the manual, the Owner may grant the Society remote access to its computerised system (see [2.2.1]), which is to include the information requested in [2.3.1].

2.3.3 The following information is to be available on board:

a) all the documentation listed in [2.3.1], duly updated

b) the maintenance instructions for each item of machinery, as applicable (supplied by the manufacturer or by the shipyard)

c) the CBM data of the machinery, including all data since the last dismantling and the original reference data

d) reference documentation (trend investigation procedures etc.)

e) the records of maintenance performed, including conditions found, repairs carried out, spare parts fitted

f) the list of personnel on board in charge of the PMS management.

3 Implementation of the system and approval validity

3.1

3.1.1 When the documentation submitted has been approved, the additional class notation is issued.

3.1.2 An implementation survey is to be carried out to confirm the validity of the additional class notation (see [4.1.1]).

3.1.3 An annual report covering the year's service is to be reviewed by the Society. It is to include the following information:

- the list of items of machinery and components (item b) in [2.3.1]) and the procedure for their identification
- the preventive maintenance sheets
- the CBM data, including baseline data, all data since the last dismantling and the original reference data of the machinery checked through CBM
- any changes to the other documentation in [2.3.1]
- full trend analysis (including spectrum analysis for vibrations) of machinery displaying operating parameters exceeding acceptable tolerances. In such cases, the actions taken to restore the values of the parameters within the acceptable tolerances are also to be reported.

3.1.4 An annual survey is to be carried out to maintain the validity of the PMS (see [4.2]).

The issues listed in [3.1.3] may be examined in the annual survey.

3.1.5 The survey arrangement for machinery under the PMS can be cancelled by the Society if it is apparent that the PMS is not being satisfactorily carried out either from the maintenance records or the general condition of the machinery, or when the agreed intervals between overhauls are exceeded.

3.1.6 The case of sale or change of management of the unit or transfer of class is to cause the approval to be reconsidered.

3.1.7 The unit Owner may, at any time, cancel the survey arrangement for machinery under the PMS by informing the Society in writing and in this case the items which have been inspected under the PMS since the last annual survey can be credited for class at the discretion of the attending Surveyor.

4 Surveys

4.1 Implementation Survey

4.1.1 The Implementation Survey is to be carried out by the Society's Surveyor within one year from the date of approval.

4.1.2 The scope of this survey is to verify that:

- the PMS is implemented in accordance with the approved documentation and is suitable for the type

and complexity of the components and systems on board

- the documentation required for the annual survey is produced by the PMS
- the requirements of surveys and testing for retention of class are complied with
- the shipboard personnel are familiar with the PMS procedures and the CBM, if applied
- the CBM data, including baseline data and all data since the last dismantling of the machinery checked through CBM, are stored and managed correctly.

4.1.3 When this survey is carried out and the implementation is found in order, a report describing the system is to be submitted to the Society and the system may be put into service.

4.2 Annual Survey of the PMS

4.2.1 An annual survey of the PMS is to be carried out by a Surveyor of the Society and preferably concurrently with the annual survey of machinery.

4.2.2 The Surveyor is to review the annual report (or verify that it has been reviewed by the Society) and to check that any change to the approved PMS is submitted to the Society for agreement and approval, and that the personnel on board in charge of the PMS have the appropriate authorisation (see Pt A, Ch 2, App 1).

4.2.3 The purpose of this survey is to verify that the scheme is being correctly operated, in particular that all items (to be surveyed in the relevant period) have actually been surveyed in due time, and that the machinery has been functioning satisfactorily since the previous survey. A general examination of the items concerned is to be carried out.

4.2.4 The performance and maintenance records are to be examined to verify that the machinery has functioned satisfactorily since the previous survey or action has been taken in response to machinery operating parameters exceeding acceptable tolerances and that the overhaul intervals have been maintained.

4.2.5 Written details of breakdown or malfunction are to be made available.

4.2.6 Description of repairs carried out is to be examined. Any machinery part which has been replaced by a spare due to damage is to be retained on board, where possible, until examined by a Surveyor of the Society.

4.2.7 At the discretion of the Surveyor, function tests, confirmatory surveys and random check readings, where condition monitoring equipment is in use, are to be carried out as far as practicable and reasonable.

4.2.8 Upon the satisfactory outcome of this survey, the Surveyor confirms the validity of the PMS and decides which items can be credited for class.

5 Damage and repairs

5.1

5.1.1 Damage to components or items of machinery is to be reported to the Society. The repairs of such damaged components or items of machinery are to be carried out to the satisfaction of the Surveyor.

5.1.2 Any repair and corrective action regarding machinery under the PMS is to be recorded in the PMS logbook and repair verified by the Surveyor at the annual survey.

5.1.3 In the case of overdue outstanding recommendations or records of unrepaired damage which would affect the PMS, the relevant items are to be kept out of the PMS until the recommendations are fulfilled or the repairs carried out.

6 Machinery survey in accordance with a Condition Based Maintenance program

6.1 General on Condition Based Maintenance

6.1.1 Condition Based Maintenance (CBM) is the process of extracting prognostic information from machines to indicate their actual wear and degradation and the relevant rate of change (i.e. trend), on the basis of which the maintenance tasks can be adjusted flexibly in accordance to their actual status. The cost effectiveness of the CBM approach is related to the criticality of the monitored items, the reliability of the CBM techniques in providing valuable information and the ease of the interpretation of the results and their trends. In any case, especially for complex machine types, it cannot be expected that CBM can predict the failure mechanism of every component, and opening up will remain the only possible solution to check certain items.

The choice of the items to be included in the CBM program is up to the Owner.

The minimum parameters to be checked in order to monitor the conditions of the various machinery for which this type of maintenance is accepted are indicated in [6.3] and [6.4]. The frequency of the measurements can be increased according to the criticality of the equipment. In general, the CBM strategy and its extent, inclusive of the acceptability limits, are to be approved by the Manufacturer. CBM techniques not included in this Section may be accepted if they are proposed or established by the Manufacturer of a machine.

Guidance on CBM can be found in the Society "Guide for the Application of Condition Based Maintenance in the Planned Maintenance Scheme".

6.2 Roles and Responsibilities

6.2.1 Operator

At the time of the request for approval of the machinery Planned Maintenance Scheme, the Operator is to submit the CBM details as specified in [6.3] and [6.4], the techniques and the tools that will be employed; for onboard

instrumentation, the operating manual and user's guide supplied by the Manufacturer are to be part of the unit's maintenance documentation.

The strategy for the items subjected to CBM is to be computer based and a minimum number of readings is to be taken during the period between annual surveys. CBM does not absolve the machinery personnel of the responsibility to perform visual inspections of the items.

The reading points are to be clearly marked and identified by Memory Identification Card.

The documentation is also to include the responsibility chart of the dedicated human resources for CBM, which may be internal (i.e. shipboard or shoreside staff) or external (professional engineering companies), and the relevant qualifications.

The CBM strategy, inclusive of the description of the tools to be used, dedicated personnel, measurements to be taken etc, is to be an integral part of the PMS survey and is to be included in a dedicated section of the PMS manual.

6.2.2 Society

The Planned Maintenance Scheme will be reviewed for approval with particular reference to the CBM proposals. The Society reserves the right to require the baseline measurements for a period of at least six months, according to the age and condition of the unit's machinery.

The Society's Surveyors retain the right to test or open up the machinery, irrespective of the presence of CBM, if deemed necessary.

6.2.3 Chief Engineer

The presence of a CBM does not absolve the Chief Engineer from his duties, including the responsibility for interventions on machines according to his experience and judgment. The Chief Engineer is to ensure that the CBM parameters are recorded at the agreed intervals. This is to include an initial or "baseline" set of readings, against which further data can be compared.

6.2.4 Annual survey

The requirements for an annual survey of the machinery maintenance and monitoring records are the same as those given in [4.2]. At the annual survey the Chief Engineer is to make available the following maintenance and monitoring records, in addition to those specified in [4.2]:

- CBM records for each item to be credited for class. The records are to indicate where acceptable limits have been exceeded and what actions were taken.
- Calibration certificates for instrumentation used to take measurements, if applicable.

The responsibilities of the Society's Surveyors at the annual survey, additional to those described in [4.2], are:

a) to examine the machinery and monitoring records in sufficient depth to ensure that the scheme has been operated correctly and that the machinery has functioned satisfactorily since the previous survey.

b) to examine the CBM records to verify that the parameters lie within the specified limits (or, in the case of a malfunction in a machine, to check the readings taken just before the malfunction for information to be used in the preparation of the relevant Damage Report). Baseline condition data are to be compared with subsequent readings to ascertain the trend characteristics. The Society's Surveyors may require confirmatory readings on available running machinery to be taken for comparison with the unit's records.

c) to check the calibration certificates for CBM instrumentation and probe the crew's ability to manage CBM tools and records.

6.3 CBM criteria for main machinery

6.3.1 Diesel engines for propulsion, if any, and main electrical generation

Tab 1 lists the minimum checks to be carried out according to the engine service.

Table 1

Parameters to be monitored	Diesel engine (single or dual fuel) for direct main propulsion, if any		Diesel engine for electric power generation	
	Request	Minimum periodicity	Request	Minimum periodicity
Power output **(1)**	Yes	Weekly	Yes	Weekly
Running hours	Yes	Weekly	Yes	Weekly
Rotational speed	Yes	Weekly	Yes	Weekly

(1) To be read by a torquemeter or other equivalent instrument, or through the governor output, or by taking the position of the rack

(2) Reading points of turbocharger's rotational speed and bearing vibrations are to be identified according to the Manufacturer's instructions

Note 1: If the Owner opts to monitor the turbocharger(s) independently of the diesel engine, the following measures are to be taken on a weekly basis as a minimum:

- Exhaust gas temperature before/after turbocharger
- Charge air pressure at receiver
- Turbocharger rotational speed and vibration.

Reading points are to be identified according to the Manufacturer's instructions.

Parameters to be monitored	Diesel engine (single or dual fuel) for direct main propulsion, if any		Diesel engine for electric power generation	
	Request	Minimum periodicity	Request	Minimum periodicity
Indicated pressure diagram (where possible) or pressure-time curves	Yes	Weekly	Yes	Weekly
Fuel oil temperature and/or viscosity	Yes	Weekly	Yes	Weekly
Charge air pressure and temperature at receiver	Yes	Weekly	Yes	Weekly
Exhaust gas temperature for each cylinder	Yes	Weekly	No	-
Exhaust gas temperature before and after the turbochargers	Yes	Weekly	Yes	Weekly
Temperatures and pressure of engine cooling system	Yes	Weekly	Yes	Weekly
Temperatures and pressure of engine lube oil system	Yes	Weekly	Yes	Weekly
Rotational speed of turbochargers **(2)**	Yes	Weekly	Yes	Weekly
Bearing vibrations of turbochargers **(2)**	Yes	Monthly	Yes	Monthly
Results of lube oil analysis	Yes	3 months	Yes	6 months
Crankshaft deflection readings	Yes	6 months	Yes	6 months
Analysis of the fluid of crankshaft torsional vibration damper (if viscous type) according to maker's instructions	Yes	6 months or as per maker's instruction	Yes	6 months or as per maker's instruction
Temperature of main bearings and crankcase pressure	Yes	Weekly Where available	Yes	Weekly Where available
Fuel oil analysis (ISO 8217:2005)	Yes	At every bunkering	Yes	At every bunkering
Engine load (%)	No	-	Yes	Weekly
Alternator load (kW)	No	-	Yes	Weekly
Inspection of bedplate structure/ chocks / down bolts	Yes	6 months	Yes	6 months
Vibration of bearings of diesel generator and alternator	No	-	Yes	4 months

(1) To be read by a torquemeter or other equivalent instrument, or through the governor output, or by taking the position of the rack

(2) Reading points of turbocharger's rotational speed and bearing vibrations are to be identified according to the Manufacturer's instructions

Note 1: If the Owner opts to monitor the turbocharger(s) independently of the diesel engine, the following measures are to be taken on a weekly basis as a minimum:

- Exhaust gas temperature before/after turbocharger
- Charge air pressure at receiver
- Turbocharger rotational speed and vibration.

Reading points are to be identified according to the Manufacturer's instructions.

6.3.2 Emergency diesel generator

The parameters to be checked are the following:

- calibration and test of fuel nozzles
- measurement of compression of cylinders
- fuel oil filter cleaning
- lube oil analysis.

The measures are to be taken at five-year intervals as a minimum.

6.3.3 Electric propulsion motor with associated frequency converter

Tab 2 lists the minimum checks to be carried out.

Table 2

Method	Requirement
Performance Monitoring	Propulsion Motor: Continuous or periodical monthly monitoring of: • Supplying current on main switchboard (phases and windings) • Converter current (phases and windings) • Feeding transformer highest winding temperature • Motor highest winding temperature • Rotational speed • Encoder for rotor position check • Bearing temperature at drive end (D.E.) • Bearing temperature at non-drive end (N.D.E.) • Cooling air in temperature • Cooling air out temperature • Highest cubicle temperature • Converter heat exchanger temperatures • Motor D.E. and N.D.E. oil leakage detection Propulsion system insulation resistance: every 12 months
Vibration Monitoring	Periodical monitoring of motor bearings. No less than one per month
Lubricant Analysis	Regular sampling, laboratory testing. No less than one sampling every 6 months
Oil Transformer analysis	Regular sampling, laboratory testing. No less than one sampling every 6 months

6.3.4 Pods with associated frequency converter

Tab 3 lists the minimum checks to be carried out.

Table 3

Method	Requirement
Performance Monitoring	Propulsion Motor: Continuous or periodical monthly monitoring of: • Supplying current on main switchboard (phases & windings) • Converter current (phases & windings) • Feeding transformer highest winding temperature • Motor highest winding temperature • Rotational speed • Encoder for rotor position checking, including gears, if any • Pod propeller bearing temperature • Pod thrust bearing temperature • Cooling air in temperature • Cooling air out temperature • Highest cubicle temperature • Converter heat exchanger temperatures • Pod propeller end - thrust end bearings, oil/water contamination recorded value • Pod slewing sealing oil/grease leaking recorded value • Pod steering check of pump working pressure/current • Propulsion system insulation resistance (every 12 months)
Vibration Monitoring	Periodical or continuous monitoring of motor bearings. No less than one per month
Lubricant Analysis	Regular sampling, laboratory testing. No less than one sampling every 6 months. Alternatively, a fixed analyser allowing continuous oil debris monitoring can be fitted in the section from the oil return line to the filter, provided that it does not affect the oil flow in any way
Oil Transformer analysis	Regular sampling, laboratory testing. No less than one sampling every 6 months

6.3.5 Gas turbines

Tab 4 lists the minimum checks to be carried out. The periodicity of the measures is to be defined by the Manufacturer.

In addition, shut-down systems and safety devices are to be checked at Annual Survey.

6.3.6 Gearing

Tab 5 lists the minimum checks to be carried out.

Table 4

Method	Requirement
Visual Inspection	Periodical inspection of : • intakes and exhaust ducts • inlet guide vanes • compressor (first stage) • casings • auxiliaries • running clearances (as far as practicable)
Borescope	Periodical inspection of : • compressor stators • guide vanes and blades • combustion chambers • turbine nozzles and blades
Vibration Monitoring	Continuous monitoring and trend analysis of gas turbine rotor bearing vibration
Lubricant Analysis	Periodical inspection of : • magnetic particle detectors • oil filters Regular sampling of lube oil, laboratory testing Alternatively, a fixed analyser allowing continuous oil debris monitoring can be fitted in the section from the oil return line to the filter, provided that it does not affect the oil flow in any way
Fuel analysis	Regular sampling according to ISO 8217: 2005
Performance monitoring (usually provided by the automation system associated with the package)	Continuous monitoring and trend analysis of : • compressor (inlet/exit temperature, discharge pressure, speed) • turbine (inlet temperature, speed) • engine breather temperature • fatigue counter

Table 5

Method	Requirement
Condition Monitoring	Gear wheels, pinions, shafts, bearings, couplings, power clutch and driven pumps are to be inspected at every dismantling. The following checks are required: • gear backlash and pinion/shaft diametric clearance • shaft seal tightness. It may be accepted that gears and roller bearings are inspected without dismantling, as far as practicable, by means of non-invasive diagnostic techniques. Moreover, the following parameters are to be checked weekly: • bearing lubricating oil pressure • rotational speed.
Vibration Monitoring	Periodical or continuous monitoring of bearings. No less than once every 4 months
Lubricant Analysis	Regular sampling, laboratory testing. No less than one sampling every 6 months

6.3.7 Steam turbines

For the main and auxiliary steam turbines the parameters to be checked are the following:

- turbine bearing vibrations (continuous or monthly readings)
- power output (by torquemeter or other equivalent device; otherwise the number of nozzles, the inlet steam pressure and the pressure in the nozzle chamber are to be available for the power appraisal) (continuous or weekly readings)
- Rotational speed (continuous or weekly readings)
- Periodical measurement of rotor axial position using external indicators (monthly)
- Continuous or periodical monthly vibration monitoring of turbine bearing housing
- Plant performance data, i.e. steam conditions at the inlet and outlet of each turbine, saturated, superheated and desuperheated steam conditions at the outlet of boilers, condenser vacuum, sea temperature.

Lube oil analysis is requested at least once every six months.

The following additional visual inspections or checks are required:

- boiler water analysis records every six months
- inspection of rotor bearings, thrust bearings, coupling and casing axial expansion arrangements at every dismantling
- inspection of final low pressure and astern blading at every dismantling.

6.4 Miscellaneous systems and equipment

6.4.1 General

This item [6.4] summarises the minimum requirements for the most common machinery types that can be fitted on ships. In addition to the listed parameters to be checked, periodical visual inspections are to be scheduled.

6.4.2 Cooling system equipment: centrifugal pumps, electric motor driven

Periodical check of:

- rotational speed
- vibration monitoring with associated readings
- pressure at suction/delivery
- electric motor current.

Note 1: for engine driven pumps, vibration readings are always to be taken at the same engine speed (rpm).

Minimum frequency of checks:

- monthly: sea water cooling pumps, high and low temperature fresh water cooling pumps, general service low temperature pumps
- every four months: preheating high temperature cooling system pumps.

6.4.3 Lubrication oil system: worm/gear pumps, electric motor driven

Periodical check of:

- rotational speed
- vibration monitoring with associated readings
- pressure at suction/delivery
- electric motor current.

Note 1: for engine driven pumps, vibration readings are always to be taken at the same engine speed (rpm).

Minimum frequency of checks: monthly.

6.4.4 Fuel oil system: booster/supply gear pumps, electric motor driven

Periodical check of:

- rotational speed
- vibration monitoring with associated readings
- pressure at suction/delivery
- electric motor current.

Note 1: for engine driven pumps, vibration readings are always to be taken at the same engine speed (rpm).

Minimum frequency of checks: monthly.

6.4.5 Compressed air system

For the following machine types:

- starting air compressor, reciprocating, electric motor driven
- general service air compressor, piston/screw type, electric motor driven
- auxiliary blower electric motor driven,

periodical check of:

- rotational speed
- vibration monitoring with associated readings
- delivery pressure
- electric motor current,

are required.

Minimum frequency of checks: every three months.

6.4.6 Steering gear system: hydraulic pumps, electric motor driven

The following checks are required, on a monthly basis as a minimum:

- rotational speed
- vibration monitoring, (continuous or periodical readings)
- zero positioning check
- flexible hose check.

6.4.7 Purifying system : fuel oil and lube oil purifiers

The following checks are required:

a) on a monthly basis as a minimum:
   - vibration monitoring at reading point indicated by maker (vibration limits suggested by Manufacturer, because of high speed)
   - bowl rotational speed reading

b) every three months as a minimum:

- vibration monitoring periodical readings and visual inspection of fuel oil or lube oil supply gear pumps.

6.4.8 Miscellaneous liquid transfer pumps

For the following equipment types, electric motor driven:

- fuel oil transfer pumps (worm, gears)
- fresh water transfer pumps (centrifugal)
- lube oil transfer pumps (worm, gears),

the following checks are required, at least every three months:

- vibration monitoring with associated readings
- suction/delivery pressure
- electric motor current
- rotational speed.

6.4.9 Ballast, fire and general service pumps

For the following equipment types, electric motor driven:

- ballast pumps (centrifugal)
- fire pumps (centrifugal)
- general service pumps (centrifugal),

the following checks are required, at least every three months and as far as possible in the same working conditions:

- vibration monitoring with associated readings
- suction/delivery pressure
- electric motor current
- rotational speed.

6.4.10 Bilge system

For the following equipment types, electric motor driven:

- centrifugal pumps
- reciprocating pumps,

the following checks are required, at least on a monthly basis and as far as possible in the same working conditions:

- vibration monitoring with associated readings
- suction/delivery pressure
- electric motor current
- rotational speed.

6.4.11 Potable water system: centrifugal pumps, electric motor driven

The following checks are required, at least every three months and as far as possible in the same working conditions:

- vibration monitoring with associated readings
- suction/delivery pressure
- electric motor current
- rotational speed.

6.4.12 Manoeuvring equipment: bow and stern thrusters, electric motor driven

The following checks are required, at least every three months:

- vibration monitor readings of electric motor
- electric motor current to be recorded
- rotational speed
- vibration monitor readings and visual inspection of servo unit pumps of thrusters.

6.4.13 Steam system

For the following equipment type:

- main boiler feed water multistage centrifugal pumps, steam turbine driven,

the following checks are required, at least every three months:

- rotational speed,
- steam pressure/temperature at turbine inlet/outlet
- pump suction/delivery pressure
- lubricating oil analysis
- pump and turbine bearing vibration monitoring.

For the following equipment types, electric motor driven:

- auxiliary boiler feed water, single stage or multistage centrifugal pumps
- exhaust boiler circulating centrifugal pumps
- fuel oil pumps of main and auxiliary boilers
- boiler forced draught ventilators, electric motor driven,

the following checks are required, at least every three months, as far as possible in the same working conditions:

- vibration monitoring with associated readings
- suction/delivery pressure
- electric motor current
- rotational speed.

For the following equipment type, electric motor driven:

- boiler forced draught ventilators, electric motor driven,

the following checks are required, at least every three months, as far as possible in the same working conditions:

- vibration monitoring with associated readings
- electric motor current.

6.4.14 Fresh water generator

For the following equipment type, electric motor driven:

- feed, cooling, injector sea water centrifugal pumps

the following checks are required, at least on a monthly basis:

- vibration monitoring with associated readings
- rotational speed
- electric motor current
- suction/delivery pressure.

The above checks also apply for distillate and condensate centrifugal pumps, at least every three months.

6.4.15 Air conditioning and refrigeration system

For the following equipment type, electric motor driven:

- screw, piston or centrifugal compressor for HVAC, electric motor driven, direct or belt transmission,

the following checks are required, at least every three months:

- vibration monitoring with associated readings
- rotational speed
- electric motor current
- suction/delivery pressure.

6.4.16 Oil systems

For centrifugal large size cargo pumps, electric motor or steam turbine driven, the following checks are required, at least every three months:

- vibration monitoring with associated readings
- rotational speed
- electric motor current
- suction/delivery pressure.

The unit loading conditions and draught are to be recorded.

Note 1: the instruments employed are to be intrinsically safe.

For inert gas blowers (radial, centrifugal or rotary), electric motor driven, the following checks are required, at least on a monthly basis:

- vibration monitoring with associated readings
- rotational speed
- electric motor current.

6.4.17 Ventilation system

For ventilators, the following checks are required, at least every three months:

- vibration monitoring with associated readings
- rotational speed
- electric motor current.

Note 1: the following equipment may be difficult to reach and may require remote installations with cables placed outside:

- HVAC units of accommodation systems
- ventilators of various type for engine rooms, pump room, stores, purifier room with ventilator on shaft
- ventilators for evacuating exhaust from ro-ro car spaces.

6.4.18 Chemical systems

For the following components of hydraulic power packs:

- supply pumps for hydraulic power packs
- hydraulic cargo pumps
- hydraulic pump for servo units,

the following checks are required, at least every three months:

- vibration monitoring with associated readings
- electric motor current
- suction/delivery pressure.

The unit loading conditions and draught are to be recorded.

Note 1: the instruments are to be intrinsically safe; moreover, if the cargo pumps are submerged, a fixed installation is to be provided to allow vibration readings from a remote position.

6.4.19 Liquefied gas systems

For compressors of the refrigerating cycle, electric motor driven, the following checks are required, at least every three months:

- vibration monitoring with associated readings
- electric motor current
- suction/delivery pressure.

6.4.20 Refrigerated systems

For compressors screw or piston type, electric motor driven, the following checks are required, at least every three months:

- vibration monitoring with associated readings
- electric motor current
- suction/delivery pressure.

6.4.21 Electrical switchboard

For low voltage panels and medium voltage panels (if practicable), a thermographic inspection is required at least yearly, in the conditions of maximum expected load. The same techniques may also be applied to cables, piping or even to machinery parts to extract information additional to the other CBM techniques.

Part F
Additional Class Notations

Chapter 2
AUTOMATION SYSTEMS (AUT)

SECTION 1 UNATTENDED MACHINERY SPACES (AUT-UMS)

SECTION 2 CENTRALISED CONTROL STATION (AUT-CCS)

SECTION 1 UNATTENDED MACHINERY SPACES (AUT-UMS)

1 General

1.1 Application

1.1.1 The additional class notation **AUT-UMS** is assigned in accordance with Pt A, Ch 1, Sec 2, [6.2.2] to units fitted with automated installations enabling periodically unattended operation of machinery spaces, and complying with the requirements of this Section.

1.1.2 The arrangements provided are to be such as to ensure that the safety of the unit, is equivalent to that of a unit having the machinery spaces manned.

1.2 Communication system

1.2.1 A reliable means of vocal communication is to be provided between the main machinery control room and the engineer officers' accommodation.

This means of communication is to be foreseen in collective or individual accommodation of engineer officers.

1.2.2 Means of communication are to be capable of being operated even in the event of failure of supply from the main source of electrical power.

2 Documentation

2.1 Documents to be submitted

2.1.1 In addition to those mentioned in Part C, Chapter 3, the documents in Tab 1 are required.

Table 1 : Documents to be submitted

No.	(1)	Document
1	A	Means of communication diagram
2	A	Technical description of automatic engineer's alarm and connection of alarms to accommodation and bridge, when applicable
3	A	System of protection against flooding
4	A	Fire detection system: diagram, location and cabling
(1) A : to be submitted for approval		

3 Fire and flooding precautions

3.1 Fire prevention

3.1.1 The requirements regarding piping and arrangements of fuel oil and lubricating oil systems given in Pt C, Ch 1, Sec 10 of the Rules for the Classification of Ships are applicable.

3.1.2 Where necessary, oil fuel and lubricating oil pipes are to be screened or otherwise suitably protected to avoid, as far as practicable, oil spray or oil leakages on to hot surfaces or into machinery air intakes. The number of joints in such piping systems is to be kept to a minimum and, where practicable, leakages from high-pressure oil fuel pipes are to be collected and arrangements provided for an alarm to be given.

3.1.3 Where daily service oil fuel tanks are filled automatically, or by remote control, means are to be provided to prevent overflow spillages. Other equipment which treats flammable liquids automatically, e.g. oil fuel purifiers, which, whenever practicable, are to be installed in a special space reserved for purifiers and their heaters, are to have arrangements to prevent overflow spillages.

3.1.4 Where daily service oil fuel tanks or settling tanks are fitted with heating arrangements, a high-temperature alarm is to be provided if the flashpoint of the oil fuel can be exceeded.

3.2 Fire detection

3.2.1 For fire detection, the requirements given in are applicable.

3.2.2 An automatic fire detection system is to be fitted in machinery spaces of Category A as defined in XXXX intended to be unattended.

3.2.3 Power or system failures are to initiate an audible alarm distinguishable from the fire alarm.

3.2.4 The fire detection indicating panel is to be located on the navigating bridge, fire control station, or other accessible place where a fire in the machinery space will not render it inoperative.

3.2.5 The fire detection indicating panel is to indicate the place of the detected fire in accordance with the arranged fire zones by means of a visual signal. Audible signals clearly distinguishable in character from any other signals are to be audible throughout the navigating bridge and the accommodation area of the personnel responsible for the operation of the machinery space.

3.2.6 The type and location of detectors are to be approved by the Society and a combination of detector types is recommended in order to enable the system to react to more than one type of fire symptom.

3.2.7 Flame detectors may be installed, although they are to be considered as complementary and are not to replace the main installation.

3.2.8 Fire detector zones are to be arranged in a manner that will enable the operating staff to locate the seat of the fire. The arrangement and the number of loops and the location of detector heads are to be approved in each case. Air currents created by the machinery are not to render the detection system ineffective.

3.2.9 When fire detectors are provided with the means to adjust their sensitivity, necessary arrangements are to be allowed to fix and identify the set point.

3.2.10 When it is intended that a particular loop or detector is to be temporarily switched off, this state is to be clearly indicated. Reactivation of the loop or detector is to be performed automatically after a preset time.

3.2.11 The fire detection indicating panel is to be provided with facilities for functional testing.

3.2.12 Facilities are to be provided in the fire detecting system to manually release the fire alarm from the following places:

- passageways having entrances to engine and boiler rooms
- the navigating bridge
- the control station in the engine room.

3.3 Fire fighting

3.3.1 For fire fighting, the requirements given in XXXX apply.

3.4 Protection against flooding

3.4.1 Bilge wells or machinery spaces bilge levels are to be monitored in such a way that the accumulation of liquid is detected in normal angles of trim and heel.

3.4.2 Where the bilge pumps are capable of being started automatically, means are to be provided to indicate when the influx of liquid is greater than the pump capacity or when the pump is operating more frequently than would normally be expected.

3.4.3 Where the bilge pumps are automatically controlled, they are not be started when the oil pollution level is higher than accepted in Pt C, Ch 1, Sec 10 of the Rules for the Classification of Ships.

3.4.4 The location of controls of any valve serving a sea inlet, a discharge below the waterline or a bilge injection system are to be so sited as to allow adequate time for operation in case of influx of water to the space, having regard to the time likely to be required in order to reach and operate such controls. If the level to which the space could become flooded with the unit in the fully loaded condition so requires, arrangements are to be made to operate the controls from a position above such level.

3.4.5 Bilge level alarms are to be given at the main control station, the engineers' accommodation area and the navigating bridge.

4 Control of machinery, including requirements for MODU

4.1 General

4.1.1 Under all sailing conditions, including manoeuvring, the speed, direction of thrust and, if applicable, the pitch of the propeller are to be fully controllable from the navigation bridge.

4.1.2 All manual operations or services expected to be carried out with a periodicity of less than 24 h are to be eliminated or automated, particularly for: lubrication, topping up of make up tanks and filling tanks, filter cleaning, cleaning of centrifugal purifiers, drainage, load sharing on main engines and various adjustments. Nevertheless, the transfer of operation mode may be effected manually.

4.1.3 A centralised control position is to be arranged with the necessary alarm panels and instrumentation indicating any alarm.

4.1.4 Parameters for essential services which need to be adjusted to a preset value are to be automatically controlled.

4.1.5 The control system is to be such that the services needed for the operation of the main propulsion machinery and its auxiliaries are ensured through the necessary automatic arrangements.

4.1.6 It is to be possible for all machinery essential for the safe operation of the unit to be controlled from a local position, even in the case of failure in any part of the automatic or remote control systems.

4.1.7 The design of the remote automatic control system is to be such that in the case of its failure an alarm will be given. Unless impracticable, the preset speed and direction of thrust of the propeller is to be maintained until local control is in operation.

4.1.8 Critical speed ranges, if any, are to be rapidly passed over by means of an appropriate automatic device.

4.1.9 Propulsion machinery is to stop automatically only in exceptional circumstances which could cause quick critical damage, due to internal faults in the machinery. The design of automation systems whose failure could result in an unexpected propulsion stop is to be specially examined. An overriding device for cancelling the automatic shutdown is to be considered.

4.1.10 Where the propulsive plant includes several main engines, a device is to be provided to prevent any abnormal overload on each of them.

4.1.11 Where standby machines are required for other auxiliary machinery essential to propulsion, automatic changeover devices is to be provided.

4.2 Diesel propulsion plants

4.2.1 When a diesel engine is used for the propulsion plant, monitoring and control of equipment is to be performed according to Tab 2 for slow speed engines or Tab 3 for medium or high speed engines.

Table 2 : Monitored parameters for main propulsion low speed diesel engine

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote					
Identification of system parameter	Alarm activation	Remote indication	Slow-down with alarm	Shut-down with alarm	Automatic start of stand by pump with alarm
Fuel oil system					
• Fuel oil pressure after filter (engine inlet)	L	R			
					X
• Fuel oil viscosity before injection pumps or fuel oil temperature before injection pumps (for engine running on heavy fuel)	H + L				
• Leakage from high pressure pipes where required	H				
• Common rail fuel oil pressure	L				
Lubricating oil system					
• Lubricating oil to main bearing and thrust bearing pressure	L	R	X		
				X	
					X
• Lubricating oil to crosshead bearing pressure when separate	L	R	X		
				X	
					X
• Lubricating oil to camshaft pressure when separate	L				
	LL			X	
					X
• Lubricating oil to camshaft temperature when separate	H				
• Lubricating oil inlet temperature	H				
• Thrust bearing pads or bearing outlet temperature	H		X		
	HH			X	
• Main, crank, crosshead bearing, oil outlet temperature or oil mist concentration in crankcase **(5)**	H		X		
• Flow rate cylinder lubricator (each apparatus)	L		X		

(1) Not required, if the coolant is oil taken from the main cooling system of the engine.
(2) Where outlet flow cannot be monitored due to engine design, alternative arrangement may be accepted.
(3) Where one common cooling space without individual stop valves is employed for all cilynder jackets.
(4) Where separate lubrificating oil systems are installed (e.g. camshaft, rocker arms, etc.), individual level alarms are required for the tanks.
(5) When required by Pt C, Ch 1, Sec 2, [4.3.5] of the Rules for the Classification of Ships or by SOLAS Reg.II-1/47.2.
(6) Unless provided with a self-contained lubrificating oil system integrated with the turbocharger.
(7) Where outlet temperature from each bearing cannot be monitored due to the engine/turbocharger design alternative arrangements may be accepted. Continuous monitoring of inlet temperature in combination with specific intervals for bearing inspection in accordance with the turbocharger manufacturer's instructions may be accepted as an alternative.

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote					
Identification of system parameter	Alarm activation	Remote indication	Slow-down with alarm	Shut-down with alarm	Automatic start of stand by pump with alarm
• Level in lubricating oil tanks or oil sump, as appropriate **(4)**	L				
• Common rail servo oil pressure	L				
• Lubricating oil to turbocharger inlet pressure **(6)**	L				
• Turbocharger lubricating oil outlet temperature on each bearing **(7)**	H				
• Speed of turbocharger		R			
Piston cooling system					
• Piston coolant inlet pressure	L		X **(1)**		
					X
• Piston coolant outlet temperature on each cylinder	H		X		
• Piston coolant outlet flow on each cylinder **(2)**	L		X		
• Level of piston coolant in expansion tank	L				
Sea water cooling system					
• Sea water cooling pressure	L				
					X
Cylinder fresh cooling water system					
• Cylinder fresh cooling water system inlet pressure	L		X		
					X
• Cylinder fresh cooling water outlet temperature (from each cylinder) or cylinder water outlet temperature (general) **(3)**	H		X		
• Oily contamination of engine cooling water system (when main engine cooling water is used in fuel and lubricating oil heat exchangers)	H				
• Level of cylinder cooling water in expansion tank	L				
Fuel valve coolant system					
• Pressure of fuel valve coolant	L				
					X
• Temperature of fuel valve coolant	H				
• Level of fuel valve coolant in expansion tank	L				
Starting and control air system					
• Starting air pressure before main shut off valve	L	R			

(1) Not required, if the coolant is oil taken from the main cooling system of the engine.

(2) Where outlet flow cannot be monitored due to engine design, alternative arrangement may be accepted.

(3) Where one common cooling space without individual stop valves is employed for all cilynder jackets.

(4) Where separate lubrificating oil systems are installed (e.g. camshaft, rocker arms, etc.), individual level alarms are required for the tanks.

(5) When required by Pt C, Ch 1, Sec 2, [4.3.5] of the Rules for the Classification of Ships or by SOLAS Reg.II-1/47.2.

(6) Unless provided with a self-contained lubrificating oil system integrated with the turbocharger.

(7) Where outlet temperature from each bearing cannot be monitored due to the engine/turbocharger design alternative arrangements may be accepted. Continuous monitoring of inlet temperature in combination with specific intervals for bearing inspection in accordance with the turbocharger manufacturer's instructions may be accepted as an alternative.

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote					
Identification of system parameter	Alarm activation	Remote indication	Slow-down with alarm	Shut-down with alarm	Automatic start of stand by pump with alarm
• Control air pressure	L				
• Safety air pressure	L				
Scavenge air system					
• Scavenging air receiver pressure		R			
• Scavenging air box temperature (detection of fire in receiver, see Ch 3, Sec 1, [3.2.2])	H		X		
• Scavenging air receiver water level	H				
Exhaust gas system					
• Exhaust gas temperature after each cylinder	H	R	X		
• Exhaust gas temperature after each cylinder, deviation from average	H				
• Exhaust gas temperature before each turbocharger	H	R			
• Exhaust gas temperature after each turbocharger	H	R			
Miscellaneous					
• Engine speed (and direction of speed when reversible)		R			
• Engine overspeed	H			X	
• Wrong way	X				
• Control, safety, alarm system power supply failure	X				

(1) Not required, if the coolant is oil taken from the main cooling system of the engine.

(2) Where outlet flow cannot be monitored due to engine design, alternative arrangement may be accepted.

(3) Where one common cooling space without individual stop valves is employed for all cilynder jackets.

(4) Where separate lubrificating oil systems are installed (e.g. camshaft, rocker arms, etc.), individual level alarms are required for the tanks.

(5) When required by Pt C, Ch 1, Sec 2, [4.3.5] of the Rules for the Classification of Ships or by SOLAS Reg.II-1/47.2.

(6) Unless provided with a self-contained lubrificating oil system integrated with the turbocharger.

(7) Where outlet temperature from each bearing cannot be monitored due to the engine/turbocharger design alternative arrangements may be accepted. Continuous monitoring of inlet temperature in combination with specific intervals for bearing inspection in accordance with the turbocharger manufacturer's instructions may be accepted as an alternative.

Table 3 : Monitored parameter for main propulsion medium or high speed diesel engine

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote					
Identification of system parameter	Alarm activation	Remote indication	Slow-down with alarm	Shut-down with alarm	Automatic start of stand by pump with alarm
Fuel oil system					
• Fuel oil pressure after filter (engine inlet)	L	R			
					X
• Fuel oil viscosity before injection pumps or fuel oil temperature before injection pumps (for engine running on heavy fuel)	H + L				
• Leakage from high pressure pipes where required	H				
• Common rail fuel oil pressure	L				
Lubricating oil system					
• Lubricating oil to main bearing and thrust bearing pressure	L	R			
				X	
					X
• Lubricating oil filter differential pressure	H	R			
• Lubricating oil inlet temperature	H	R			
• Oil mist concentration in crankcase **(1)**	H			X	
• Flow rate cylinder lubricator (each apparatus)	L		X		
• Common rail servo oil pressure	L				
• Lubricating oil to turbocharger inlet pressure **(2)**	L	R			
• Turbochanger lub oil temp. each bearing **(4)**	H	R			
Sea water cooling system					
• Sea water cooling pressure	L	R			
					X
Cylinder fresh cooling water system					
• Cylinder water inlet pressure or flow	L	R	X		
					X
• Cylinder water outlet temperature (general)	H	R			
			X		
• Level of cylinder cooling water in expansion tank	L				
Starting and control air system					
Starting air pressure before main shut-off valve	L	R			
Control air pressure	L	R			
Scavenge air system					

(1) When required by Pt C, Ch 1, Sec 2, [4.3.5] of the Rules for the Classification of Ships or by SOLAS Reg.II-1/47.2.
One oil mist detector for each engine having two independent outputs for initiating the alarm and shut-down would satisfy the requirement for independence between alarm and shut-down system.

(2) Unless provided with a self-contained lubrificating oil system integrated with the turbocharger.

(3) For engine power > 500 kW/cyl.

(4) Where outlet temperature from each bearing cannot be monitored due to the engine/turbocharger design alternative arrangements may be accepted. Continuous monitoring of inlet pressure and inlet temperature in combination with specific intervals for bearing inspection in accordance with the turbocharger manufacturer's instructions may be accepted as an alternative.

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote					
Identification of system parameter	Alarm activation	Remote indication	Slow-down with alarm	Shut-down with alarm	Automatic start of stand by pump with alarm
• Scavenging air receiver temperature	H				
Exhaust gas system					
• Exhaust gas temperature after each cylinder **(3)**	H	R	X		
• Exhaust gas temperature after each cylinder **(3)**, deviation from average	H				
Miscellaneous					
• Engine speed		R			
• Engine overspeed	H			X	
• Control, safety, alarm system power supply failure	X				

(1) When required by Pt C, Ch 1, Sec 2, [4.3.5] of the Rules for the Classification of Ships or by SOLAS Reg.II-1/47.2.
One oil mist detector for each engine having two independent outputs for initiating the alarm and shut-down would satisfy the requirement for independence between alarm and shut-down system.

(2) Unless provided with a self-contained lubrificating oil system integrated with the turbocharger.

(3) For engine power > 500 kW/cyl.

(4) Where outlet temperature from each bearing cannot be monitored due to the engine/turbocharger design alternative arrangements may be accepted. Continuous monitoring of inlet pressure and inlet temperature in combination with specific intervals for bearing inspection in accordance with the turbocharger manufacturer's instructions may be accepted as an alternative.

4.3 Electrical propulsion plant

4.3.1 Documents to be submitted

The following additional documents are to be submitted to the Society:

- A list of the alarms and shutdowns of the electrical propulsion system
- When the control and monitoring system of the propulsion plant is computer based, a functional diagram of the interface between the programmable logic controller and computer network.

4.3.2 Alarm system

The following requirements are applicable to the alarm system of electrical propulsion:

- Alarms circuits of electrical propulsion are to be connected to the main alarm system on board. As an alternative, the relevant circuit may be connected to a local alarm unit. In any case, a connection between the local alarm unit and the main alarm system is to be provided.
- The alarms can be arranged in groups, and shown in the control station. This is acceptable when a discrimination is possible locally.
- When the control system uses a computer based system, the requirements of Pt C, Ch 3, Sec 4 of the Rules for the Classification of Ships are applicable, in particular, for the data transmission link between the alarm system and the control system.
- Individual alarms are considered as critical and are to be individually activated at the control stations, and acknowledged individually.
- Shutdown activation is to be considered as an individual alarm.

4.3.3 Safety functions

The following requirements are applicable to the safety system of electrical propulsion:

- As a general rule, safety stop using external sensors such as temperature, pressure, overspeed, main cooling failure, stop of converter running by blocking impulse is to be confirmed by the automatic opening of the main circuit using a separate circuit.
- In order to avoid accidental stop of the propulsion line and limit the risk of blackout due to wire break, the tripping of the main circuit-breaker is to be activated by an emission coil with a monitoring of the line wire break.
- In the case of a single line propulsion system, the power limitation order is to be duplicated.
- As a general rule, when the safety stop is activated, it is to be maintained until local acknowledgement.

4.3.4 Transformers

For transformers, parameters according to Tab 4 are to be controlled or monitored.

4.3.5 Converters

For converters, parameters according to Tab 5, Tab 6 and Tab 7 are to be monitored or controlled.

4.3.6 Smoothing coil

For the converter reactor, parameters according to Tab 8 are to be monitored or controlled.

4.3.7 Propulsion electric motor

For propulsion electric motors, parameters according to Tab 9 are to be monitored or controlled.

4.3.8 All parameters listed in the tables of this item are considered as a minimum requirement for unattended machinery spaces.

Some group alarms may be locally detailed on the corresponding unit (for instance loss of electronic supply, failure of electronic control unit, etc.)

4.4 Shafting, clutches, CPP, gears

4.4.1 For shafting and clutches, parameters according to Tab 10 are to be monitored or controlled.

4.4.2 For controllable pitch propellers, parameters according to Tab 11 are to be monitored or controlled.

4.4.3 For reduction gears and reversing gears, parameters according to Tab 12 are to be monitored or controlled.

Table 4 : Transformers

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Motor			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Earth failure on main propulsion circuits	I						
Circuit-breaker, short-circuit	I **(2)**			X			
Circuit-breaker, overload	I **(2)**			X			
Circuit-breaker, undervoltage	I **(2)**			X			
Temperature of winding on phase 1, 2, 3 **(1)**	G						
	I, H		X **(3)**				
	I, HH			X			
Temperature sensor failure (short-circuit, open circuit, supply failure)	G						
Cooling pump pressure or flow	G, L						
			X				
						X	
Cooling medium temperature	G, H			X			
Leak of cooling medium	G						
			X				

(1) A minimum of 6 temperature sensors are to be provided :
- 3 temperature sensors to be connected to the alarm system (can also be used for the redundant tripping of the main circuit-breaker)
- 3 temperature sensors connected to the control unit.

(2) To be kept in the memory until local acknowledgement.

(3) Possible override of slowdown by the operator.

Table 5 : Network converter

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Motor			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Short-circuit current I max	I			X			
Overvoltage	G			X			
Undervoltage	G						
Phase unbalanced	I			(X) **(1)**			
Power limitation failure	I						
Protection of filter circuit trip	I						
Circuit-breaker opening operation failure	I						
Communication circuit, control circuits, power supplies, watchdog of control system according to supplier's design	G			X			
(1) This parameter, when indicated in brackets, is only advisable according to the supplier's requirements.							

Table 6 : Motor converter

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Motor			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Short-circuit current I max	I			X			
Overvoltage	G			X			
Undervoltage	G			X			
Phase unbalanced	I						
Protection of filter circuit trip	I						
Communication circuit, control circuits, power supplies, watchdog of control system according to supplier's design	G			X			
Speed sensor system failure	G					X **(1)**	
Overspeed	I			X			
(1) Automatic switch-over to the redundant speed sensor system.							

Table 7 : Converter cooling circuit

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Motor			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Air cooling temperature high	I	R					
Ventilation, fan failure	G						
			X				
Cooling pump pressure or flow low	G	R					
						X	
Cooling fluid temperature high	G						

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Motor			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Leak of cooling medium	G						
			X				
Temperature sensor failure (short-circuit, open circuit, supply failure)	G						

Table 8 : Smoothing coil

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Motor			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Temperature of coil	I, H	R					
	I, HH						
Cooling air temperature	I, H						
Ventilation fan failure	G						
			X				
Cooling pump pressure or flow low	G	R					
						X	
Cooling fluid temperature high	G						
Leak of cooling medium	G						
			X				
Temperature sensor failure (short-circuit, open circuit, supply failure)	G						

Table 9 : Propulsion electric motor

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Motor			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Automatic tripping of overload and short-circuit protection on excitation circuit	G, H			H			
Loss of excitation	G			X			
Winding current unbalanced	G						
Harmonic filter supply failure	I						
Interface failure with power management system	I		X				
Earthing failure on stator winding and stator supply	I	R					
Temperature of winding on phase 1, 2, 3	G	R					
	I, H		X				
	I, HH			X			
Motor cooling air temperature	I, H	R					
Cooling pump pressure or flow	G ,L	R					
			X				
						X	
Cooling fluid temperature	G, H						

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Motor			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Leak of cooling medium	G						
			X				
Temperature sensor failure (short-circuit, open circuit, supply failure)	G						
Motor bearing temperature	G, H	R					
Bearing lubrication oil pressure (for self-lubricated motor, when the speed is under the minimum RPM specified by the manufacturer, shutdown is to be activated)	I, L	R					
			X				
						X	
Bearing lubrication oil pressure	G, L						
Turning gear engaged	I						
Brake and key engaged	I						
Shaft reduction gear bearing temperature	I, H						
Shaft reduction gear lubricating oil temperature	I, H						
Shaft reduction gear bearing pressure	I, L						
				X			

Table 10 : Shafting and clutches of propulsion machinery

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Main Engine			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Temperature of each shaft thrust bearing (not applicable for ball or roller bearings)	H		X				
Sterntube bush oil gravity tank level	L						
Clutch lubricating oil temperature	H						
Clutch oil tank level	L						
Clutch control oil pressure	L						
	LL					X	

Table 11 : Controllable pitch propeller

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Main Engine			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Control oil temperature	H						
Oil tank level	L						
Control oil pressure	L						
	LL					X	

Table 12 : Reduction gears/reversing gears of propulsion machinery

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Main Engine			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Lubricating oil temperature	H	R					
Lubricating oil pressure	L	R				X	
	LL			X			
Oil tank level	L						
Plain bearing temperature	H						
	HH			X			

4.5 Auxiliary systems

4.5.1 Where standby machines are required for other auxiliary machinery essential to propulsion, automatic change-over devices is to be provided.

Change-over restart is to be provided for the following systems:

- cylinder, piston and fuel valve cooling
- cylinder cooling of diesel generating sets (where the circuit is common to several sets)
- main engine fuel supply
- diesel generating sets fuel supply (where the circuit is common to several sets)
- sea water cooling for propulsion plant
- sea water to main condenser (main turbines)
- hydraulic control of clutch, CPP or main thrust unit
- thermal fluid systems (thermal fluid heaters).

4.5.2 When a standby machine is automatically started, an alarm is to be activated.

4.5.3 When the propulsion plant is divided into two or more separate units, the automatic standby auxiliary may be omitted, when the sub-units concerned are fully separated with regard to power supply, cooling system, lubricating system etc.

Some of the propulsive plants may be partially used for reasons of economy (use of one shaft line or one propulsion engine for instance). If so, automatic change-over, necessary for this exploitation mode, is to be provided.

4.5.4 Means are to be provided to keep the starting air pressure at the required level where internal combustion engines are used for main propulsion.

4.5.5 Where daily service fuel oil tanks are filled automatically, or by remote control, means are to be provided to prevent overflow spillages.

4.5.6 Arrangements are to be provided to prevent overflow spillages coming from equipment treating flammable liquids.

4.5.7 Where daily service fuel oil tanks or settling tanks are fitted with heating arrangements, a high temperature alarm is to be provided if the flashpoint of the fuel oil can be exceeded.

4.5.8 For auxiliary systems, the following parameters, according to Tab 13 to Tab 23 are to be monitored or controlled.

Table 13 : Control and monitoring of auxiliary electrical systems

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Main Engine			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Electric circuit, blackout	X						
Power supply failure of control, alarm and safety system	X						

Table 14 : Incinerators

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Incinerator			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Stand-by Start	Stop
Combustion air pressure	L			X			
Flame failure	X			X			
Furnace temperature	H			X			
Exhaust gas temperature	H						
Fuel oil pressure	L						
Fuel oil temperature or viscosity , where heavy fuel is used	H + L						

Table 15 : Auxiliary boilers

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Boiler			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Water level	L + H			X	X		
Fuel oil temperature	L + H			X	X		
Flame failure	X			X			
Combustion air supply fan low pressure				X			
Temperature in boiler casing (fire)	H						
Steam pressure	H **(1)**			X	X		
Steam temperature				X **(2)**			

(1) When the automatic control does not cover the entire load range from zero load.
(2) For superheated steam over 330°C.

Table 16 : Fuel oil system

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			System			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Fuel oil tank level, overflow	H **(1)**						
Air pipe water trap level on fuel oil tanks	H **(2)**						
Outlet fuel oil temperature	H **(4)**			X **(5)**	X		
Sludge tank level	H						
Fuel oil settling tank level	H **(1)**						
Fuel oil settling tank temperature	H **(3)**						
Fuel oil centrifugal purifier overflow	H			X			
Fuel oil in daily service tank level	L						
Fuel oil daily service tank temperature	H **(3)**				X		
Fuel oil in daily service tank level (to be provided if no suitable overflow arrangement)	H **(1)**						

(1) Or sight-glasses on the overflow pipe.
(2) Or alternative arrangement as per Pt C, Ch 1, Sec 10, [9.1.7] of the Rules for the Classification of Ships.
(3) Applicable where heating arrangements are provided.
(4) Or low flow alarm in addition to temperature control when heated by steam or other media.
(5) Cut off of electrical power supply when electrically heated.

Table 17 : Lubricating oil system

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			System			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Air pipe water trap level of lubricating oil tank See Pt C, Ch 1, Sec 10, [9.1.7] of the Rules for the Classification of Ships	H						
Sludge tank level	H						
Lubricating oil centrifugal purifier overflow	H						
(stop of oil supply)							X

Table 18 : Thermal oil system

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			System			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Forced draft fan stopped				X			
Thermal fluid temperature	H						
				X			
Thermal fluid pressure							X
Flow through each element	L			X			
Heavy fuel oil temperature or viscosity	H + L				X		
Burner flame failure	X			X			
Flue gas temperature (when exhaust gas heater)	H			X			
Expansion tank level	L						X **(1)**
(1) Stop of burner and fluid flow.							

Table 19 : Hydraulic oil system

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			System			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Pump pressure	L + H						
Service tank level	L **(1)**						
(1) The low level alarm is to be activated before the quantity of lost oil reaches 100 litres or 50% of the circuit volume , whichever is the lesser.							

Table 20 : Boiler feed and condensate system

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			System			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Sea water flow or equivalent	L					X	
Vacuum	L						
	LL			X			
Water level in main condenser (unless justified)	H + L						
					X		
	HH			X			
Salinity of condensate	H						
Feed water pump delivery pressure	L					X	
Feed water tank level	L						
Deaerator inside temperature or pressure	L + H **(1)**						
Water level in deaerator	L + H						
Extraction pump pressure	L						
Drain tank level	L + H						
(1) In the case of forced circulation boiler.							

Table 21 : Compressed air system

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			System			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Stand-by Start	Stop
Air temperature at compressor outlet	H						
Compressor lubricating oil pressure (except where splash lubrication)	LL			X			

Table 22 : Cooling system

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			System			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Sea water pump pressure or flow	X					X	
	L						
Fresh water pump pressure or flow	X					X	
	L						
Level in cooling water expansion tank	L						

Table 23 : Thrusters

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Thruster			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Control oil pressure (preferably before cooler)	L					L	
Oil tank level	L						

4.6 Control of electrical installation

4.6.1 Where the electrical power can normally be supplied by one generator, suitable load shedding arrangement are to be provided to ensure the integrity of supplies to services required for propulsion and steering as well as the safety of the unit.

4.6.2 In the case of loss of the generator in operation, adequate provision are to be made for automatic starting and connecting to the main switchboard of a standby generator of sufficient capacity to permit propulsion and steering, if applicable, and to ensure the safety of the unit with automatic restarting of the essential auxiliaries including, where necessary, sequential operations.

4.6.3 The standby electric power is to be available in not more than 45 seconds.

4.6.4 If the electrical power is normally supplied by more than one generator simultaneously in parallel operation, provision is to be made, for instance by load shedding, to ensure that, in the case of loss of one of these generating sets, the remaining ones are kept in operation without overload to permit propulsion and steering, if applicable, and to ensure the safety of the unit.

4.6.5 Following a blackout, automatic connection of the standby generating set is to be followed by an automatic restart of the essential electrical services. If necessary, time delay sequential steps are to be provided to allow satisfactory operation.

4.6.6 Monitored parameters for which alarms are required to identify machinery faults and associated safeguards are listed in Tab 24 and Tab 25. These alarms are to be indicated at the control location for machinery as individual alarms; where the alarm panel with all individual alarms is installed on the engine or in the vicinity, a common alarm in the control location for machinery is required. For communication of alarms from the machinery space to the bridge area and accommodation for engineering personnel, detailed requirements are contained in [5].

5 Alarm system

5.1 General

5.1.1 A system of alarm displays and controls is to be provided which readily allows identification of faults in the machinery and satisfactory supervision of related equipment. This may be arranged at a main control station or, alternatively, at subsidiary control stations. In the latter case, a master alarm display is to be provided at the main control station showing which of the subsidiary control stations is indicating a fault condition.

5.1.2 Unless otherwise justified, separation of monitoring and control systems is to be provided.

5.1.3 The alarm system is to be designed to function independently of control and safety systems, so that a failure or malfunction of these systems will not to prevent the alarm system from operating. Common sensors for alarms and automatic slowdown functions are acceptable as specified in each specific table.

Table 24 : Auxiliary medium/high speed reciprocating I.C. engines driving generators

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote					
Identification of system parameter	Alarm	Remote indication	Slow-down with alarm	Shut-down with alarm	Automatic start of stand-by pump with alarm
Fuel oil viscosity or temperature before injection pumps	L + H				
Fuel oil leakage from high pressure pipes	H				
Lubricating oil temperature	H				
Lubricating oil pressure	L				
				X **(1)**	
Oil mist concentration in crankcase **(3)**				X	
Pressure or flow of cooling water	L				
Temperature of cooling water or cooling air	H				
Level in cooling water expansion tank, if not connected to main system	L				
Overspeed activated				X	
Level in fuel oil daily service tank	L				
Starting air pressure	L				
Exhaust gas temperature after each cylinder **(2)**	H				
Common rail fuel oil pressure	L				
Common rail servo oil pressure	L				

(1) Not applicable to emergency generator set.

(2) For engine power above 500 kW/cyl.

(3) When required by Pt C, Ch 1, Sec 2, [4.3.5] of the Rules for the Classification of Ships or by SOLAS Reg.II-1/47.2.
One oil mist detector for each engine having two independent outputs for initiating the alarm and shut-down would satisfy the requirement for independence between alarm and shut-down system.

Table 25 : Auxiliary steam turbines

Symbol convention H = High, HH = High high, G = group alarm L = Low, LL = Low low, I = individual alarm X = function is required, R = remote	Monitoring		Automatic control				
			Turbine			Auxiliary	
Identification of system parameter	Alarm	Indic	Slow-down	Shut-down	Control	Standby Start	Stop
Turbine speed		local					
					X		
	HH			X			
Lubricating oil supply pressure	L					X	
	LL			X			

5.1.4 The alarm system is to be continuously powered and shall have an automatic change-over to a standby power supply in the case of loss of normal power supply.

5.1.5 Where remote indications (R) are mentioned in the tables of this Section, they are required only for ships which are operated with the machinery space unattended but under continuous supervision from a position where control and monitoring devices are centralised, without the traditional watch service being provided by personnel in the machinery space.

5.2 Alarm system design

5.2.1 The alarm system and associated sensors are to be capable of being tested during normal machinery operation.

5.2.2 Insulation faults on any circuit of the alarm system are to generate an alarm, when an insulated earth distribution system is used.

5.2.3 An engineers' alarm is to be activated when the machinery alarm has not been accepted in the machinery spaces or control room within 2 minutes.

5.2.4 The alarm system is to have a connection to the engineers' public rooms and to each of the engineers' cabins through a selector switch, to ensure connection to at least one of those cabins.

5.3 Machinery alarm system

5.3.1 The local silencing of the alarms on the bridge or in accommodation spaces is not to stop the audible machinery space alarm.

5.3.2 Machinery faults are to be indicated at the control locations for machinery.

5.4 Alarm system on navigating bridge

5.4.1 Alarms associated with faults requiring speed reduction or automatic shutdown are to be separately identified on the bridge.

5.4.2 The alarm system is to activate an audible and visual alarm on the navigation bridge for any situation which requires action by or the attention of the officer on watch.

5.4.3 Individual alarms are to be provided at the navigation bridge indicating any power supply failures of the remote control of propulsion machinery.

5.4.4 Where remote indications (R) are mentioned in the tables of this Section, they are required only for ships which are operated with the machinery space unattended but under continuous supervision from a position where control and monitoring devices are centralised, without the traditional watch service being provided by personnel in the machinery space.

6 Safety systems

6.1 General

6.1.1 Safety systems of different units of the machinery plant are to be independent. Failure in the safety system of one part of the plant is not to interfere with the operation of the safety system in another part of the plant.

6.1.2 In order to avoid undesirable interruption in the operation of machinery, the system is to intervene sequentially after the operation of the alarm system by:

- starting of standby units
- load reduction or shutdown, such that the least drastic action is taken first.

A suitable alarm is to be activated at the starting of those pumps for which automatic starting is required.

6.1.3 If overriding devices of the required automatic reduction of power (slowdown) are provided, they are to be so arranged as to preclude their inadvertent operation, and a suitable alarm is to be activated by their operation.

6.1.4 If overriding devices of the required automatic stops (shutdown) are provided, they are to be so arranged as to preclude their inadvertent operation, and a suitable alarm is to be operated by their activation. When the engine is stopped automatically, restarting after restoration of normal operating conditions is to be possible only after manual reset, e.g. bypassing the control lever through the 'stop' position.

Automatic restarting is not permissible.

6.1.5 After stoppage of the propulsion engine by a safety shutdown device, the restart is only to be carried out, unless otherwise justified, after setting the propulsion bridge control level on «stop».

7 Testing

7.1 General

7.1.1 Tests of automated installations are to be carried out according to Pt C, Ch 3, Sec 6 of the Rules for the Classification of Ships to determine their operating conditions. The details of these tests are defined, in each case, after having studied the concept of the automated installations and their construction. A complete test program is to be submitted to the Society and may be as follows.

7.1.2 The tests of equipment carried out alongside the quay under normal conditions of use include, for instance:

- the electrical power generating set
- the auxiliary steam generator
- the automatic bilge draining system
- automatic centrifugal separators or similar purifying apparatus
- automatic change-over of service auxiliaries
- detection of high pressure fuel leaks from diesel generating sets or from flexible boiler burner pipes.

7.1.3 Sea trials are used to demonstrate the proper operation of the automated machinery and systems. For this purpose, for instance, the following tests are to be carried out:

- Test of the remote control of propulsion:
  - checking of the operation of the automatic control system: programmed or unprogrammed starting speed increase, reversal, adjusting of the propeller pitch, failure of supply sources, etc.
  - checking of the crash astern sequence, to ensure that the reversal sequence is properly performed from full away, the unit sailing at its normal operation speed. The purpose of this check is not to control the nautical performances of the unit (such as stopping distance, etc.)
  - finally, checking of the operation of the whole installation in normal working conditions, i.e. as a general rule without watch-keeping personnel for the monitoring and/or running of the machinery during 4 h at least
  - The following procedure may, for instance, be chosen: «underway» during 3 h, then increasing to «full ahead». Staying in that position during 5 min. Then stopping for 15 min. Then, putting the control lever in the following positions, staying 2 minutes in each one: astern slow, astern half, astern full, full ahead, half ahead, stop, full astern, stop, ahead dead slow, half ahead, then increasing the power until «underway» position for the remaining time.
- Test of the operating conditions of the electrical production :
  - automatic starting of the generating set in the event of a blackout
  - automatic restarting of auxiliaries in the event of a blackout
  - load-shedding in the event of generating set overload
  - automatic starting of a generating set in the event of generating set overload.
- Test of fire and flooding system:
  - Test of normal operation of the fire detection system (detection, system faults)
  - Test of detection in the scavenging air belt and boiler air duct
  - Test of the fire alarm system
  - Test of protection against flooding.
- Test of operating conditions, including manoeuvring, of the whole machinery in an unattended situation for 4 h.

SECTION 2 CENTRALISED CONTROL STATION (AUT-CCS)

1 General

1.1 Application

1.1.1 The additional class notation **AUT-CCS** is assigned in accordance with Pt A, Ch 1, Sec 2, [6.2.3] to units fitted with a machinery installation operated and monitored from a centralised control station (CCS), and complying with the requirements of this Section.

It applies to units which are intended to be operated with machinery spaces unattended, but with continuous supervision from a position where control and monitoring devices of machinery are centralised.

1.1.2 Remote indications for continuous supervision of the machinery are to be located in a centralised control position, to allow a watch service of the machinery space.

1.2 Communication system

1.2.1 A means of communication is to be provided between the centralised control station, the engineers's accommodation and, where necessary, the machinery spaces.

1.2.2 Means of communication are to be operable even in the case of failure of the main source of electrical power supply.

2 Documentation

2.1 Documents to be submitted

2.1.1 In addition to those mentioned in Part C, Chapter 3; Tab 1 documents according to are required.

Table 1 : Documentation to be submitted

No.	I/A **(1)**	Document
1	A	Means of communication diagram
2	A	Central control position layout and location
3	A	System of protection against flooding
(1) A: to be submitted for approval I: to be submitted for information.		

3 Fire and flooding precautions

3.1 General

3.1.1 The requirements mentioned in Sec 1, [3] are applicable, except for Sec 1, [3.4.5].

3.1.2 The flooding alarms are to be transmitted to the centralised control position.

4 Control of machinery including requirements for MODU

4.1 Propulsion plant operation

4.1.1 The centralised control position is to be designed, equipped and installed so that the machinery operation is as safe and effective as if it were under direct supervision.

4.1.2 Monitoring and control of main systems are to be designed according to the requirements mentioned in Sec 1, [4]. Additional indications in the centralised control position are required, and shown in the table with the symbol R.

4.1.3 In the centralised control position, it is to be possible to restore the normal electrical power supply in the case of power failure (e.g. with remote control of the generating sets), unless an automatic restart is provided.

4.1.4 Automatic restart of essential auxiliaries for propulsion and steering may be replaced by remote control from the centralised control position.

4.1.5 The status of machinery (in operation or on standby) and all parameters crucial to the safe operation of essential machinery are to be shown at the centralised control position.

4.1.6 Under all sailing conditions including manoeuvring, the speed, direction of thrust and, if applicable, the pitch of the propeller are also to be fully controllable from the centralised control position.

4.1.7 In addition to the requirements in Sec 1, [4.1.10], the device to prevent overload, when automatic or remote controlled from the centralised control position, is to be fitted with an alarm indicating the necessity of slowing down.

4.2 Control position location

4.2.1 The centralised control position is to be located in the machinery space or adjacent to it. Other arrangements are to be submitted to the satisfaction of the Society.

4.2.2 If the centralised control position is an enclosed space located in the machinery spaces, it is to be provided with two safe fire escapes.

5 Alarm system

5.1 General

5.1.1 The alarm system is to be designed according to Sec 1, [5].

5.1.2 Every alarm is to be indicated visually and audibly at the centralised control position. If an alarm function has not received attention locally within a limited time, an alarm clearly audible in the engineers' accommodation is to be activated.

6 Safety system

6.1 General

6.1.1 Safeguard disactivation, if provided at the centralised control position, is to be so arranged so that it cannot be operated accidentally; the indication «safety devices off» is to be clearly visible. This device is not to disactivate the overspeed protection.

6.1.2 Safety systems provided with automatic operation may be replaced by remote manual operation from the centralised control position.

7 Testing

7.1 Tests after completion

7.1.1 Tests are to be carried out of all systems which are required to be in operation at the quay, such as the fuel oil purifier system, electrical power generation, auxiliary steam generator, etc.

7.2 Sea trials

7.2.1 The sea trials are to demonstrate the proper operation of automation systems. A detailed test program is to be submitted for approval. As a minimum, the following are to be tested:

- the remote control system of propulsion machinery
- electrical production and distribution
- efficiency of the fire detection and fire alarm system
- protection against flooding
- continuous operation in all sailing conditions, including manoeuvring, for 4 hours with unattended machinery spaces and at least one person in CCS.

Part F
Additional Class Notations

Chapter 3
HULL STRESS AND MOTION MONITORING (MON-HULL)

SECTION 1 HULL STRESS AND MOTION MONITORING (MON-HULL)

SECTION 1 HULL STRESS AND MOTION MONITORING (MON-HULL)

1 General

1.1 Application

1.1.1 The additional class notation **MON-HULL** is assigned in accordance with Pt A, Ch 1, Sec 2, [6.3.2] to units equipped with a Hull Stress and Motion Monitoring System (hereafter referred to as Hull Monitoring System for easy reference), complying with the requirements of this Section.

1.1.2 A Hull Monitoring System is a system which:

- provides real-time data to the Master and officers of the unit on hull girder longitudinal stresses and motions the unit experiences.
- allows the real-time data to be condensed into a set of essential statistical results; the set is to be periodically updated, displayed and stored on a removable medium.

  The information to be stored may be selected in view of later exploitation by the Owner, for instance as an element in the exploitation of the unit or as an addition to its logbook.

Note 1: The information provided by the Hull Monitoring System is to be considered as an aid to the Master. It does not replace his own judgement or responsibility.

1.2 Documentation

1.2.1 The following documents are to be submitted to the Society for approval:

- specification of the main components: sensors, processing units, display unit, storage unit, power supply and cabling
- functional scheme of the system
- principles and algorithm used for the data processing
- determination of measurement ranges
- determination of data limits
- calibration procedure including calibration values and tolerances.

1.3 Data limits, warning levels

1.3.1 The information provided by the transducers is to be compared against limits corresponding to maximum values obtained from the requirements on the basis of which the hull structure is approved.

These limits cannot be crossed and their approach is to be signalled to the crew in order for a corrective action to be carried out.

1.3.2 The above information and the related statistics can also be compared against warning levels determined by the Owner.

These warning levels are always to be less than the maximum values obtained from the requirements on the basis of which the hull structure is approved.

When a warning level is reached, a signal is to be emitted, different from the signals for the limits mentioned in [1.3.1].

2 Hull monitoring system

2.1 Main functions

2.1.1 The Hull Monitoring System is to be able to ensure the following main functions:

- collection of data
- data processing: scaling, consistency checking, statistical processing
- display management, handling of alarms and warnings
- selection, compression, if any, and storage of the results.

Note 1: The resources needed for the later onshore exploitation of the recorded results need not be considered as part of the Hull Monitoring System, provided that they cannot access the storage medium in order to modify the content.

2.2 Sensors

2.2.1 The sensors are to consist of a set of devices able to provide at least:

- information on the longitudinal stresses in the main deck, at least at one location where the maximum hull girder normal stress can be expected during operation, loading and unloading.
- information on the vertical acceleration at the bow.

  For a consistent monitoring of the vertical acceleration in any point of the hull girder, acceleration is also to be collected at the stern.
- information on the transverse acceleration due to the roll and to the heel.

2.2.2 Attention is drawn to the possible existence of local strains induced by temperature gradients in the hull structure.

The strain sensors are to be located in areas free from these temperature gradients.

If a temperature compensation device is implemented, the Manufacturer is to demonstrate its effectiveness on site.

2.2.3 The sensors are to comply with the applicable requirements concerning protection against conducted and radiated electric and radioelectric emissions.

2.2.4 The sensors are to be selected and installed in such a way that a periodical on-site recalibration can be carried out without extra equipment.

When this operation is impossible, the Manufacturer is to declare the period and procedure for the bench test calibration and demonstrate that the initial calibration remains valid within the period.

2.3 Specifications

2.3.1 For each type of measurement, the Manufacturer is to state the limits of the domain, according to the unit.

The limits are to include:

- the strain ranges
- the acceleration ranges
- the corresponding frequency range
- the temperature ranges: sea water, open air, hull structure, sheltered, accommodation.

2.3.2 The global resolution of the instrument is to be such that the incertitude as to the displayed information is less than 7% of its full scale display. The global resolution applies on the entire domain; the specification of the components is to be set accordingly.

2.3.3 The system is to be able to detect and signal the malfunctions which can impair the validity of the data, e.g.:

- data are out of range
- data remain strictly constant
- data are corrupted by high intensity noise
- the system stops or hangs.

2.4 Data processing

2.4.1 Wave-induced data are to be processed through a cyclical statistical procedure; the procedure (maximum peak value, RMS, mean value, frequency spectrum, etc.) is to be selected in order that the displayed information is significant, not confusing, immediately understood and as close as possible to the nautical experience of the crew.

The procedure is to produce smoothed results that are not to deviate by more than 10% from one cycle to the next when in steady operation conditions.

The procedure is to be such that a significant change in the operation conditions appears on the display after no more than three cycles.

2.4.2 It is recommended that the Hull Monitoring System should be linked to the loading instrument for a secure transfer of information from the instrument to the system.

This arrangement is to allow for the actual still water hull girder stresses, converted to longitudinal bending moments, as issued by the system, to be compared against the predicted values from the loading instrument.

2.5 Visual display

2.5.1 A graphical display is to be fitted, with the following features:

- it is to be simple, clear and non-confusing
- the user is to be able to obtain the information through one reading
- it is to be readable at a distance of at least 0,5 m
- two major pieces of information (e.g. stress and vertical acceleration at bow) are declared as "default conditions" and displayed at power up and in the absence of keystroke from the user
- when an alarm is emitted, the corresponding information is to be displayed instead of the above "default conditions".

2.5.2 When the system detects a malfunction, the corresponding status is to be superimposed on the display.

2.6 Alarms

2.6.1 For each limit stated in [1.3.1], visual and audible alarms are to be fitted on the bridge to indicate when the limit is approached and exceeded.

The alarms associated with each limit are to be clearly distinguishable from those relevant to other limits.

2.6.2 When a warning level is reached (see [1.3.2]), a visible signal is to be issued, distinct from those of the alarms for limits stated in [2.6.1].

2.6.3 When the system detects a malfunction, the alarms and warnings associated with the data are to be inhibited and a malfunction alarm is to be issued (see also [2.5.2]).

2.7 Data storage

2.7.1 The data are to be stored either by a recording device which is part of the Hull Monitoring System, according to [2.7.2] to [2.7.4], or by the integrated bridge system, if any.

2.7.2 An electronic data storage recording device suitable for accumulating statistical information for feedback purposes is to be fitted.

2.7.3 The data storage recording device is to be:

- entirely automatic, excluding replacement operations of the storage support
- such that its operation does not interrupt or delay the process of collecting and treating data.

2.7.4 Data are to be recorded with information on the date and time.

2.8 Exploitation and checking of stored data

2.8.1 The data stored according to [2.7] are to be treated by the Owner through a statistical process.

2.8.2 Periodicity of exploitation of data is to be defined by the Owner depending on the unit's operation.

2.8.3 Means are to be incorporated which ensure that the integrity of the collected data can be checked at the exploitation stage.

2.9 Power supply unit

2.9.1 The Hull Monitoring System is to be powered by the main power source of the unit and in addition with an internal uninterruptible 30 minute power source.

2.10 Calibration

2.10.1 The initial calibration of the Hull Monitoring System is to be based on an approved loading case in still water.

The differences between results obtained from the Hull Monitoring System and approved values are to be less than 5%.

2.10.2 The initial calibration of the Hull Monitoring System is to be carried out with a Surveyor in attendance.

2.11 Periodical inspections

2.11.1 Checks of the main functions of the Hull Monitoring System are to be carried out at intervals as agreed by the Society and not exceeding one year.

The instrument is to include an auto-checking facility so that the verification of the Hull Monitoring System can be carried out without the need of external devices.

Part F
Additional Class Notations

Chapter 4
GREEN PLUS

SECTION 1 SEA AND AIR POLLUTION PREVENTION (GREEN PLUS)

APPENDIX 1 DEFINITIONS RELEVANT THE GREEN PLUS NOTATION

APPENDIX 2 BASIC AND ADDITIONAL SYSTEMS, COMPONENTS AND PROCEDURAL MEANS TO EVALUATE THE UNIT'S ENVIRONMENTAL INDEX AS PER THE GREEN PLUS NOTATION

SECTION 1 SEA AND AIR POLLUTION PREVENTION (GREEN PLUS)

1 General

1.1 Application

1.1.1 The additional class notation **GREEN PLUS** is assigned to units designed and provided with systems, components and procedural means to control and prevent the emission of polluting substances into the sea and the air, in accordance with the requirements of [6].

2 Definitions

2.1

2.1.1 Definitions are those given in:

- MARPOL 73/78 as amended and
- App 1.

3 Documents to be submitted

3.1

3.1.1 The list of plans and documents to be submitted is given in Tab 1. The Society reserves the right to request the submission of additional documents in the case of non-conventional design or if it is deemed necessary for the evaluation of the systems and components.

Table 1 : Documents to be submitted

No.	A/I **(1)**	Document
1	I	Unit Environmental Management Plan
2	A	Drawings with indication of capacities of fuel, sludge and lubricating oil tanks and distances from the base line and shell plates
3	A	Tank general arrangement plan showing the bilge tanks, their capacities and alarms
4	I	General arrangement plan with indication of the zone intended for the stowage of packaged harmful substances in relation to the other zones of the unit
5	I	Plans of systems and equipment to discharge harmful substances in case of emergency and to dispose of and wash possible leaks
6	A	Tank general arrangement plan showing the treated sewage holding tanks, their capacities and their alarms
7	I	Tank general arrangement plan showing the grey water holding tanks, their capacities and relevant alarms
8	A	Ballast water management plan
9	A	Garbage management plan including information on garbage treatment equipment and its control and monitoring system
10	I	General arrangements of refrigeration plants including the indication of retention facilities
11	I	Data sheets with list of intended refrigerants to be used in the different refrigeration systems, their quantities and their GWP and ODP
12	I	Data sheets with the list of fixed fire-fighting means used, their quantities and GWP values
13	I	Detailed plans of systems and equipment to limit SOx emission
14	I	Drawings of fuel oil system, arrangements and procedures for use of separate fuel oil
(1) A = to be submitted for approval in four copies; I = to be submitted for information in duplicate.		

4 Requisites

4.1 General requirements

4.1.1 A Unit Environmental Manager, as defined in App 1, [1.2], is to be available on board.

4.1.2 An Environmental Management Plan, specific to the unit, is to be developed and made available on board. The Plan is to contain at least the procedures listed in App 2.

4.1.3 Adequate training on environmental issues is to be planned, carried out and documented for all the persons on board having influence on the environmental behavior of the unit.

4.2 Basic systems, components and procedural means

4.2.1 Basic systems, components and procedural means, a unit is to be equipped with, are those defined in the requirements of the IMO Conventions in force, as applicable to the unit.

4.3 Additional systems, components and procedural means

4.3.1 The list of additional systems, components and procedural means which can be considered for the assignment of the notation and the values to be used for the calculation of the relevant environmental index, as indicated in [5], are given in the third and fourth column of Tab 2, respectively.

Table 2 : Additional systems, components and procedural means

No.	Pollution source	Item	Environmental index	References (App 2)
1	Oil from Machinery Spaces	Bilge Water Treatment (15 ppm with alarm and automatic stop)	2	[1.1.2]
		Bilge Water Treatment (5 ppm with alarm and automatic stop)	5	[1.1.3]
		Bilge Water Treatment (5 ppm with alarm, automatic stop and recorder)	10	[1.1.4]
		Bilge oil tank	2	[1.1.5]
		Sludge tank	2	[1.1.6]
		Restrictions in the use of unit's fuel tanks for ballast	1	[1.1.7]
		Fuel oil tank protection by means of tank boundary distance from the unit side and bottom	8	[1.1.8]
		Fuel oil tank protection by means of outflow calculation	5	[1.1.9]
		Lubricating oil and sludge tank protection by means of tank boundary distance from the unit side and bottom	7	[1.1.10]
		Lubricating oil and sludge tank protection by means of outflow calculation	5	[1.1.11]
		Oil tank overflow	2	[1.1.12]
		Gutters	2	[1.1.13]
		Dry bilge concept	3	[1.1.14]
		Sludge oil collection and handling facilities	2	[1.1.15]
		Water-lubricated stern tube bearings **(2)**	5	[1.1.16]
		Magnetic coupling on oil pumps	5	[1.1.17]
		Biodegradable lube oil	5	[1.1.18]
		Restriction in the use of hydraulic plants	7	[1.1.19]
2	Oil from cargo area	Cargo tank protection (for FSO and FPSO)	10	[1.2.2]

(1) To be weighted
(2) In case of MODU

No.	Pollution source	Item	Environmental index	References (App 2)
3	Sewage	Treatment plant: effluent quality as per IMO MEPC.2(VI)	2	[1.5.1]
		Treatment plant: effluent quality as per IMO MEPC.159(55)	5	[1.5.2]
		Advanced treatment plant or additional polishing stage: effluent quality as per ADEC Title XIV (33 CFR Part 159 Subpart E)	8	[1.5.3]
		Holding tank	5	[1.5.4]
		Sewage record book	3	[1.5.5]
4	Grey water	Treatment plant: effluent quality as per IMO MEPC.2(VI)	3	[1.6.1]
		Treatment plant: effluent quality as per IMO MEPC.159(55)	7	[1.6.2]
		Advanced treatment plant or additional polishing stage: effluent quality as per ADEC Title XIV (33 CFR Part 159 Subpart E)	10	[1.6.3]
		Holding tank	5	[1.6.4]
		Grey water record book	3	[1.6.5]
5	Garbage	Garbage Management Plan	2	[1.7.1]
		Recycling	10	[1.7.2]
		Advanced recycling	15	[1.7.3]
6	Other sources	Ballast water exchange **(2)**	5	[1.8.1]
		Ballast water treatment **(2)**	10	[1.8.2]
		Marine growth prevention systems	5	[1.8.3]
7	Ozone-depleting substances	Refrigerating facilities	5	[2.1.2]
		Restrictions in the use of GWP substances	10 **(1)**	[2.1.3]
8	Green house gases and pollutants	Non fossil fuels (use of electric power generators and/or propulsion systems that do not use prime movers generating GHGs and pollutants (e.g. fuel cells, etc.))	30 **(1)**	[2.2.1]
		Second generation of bio-fuels	20 **(1)**	[2.2.2]
		Tool to manage handling and consumption of fuels	5	[2.2.3]
		Energy saving and energy conservation	10	[2.2.4]
		Computerized system to monitor fuel consumption	5	[2.2.5]
		Optimization of Air Conditioning (AC) plant (including passive means to decrease AC demand, e.g. reflective glazing)	10	[2.2.6]
		Low energy consumption lights	5	[2.2.7]

(1) To be weighted
(2) In case of MODU

No.	Pollution source	Item	Environmental index	References (App 2)
9	NOx	Gas to liquids (GTL) fuels (NOx emission lower than the limits as per Annex VI to MARPOL 73/78 as amended from prime movers and auxiliary boilers)	15 **(1)**	[2.3.2]
		Fossil fuel pre-treatment (e.g. water emulsion), or water injection into combustion chamber, or scavenging air, or combination of these (NOx emissions lower than the limits as per Annex VI to MARPOL 73/78 as amended from prime movers and auxiliary boilers)	5 **(1)**	[2.3.3]
		Dual-fuel engines running with LNG (NOx emissions lower than the limits as per Annex VI to MARPOL 73/78 as amended from prime movers)	15 **(1)**	[2.3.4]
		Exhaust gas treatment (abatement of not less than 85% of total generated NOx by prime movers)	20 **(1)**	[2.3.5]
		NOx emissions monitoring and recording	3	[2.3.6]
10	SOx	SOx limits (global 3% and SECA 1,5%)	5	[2.4.1]
		SOx limits (1,0%)	20	[2.4.2]
		SOx limits (0,1%)	30	[2.4.3]
		Gas to liquids (GTL) fuels	10 **(1)**	[2.4.4]
		Blending fossil fuel with second-generation bio-fuels	10 **(1)**	[2.4.5]
		Dual-fuel engines running with LNG (gasoil only used as back-up in an emergency)	10 **(1)**	[2.4.6]
		Exhaust gas treatment (abatement of not less than 85% of total generated SOx by prime movers)	20 **(1)**	[2.4.7]
		SOx emissions monitoring and recording	3	[2.4.8]
11	Particulates	Gas to liquids (GTL) fuels (lower PMs emissions)	20 **(1)**	[2.5.1]
		Fuel treatment (lower PMs emissions achieved by fossil fuel pre-treatment (e.g. water emulsion), or blending of pre-treated fossil fuel with second-generation bio-fuels, or combination of these)	15 **(1)**	[2.5.2]
		Lower PMs emission achieved by modifications in prime movers (e.g. common rail) that do not increase other pollutants and GHGs emissions	15 **(1)**	[2.5.3]
		Dual-fuel engines running with LNG (gasoil only used as back-up in emergency)	20 **(1)**	[2.5.4]
		Exhaust gas treatment (abatement of not less than 85% of total generated PMs by prime movers)	10 **(1)**	[2.5.5]
12	CO_2	Gas to liquids (GTL) fuels (reduction in CO_2 emission)	10 **(1)**	[2.6.1]
		Blending fossil fuel with second-generation bio-fuels (reduction in CO_2 emission)	10 **(1)**	[2.6.2]
		Dual-fuel engines running with LNG (gasoil only used as back-up in emergency)	5 **(1)**	[2.6.3]
		CO_2 monitoring and recording	3	[2.6.4]
13	Unit at scrap	Unit recycling - Green Passport	10	[2.7.1]

(1) To be weighted
(2) In case of MODU

4.4 Applicable requirements

4.4.1 The applicable requirements for each basic and additional system, component installed and procedural means adopted are given in App 2.

5 Environmental index

5.1 Index calculation

5.1.1 The environmental index is obtained by adding up the values of the contributions for each additional system, component and procedural means (items) the unit is equipped with, according to Tab 2.

No contribution to the unit's environment index or to the coverage of the relevant pollution source (see [6.1] b)) will be given by those items which are compulsory for the unit, due to:

a) unit tonnage, navigation, etc, or

b) entry into force of IMO Conventions' new requirements.

6 Assignment

6.1 Criteria

6.1.1 The additional class notation **GREEN PLUS** is assigned to a unit:

a) complying with [4.1] and [4.2]

b) having additional systems, components and procedural means selected from items of Tab 2, pertaining to at least ten different pollution sources (as listed in the second column of Tab 2) and

c) having an environmental index calculated in accordance with [5.1] greater than or equal to 100.

7 Novel features

7.1 General

7.1.1 For the assignment of the notation the Society may consider systems, components and procedural means not listed in Tab 2 based on novel principles and features on the basis of tests, calculations or other supporting information.

7.2 Examples

7.2.1 Equipment to maximize the recovery of waste heat, electrical propulsion systems designed to have the maximum efficiency at the different operational conditions of the unit and any other fuel saving techniques may be considered by the Society, on the basis of comparative studies to be submitted, for the calculation of the unit's environmental index.

8 Systems and components

8.1 Systems and components certification

8.1.1 When systems and components are recognized as being capable of improving the unit's environmental behavior, the Society may issue, upon request of the applicant (manufacturer or responsible vendor) a certificate stating the environmental properties of the system or component.

The certificate may be issued in accordance with applicable national or international standards or, in the absence of such standards, on the basis of the manufacturer's standards or specifications.

The compliance to the reference document is ascertained by means of:

- execution of tests; or
- review of test documentation; or
- evidence of positive results during in-service operation; or
- any combination of the above criteria.

APPENDIX 1 DEFINITIONS RELEVANT THE GREEN PLUS NOTATION

1 General

1.1 MARPOL 73/78

1.1.1 MARPOL 73/78 is the IMO "International Convention for the Prevention of Pollution from units, 1973/78, including the Annexes from I to VI as amended.

1.2 Unit Environmental Manager

1.2.1 Unit Environmental Manager is an officer in service on board, in charge of the management and control of the procedures and activities relevant to the requirements of this Chapter.

1.3 Unit recycling

1.3.1 The terms regarding unit recycling used in this Chapter have the meaning provided in IMO Resolution A.962(23) to the wording “ship recycling”.

2 Definitions in connection with prevention of sea pollution

2.1 Grey water

2.1.1 Grey water means drainage from dishwasher, galley, shower, laundry, bath, washbasin drains and toilette scuppers.

2.2 Grey water - Maximum number of persons

2.2.1 Maximum number of persons on board, for the purpose of calculating grey water retention capacity, means the maximum number of persons that can be accommodated in cabins plus the crew.

2.3 Harmful aquatic organisms and pathogens

2.3.1 Harmful aquatic organisms and pathogens means bacteria, plants and animals which can survive in a viable form in the ballast water and sediments.

2.4 Harmful substance

2.4.1 Harmful substance means any substance which, if introduced into the sea, is liable to create hazards to human health, harm living resources and marine life, damage amenities or interfere with other legitimate uses of the sea, and includes any substance subject to control by MARPOL 73/78.

2.5 Harmful substances carried in packaged form

2.5.1 Harmful substances are those substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code (IMDG Code) as amended. Packaged form is the form of containment specified for harmful substances in the IMDG Code.

2.6 Oily wastes

2.6.1 Oily wastes means the water removed from machinery space bilges, used lube and hydraulic oils, sludge from fuel oil and from lube oil treatment systems.

2.7 Sludge oil

2.7.1 Sludge oil means sludge from fuel and lubricating oil separators, waste lubricating oil from main and auxiliary machinery and waste oil from bilge water separators, drip trays, etc.

2.8 TBT free antifouling system

2.8.1 Antifouling system means a coating, paint, surface treatment or device used to control or prevent attachment of organisms.

TBT-free antifouling system means an antifouling system in compliance with the IMO Resolution MEPC.102(48) as amended.

2.9 Treated sewage holding tank

2.9.1 Treated sewage holding tank means a tank used for the collection and storage of the effluent of the sewage treatment plant.

2.10 AFS Certificate

2.10.1 AFS Certificate means "International Antifouling System Certificate" or statement of compliance, issued in accordance with IMO Resolution MEPC.104(48), as amended.

3 Definitions in connection with prevention of air pollution

3.1 Gas to liquid fuels (GTL)

3.1.1 Gas to liquid fuels are those fuels obtained according a refinery process which converts natural gas or other gaseous hydrocarbons into longer-chain hydrocarbons.

3.2 Global Warming Potential (GWP)

3.2.1 Global Warming Potential is the potential global warming effect of a gas compared with CO_2 on a time horizon of 100 years.

3.3 Green House Gases (GHGs)

3.3.1 A Green House Gas is any gas, such as carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), chloro fluoro carbon compounds (CFCs) that contribute to the greenhouse effect when released into the atmosphere.

3.4 Liquefied Natural Gas (LNG)

3.4.1 Liquefied natural gas or LNG is natural gas (primarily methane, CH_4) that has been converted to liquid form for ease of storage or transport.

3.5 Low energy consumption lights

3.5.1 Low energy consumption lights are lights other than incandescent light bulbs, halogen lamps and those having similar lum/W ratio, recognized by appropriate national or international standards.

3.6 Ozone Depleting Potential (ODP)

3.6.1 Ozone Depleting Potential is the potential of ozone depletion compared to CFC 11. Values of ODP for ozone depleting gases are provided in the "Montreal Protocol on Substances that Deplete the Ozone Layer".

3.7 Particulates (PMs)

3.7.1 Particulates, alternatively referred to as particulate matter (PM) or fine particles, are tiny particles of solid or liquid suspended in a gas.

3.8 Second generation bio-fuels

3.8.1 Second generation bio-fuels are those produced sustainably by using biomass comprised of the residual non-food parts of current crops, such as stems, leaves and husks that are left behind once the food crop has been extracted, as well as other crops that are not used for food purposes, such as switch grass and cereals that bear little grain, and also industry waste such as wood chips, skins and pulp from fruit pressing etc., whereby the complete cycle from production to consumption, allows to obtain, with equal total power generated, a reduction in CO_2 emissions of over 85% compared to fossil fuels.

APPENDIX 2 BASIC AND ADDITIONAL SYSTEMS, COMPONENTS AND PROCEDURAL MEANS TO EVALUATE THE UNIT'S ENVIRONMENTAL INDEX AS PER THE GREEN PLUS NOTATION

1 Prevention of sea pollution

1.1 Oil from machinery spaces

1.1.1 Compliance with Annex I to MARPOL 73/78 as amended

Compliance with Annex I to MARPOL 73/78 as amended is to be assured.

1.1.2 Bilge Water Treatment (15 ppm with alarm and automatic stop)

The oil filtering equipment is to grant maximum oil content in the effluent up to 15 ppm, be provided with an oil content meter and with a 15 ppm alarm in a manned position, combined with automatic stopping device.

The effluent from the 15 ppm filtering equipment is to be capable of being re-circulated to the bilge water holding tank, see [1.1.5].

1.1.3 Bilge Water Treatment (5 ppm with alarm and automatic stop)

The oil filtering equipment is to grant maximum oil content in the effluent up to 5 ppm, be provided with an oil content meter and with a 5 ppm alarm in a manned position, combined with automatic stopping device.

If additional equipment is installed to ensure the above performance, it is to be approved by the Society.

If the performance of 5 ppm is ensured by a system type approved according to applicable MARPOL regulations, such performance is to be verified by the Society.

The effluent from the 5 ppm filtering equipment is to be capable of being re-circulated to the bilge water holding tank, see [1.1.5].

1.1.4 Bilge Water Treatment (5 ppm with alarm, automatic stop and recorder)

In addition to [1.1.3] the following is to be provided with:

a) a monitoring and control system, supervising the overboard discharge of the treated bilge water and including a fuel oil grease monitor, a flow meter, control means, valves and fittings, capable of:
   1) providing a fail-safe system for discharging treated bilge water overboard including immediate shutdown of Bilge Water Separator in the event of
      - high oil content
      - insufficient flow of sampling water through the Oil monitor
      - the rinse/sampling valves (inlet and outlet) of the Oil monitor are not closed
   2) measuring the flow of the water and the oil content value
   3) giving alarm signals
   4) controlling the position of the overboard discharge three-way valve

   The open command of remote controlled overboard discharge valve is to be authorised from the bridge and indication of the status of manually operated overboard discharge valves is to be available on the bridge.
b) a recorder capable of recording
   1) time
   2) run stop time of bilge water separator
   3) all the data from the monitoring and control system as described in a).

1.1.5 Bilge oil tank

All machinery space bilges are to be drained into a holding tank for pre-separation upstream of the oil separation and filtering equipment.

Alternative installations may be considered on a case-by-case basis.

The volume V of the holding tank, in m^3, is to be at least:

$V = 1 + 5{,}5\ P \cdot 10^{-4}$

where P is the power of the propulsion engine plant, in kW.

In any event, it is not required that the volume V is greater than 15 m^3.

Taking into account the unit service, navigation (if any) and installed power, a smaller volume V may be accepted on a case-by-case basis.

The tank is to be so arranged as to allow periodical removal of sediments.

For units operating with fuel oil having a mass density at 15°C greater than 0,94 kg/dm^3 and viscosity at 50°C greater than 110 centistokes, this tank is to be provided with heating arrangements.

A high level alarm is to be given in a manned position.

1.1.6 Sludge tank

The sludge tank is to be so arranged as to allow periodical removal of sediments.

Sludge is to be disposed of on board through the incinerator or discharged ashore and is to be recorded in the oil record book.

Use of boilers for sludge disposal on board is not allowed.

However when a treatment system or special device is installed to improve emissions generated by sludge incineration, subject to Society's approval, use of boiler for sludge disposal may be permitted.

Units operating with heavy fuel oil are to be provided with tanks for sludge from the fuel oil purifiers with a suitable heating system.

A high level alarm is to be given in a manned position.

1.1.7 Restrictions in the use of unit's tanks for ballast

The use of tanks intended for fuel oil as ballast tanks is not allowed, irrespective of their volume.

1.1.8 Fuel oil tank protection by means of tank boundary distance from the unit side and bottom

The protection of the tanks is to be achivied applying the criteria of MARPOL Annex I Reg. 12A based upon the distance of fuel oil tanks boundary from the unit side and bottom.

In case the adoption of fuel oil tank protection criteria is compulsory for the concerned unit, no contribution to the unit's environmental index will be considered for fuel oil tank protection.

1.1.9 Fuel oil tank protection by means of outflow calculation

The protection of the tanks is to be achieved applying the criteria of MARPOL Annex I Reg. 12A based upon outflow calculation.

In case the adoption of fuel oil tank protection criteria is compulsory for the concerned unit, no contribution to the unit's environmental index will be considered for fuel oil tank protection.

1.1.10 Lubricating oil and sludge tank protection by means of tank boundary distance from the unit side and bottom

The protection of the tanks (having a capacity of 20 m^3 and above) is to be achieved applying the criteria of MARPOL, Annex I, Reg. 12A (independently from their total aggregate capacity) based upon the distance of fuel oil tanks boundary from the unit side and bottom.

The requirement is not applicable to the double bottom for lubricating oil located under the main engine.

1.1.11 Lubricating oil and sludge tank protection by means of outflow calculation

The protection of the tanks (having a capacity of 20 m3 and above) is to be achieved applying the criteria of MARPOL Annex I Reg. 12A (independently from their total aggregate capacity) based upon outflow calculation.

The requirement is not applicable to the double bottom for lubricating oil located under the main engine.

1.1.12 Oil tank overflow

a) All fuel oil and lubricating oil tanks of capacity greater than 10 m^3 are to be fitted with an overflow system and a high level alarm.

   Acceptable alternatives are:

   - an overflow system and a flow alarm in the overflow main
   - no overflow system and two high level alarms (for instance at 90% and 95% of filling).

b) The alarm signals are to be given in a suitable position from which bunkering or transfer operations are controlled.

1.1.13 Gutters

On the weather and/or superstructure decks each fuel or lubricating oil tank vent, overflow and fill pipe connection is to be fitted with a fixed container or enclosed deck area with a capacity of:

- 80 litres if the gross tonnage of the unit is between 300 and 1600
- 160 litres if the gross tonnage of the unit is greater than 1600.

1.1.14 Dry bilge concept

An adequate number of tanks of 1 m^3 minimum each is to be installed to collect drainage water from one or more equipment (e.g. diesel engine scavenging air coolers, potable water analyzers, low temperature heat exchangers) within the same compartment which have drainage water with similar characteristics. Such tanks have the function to drastically reduce water drainage to bilge spaces and so reduce the oily water, emulsified bilge water and other contaminated water collecting in bilge wells.

Each tank is to be equipped with automatic transfer means, level indicator for local control and high level alarm given in a manned position.

1.1.15 Sludge oil collection and handling facilities

An adequate number of tanks of 100 l approximate capacity each is to be installed to collect oily liquids from drains, vents, seals and glands of all equipment in machinery spaces and bunker stations connected to a fuel oil and lubricating oil system.

The tanks are to be installed outside the double bottom. Drain lines must not pass through watertight bulkheads or tank tops.

The tanks are to be in addition to the drain tanks dedicated to each purifier module for the collection of generated sludge.

The tanks are to be equipped with automatic transfer means, level indicator for local control and high level alarm given in a manned position connected to the automation system.

A hand pump is to be additionally provided which levers are to be located at floor level to facilitate operations;

where this is not possible, a platform with a vertical ladder is provided for access to the pump.

Drain tanks of purifier modules are to be provided for each purifier skid, equipped with a high level alarm given to a manned position, connected to the Control and Monitoring Panel of each purifier.

Drain tanks are to be discharged to the Sludge Tank in [1.1.6] by means of a power operated pump. All discharge lines are sized to allow pumping without the need to heat the sludge.

1.1.16 Water-lubricated stern tube bearings

Stern tube bearings, if any, are to be water lubricated.

1.1.17 Magnetic coupling on oil pumps

Magnetic couplings are to be used to connect fuel oil and lubricating oil pumps and relevant drivers.

These couplings are to be approved by the Society.

1.1.18 Biodegradable lube oil

Biodegradable oils are to be used for the lubrication of machineries, apart from diesel engines, and for hydraulic systems. The oil biodegradability characteristic is to be according to a recognized standard.

1.1.19 Restrictions in the use of hydraulic plants

All manoeuvring systems (steering gear, if any, watertight doors, hatches, valves etc) apart from, for MODU, the controllable pitch propeller actuating systems, are not to be of hydraulic type.

1.1.20 Procedures

a) The lube oil consumption of all systems having an oil to sea interface, such as main and auxiliary engines cooled by sea water, sterntubes, bow and stern thrusters, if any, and for MODU controlled pitch propellers, PODs etc, is to be recorded at least once a week in an "Oil Systems record book" aimed at detecting, through unusually high consumption, oil leakage through sealings.

   The log-book is to contain the list of all systems concerned, the consumption of each system recorded at least every week and corrective actions when carried out.

b) The Unit Environmental Management Plan, referred to in Sec 1, [4.1.2], is to include procedures covering the following:

   - oily waste management including discharge criteria;
   - preparation, filling in and maintenance of the oil record book;
   - periodical calibration, at least every six months, of the oil content meters; documentation is to be kept on board for examination during periodical surveys;
   - periodical cleaning of the bilge holding tank and of the sludge tank
   - spillage during bunkering;
   - periodical checks of the overflow systems/alarms.

1.2 Oil from cargo area

1.2.1 Compliance with Annex I to MARPOL 73/78 as amended

Compliance with Annex I to MARPOL 73/78 as amended is to be assured.

1.2.2 Cargo tank protection (for FSO and FPSO)

The entire cargo tank length is to be protected by wing tanks or other spaces not carrying oil, in compliance with Reg. 19.3.1 and 19.3.3 of Annex I to Marpol 73/78 as amended.

1.3 Noxious substances carried in bulk

1.3.1 Compliance with Annex II to MARPOL 73/78 as amended

Compliance with Annex II to MARPOL 73/78 as amended is to be assured.

1.4 Harmful substances carried in packaged form

1.4.1 Procedures

Compliance with Annex III to MARPOL 73/78 as amended is to be assured.

The carriage of harmful substances in packaged form has to comply with the requirements of MARPOL 73/78, Annex III as amended.

1.4.2 Compliance with Annex III to MARPOL 73/78 as amended

The Unit Environmental Management Plan, referred to in Sec 1, [4.1.2], is to include procedures covering the following.

a) Stowage

   1) Harmful substances are to be properly stowed and secured so as to minimise the hazards to the marine environment without impairing the safety of the unit and persons on board.

   2) Certain harmful substances, for sound scientific and technical reasons, may need to be prohibited for carriage or be limited as to the quantity which may be carried aboard any one unit. In limiting the quantity, due consideration is to be given to the size, construction and equipment of the unit, as well as the packaging and the inherent nature of the substances.

   3) Each unit carrying harmful substances is to have a special list or manifest setting forth the harmful substances on board and the location thereof. A detailed stowage plan which sets out the location of the harmful substances on board may be used in place of such special list or manifest.

b) Empty packages

   Empty packages which have been used previously for the carriage of harmful substances are themselves to be treated as harmful substances, unless adequate precautions have been taken to ensure that they contain no residue that is harmful to the marine environment.

c) Marking

1) Packages containing a harmful substance are to be durably marked with the correct technical name (trade names alone are not to be used) and, additionally, are to be durably marked or labelled to indicate that the substance is a marine pollutant. Such identification is to be supplemented where possible by other means, for example, by use of the relevant United Nations number.

2) The method of marking the correct technical name and of affixing labels on packages containing a harmful substance is to be such that this information will still be identifiable on packages surviving at least three months' immersion in the sea. In considering suitable marking and labelling, account is to be taken of the durability of the materials used and of the surface of the package.

3) Packages containing small quantities of harmful substances may be exempted from the marking requirements.

d) Leaks

1) Jettisoning of harmful substances carried in packaged form is not permitted, except where necessary for the purpose of securing the safety of the unit or saving life at sea.

2) Appropriate measures based on the physical, chemical and biological properties of harmful substances are to be taken to regulate the washing of leakages overboard, provided that compliance with such measures would not impair the safety of the unit and persons on board.

1.5 Sewage

1.5.1 Treatment plant: effluent quality as per IMO MEPC.2(VI)

A sewage treatment plant, meeting operational requirements based on the standards and test methods as detailed in Resolution MEPC.2(VI), as amended, is to be installed on board.

1.5.2 Treatment plant: effluent quality as per IMO MEPC.159(55)

A sewage treatment plant, meeting operational requirements based on the standards and test methods as detailed in Resolution MEPC.159(55) is to be installed on board.

The system performance is to be certified.

1.5.3 Advanced treatment plant or additional polishing stage: effluent quality as per ADEC Title XIV (33 CFR Part 159 Subpart E)

A sewage treatment plant, meeting operational requirements based on the standards and test methods as detailed in ADEC Title XIV (33 CFR Part 159 Subpart E) is to be installed on board.

The system performance is to be certified.

1.5.4 Holding tank

The unit is to be equipped with holding tank(s) for treated sewage with sufficient capacity to allow storage of treated sewage when in port or in no discharge areas.

The minimum total capacity of such tank(s) is to be 2 days based on the maximum number of persons on board and 96 litres/person/day if a conventional (flush-meter) system is used and 11 litres/person/day if a vacuum system is used.

A high level alarm is to be given in a manned position.

1.5.5 Sewage record book

All sewage discharges whether to sea or shore reception facilities are to be recorded in the sewage record book with indication of the date, location and quantity of sewage discharged, and are to comply with Annex IV to MARPOL 73/78 as amended.

1.5.6 Procedures

The Unit Environmental Management Plan, referred to in Sec 1, [4.1.2], is to include procedures covering the following:

- sewage management including discharge criteria and use of holding tanks in port and no discharge areas;
- preparation, filling in and maintenance of the sewage record book;
- disposal of sewage treatment plant residues. If the unit is not in a condition to dispose at sea of sewage treatment plant residues in accordance with international or national regulations, such residues are to be disposed ashore or by incineration.

1.6 Grey water

1.6.1 Treatment plant: effluent quality as per IMO MEPC.2(VI)

A grey water treatment plant, granting an effluent quality meeting the limits as detailed in Resolution MEPC.2(VI), as amended, is to be installed on board.

1.6.2 Treatment plant: effluent quality as per IMO MEPC.159(55)

A grey water treatment plant granting an effluent quality meeting the limits as detailed in Resolution MEPC.159(55) is to be installed on board.

The system performance is to be certified.

1.6.3 Advanced treatment plant or additional polishing stage: effluent quality as per ADEC Title XIV (33 CFR Part 159 Subpart E)

A grey water treatment plant granting an effluent quality meeting the limits as detailed in ADEC Title XIV (33 CFR Part 159 Subpart E) is to be installed on board.

The system performance is to be certified.

1.6.4 Holding tank

Units are to be equipped with holding tank(s) for grey water with sufficient capacity to allow storage of grey water when in port for at least 2 days. The total capacity of grey water holding tanks is to be based on the maximum number of persons (see App 1, [2.3]) on board and 200 litres/person/day.

A high level alarm is to be given in a manned position.

If the same tanks are used to hold treated sewage and grey water, their capacity is to be at least the sum of the capaci-

ties for the treated sewage holding tanks in [1.5.4] and the tanks for grey water.

A smaller volume, in any case not lower than 50% of the above capacity, may be accepted provided that:

- the unit is equipped with a system for treating grey water, able to reduce the volume of the effluent (e.g. by reusing part of the treated grey water for on board use);
- 2 days' retention is ensured;
- technical documentation, including results of onboard tests, of the system's efficiency and of effluent volume reduction is documented to the satisfaction of the Society.

Grey water is always to be discharged at a distance of more than 4 nautical miles from the nearest land or to a reception facility.

The discharging criteria do not apply when the discharge of grey water is necessary for securing the safety of the unit and those on board, or saving life at sea, or when the discharge results from damage to the unit or its equipment.

1.6.5 Grey water record book

All grey water discharges whether to sea or shore reception facilities are to be recorded in the grey water record book with indication of the date, location and quantity of grey water discharged. If the grey water is discharged to sea, the records are to include information on distance to the nearest land.

1.6.6 Procedures

The Unit Environmental Management Plan, referred to in Sec 1, [4.1.2], is to include procedures for the grey water discharge criteria and use of holding tanks in ports and in no discharge areas.

1.7 Garbage

1.7.1 Garbage Management Plan

Special consideration in the garbage management plan is to be given to the following potentially hazardous wastes, such as:

- photographic and x-ray development wastes
- cleaning solvent wastes
- photocopying and printer cartridges
- unused pharmaceuticals
- batteries
- lamp bulbs.

1.7.2 Recycling

A strategy of waste recycling is to be foreseen, adopted and documented;

The minimum total quantity of wastes landed for recycling (Wr) is to be 50% of recyclable wastes produced on board (Wb), where Wb = 40 Kg/person/year based on the number of persons the unit is certified to carry.

The amount of waste landed for recycling is to be recorded in the garbage record book, and different wastes are to be collected and landed separately.

For the purpose of this Rule, recyclable wastes include but are not limited to:

- Plastic
- Aluminium
- Glass
- Paper-Cardboard.

1.7.3 Advanced recycling

The garbage collection systems are to be designed and installed to facilitate the efficient collection of all wet waste and dry waste generated onboard and to treat such waste in the most effective and environmentally-friendly manner. All recyclable wastes are to be separated for type and treated to reduce volume and consent offloading ashore for recycling. As far as the technology allows, all processes are to be fully automatic and continuous.

1.7.4 Procedures

The Unit Environmental Management Plan, referred to in Sec 1, [4.1.2], is to include procedures covering the Garbage management and waste recycling, according to this item.

1.8 Other sources

1.8.1 Ballast water exchange

A ballast water management plan, including a ballast water record book, is to be developed in accordance with Reg. D-1 of the IMO "International Convention for the control and management of unit's ballast water and sediments, 2004" and used for ballast water management.

Unless stricter requirements are enforced by the Port State, it is recommended that ballast water exchange is carried out during international voyages at not less that 200 miles from the nearest land or, if not possible, at not less than 50 miles from nearest land in a zone with water depth not less than 200 m. The unit is not to be required to deviate from its intended voyage, or delay the voyage in order to comply with these requirements.

Systems for the treatment of ballast water may be accepted in place of the ballast water exchange, subject to consideration by the Society.

1.8.2 Ballast water treatment

A ballast water treatment plant, complying with Reg. D-2 of the IMO "International Convention for the control and management of unit's ballast water and sediments, 2004", is to be installed onboard.

The system performance is to be certified.

1.8.3 Marine growth prevention systems

Antifouling systems for pipings are to be based on environmentally friendly technologies, not discharging harmful products and approved by the Society.

2 Prevention of air pollution

2.1 Ozone depleting substances

2.1.1 Compliance with Annex VI to MARPOL 73/78 as amended

Compliance with Annex VI to MARPOL 73/78 as amended is to be assured.

2.1.2 Refrigerating facilities

The following requirements apply to units with refrigerating facilities.

They apply to:

- storage or production installation
- centralised refrigeration systems for provision stores
- centralised air conditioning plants.

They do not apply to domestic type stand-alone refrigerators and air conditioning units.

Means are to be provided to limit leaks to the atmosphere of refrigerants or their vapours in the event of failure of the plant, as well as in the case of discharge of refrigerant to an onshore reception facility.

Annual refrigerant leakage is to be less than 10% of the total refrigerant charge of each system.

The system is be fitted with evacuation (e.g. compressors) and retention facilities having the capacity to retain all the refrigerants, should the need to evacuate the whole plant arise in an emergency.

The plant is to be designed in such a way as to minimise the risk of medium release in the case of maintenance, repair or servicing; i.e. it is to be designed considering the possibility of isolating those sections which are to be serviced by a system of valves and bypasses, in such a way as not to stop the operation of the plant while in service, preventing the risk of release of the medium outside of the plant.

Materials for piping and equipment specifically designed to limit the emission of refrigerants are to be tested in accordance with the applicable requirements for testing materials intended to be used for the construction of similar types of piping and equipment and their classes and/or design conditions.

Piping and equipment specifically designed to limit the emission of refrigerants are to be inspected and tested during fabrication in accordance with the requirements applicable to similar types of piping or equipment and their classes and/or design conditions.

After installation on board, the plant acceptance trials are to include the operation of the evacuation of the entire refrigerant from the plant to the reception facilities without any release of refrigerant and/or refrigerant vapours. The control, monitoring and alarm systems are also to be tested in the presence of the Surveyor, or their functioning is to be simulated by a procedure agreed with the Society.

2.1.3 Restrictions in the use of GWP substances

The following requirements apply to units with refrigerating facilities.

They apply to:

- storage or production installation
- centralised refrigeration systems for provision stores
- centralised air conditioning plants
- refrigeration plants and air conditioning plant that do not (or only partially use) GWP substances.

Refrigeration or air conditioning plant systems using HFC designed such as to minimize piping systems carrying HFC (e.g. systems that utilize an intermediate cooling media for refrigerated cargo spaces/provision plants/AC Ventilation Units) are considered as suitable alternatives to non- GWP type.

The requirements do not apply to domestic type stand-alone refrigerators and air conditioning units.

Non-GWP refrigerants considered are, e.g. NH3, CO_2, Silica Gel or others having an equivalent GWP impact.

The environmental index in Tab 2 is weighted multiplying by R, defined as follows:

$R = (P_{TOT} - P_{HFC}) / P_{TOT}$

Where

P_{HFC} = Refrigerating capacity at - 10 °C evaporating temperature and + 25°C condensing temperature of refrigerating plant utilizing HFC [kcal/h]

P_{TOT} = Refrigerating capacity at - 10 °C evaporating temperature and + 25°C condensing temperature of any refrigerating plant independently from the utilized medium [kcal/h]

2.1.4 Procedures

The Unit Environmental Management Plan, referred to in Sec 1, [4.1.2], is to contain the following:

a) procedures to be followed to minimise the risk of depleting the refrigerant or the refrigerant vapours in all operative and emergency conditions

b) procedures for corrective actions to be undertaken in the event the annual leakage exceeds 10%

c) procedures for preparing, filling and updating the refrigerant log-book. The leakage is to be documented by consumption figures recorded in a refrigerant log-book to be kept on board and made available during periodical surveys.

2.2 Green House Gases and Pollutants

2.2.1 Non fossil fuels

Where power on board is partially or totally produced with systems which do not use fossil fuels (e.g. fuel cells, etc.), the environmental index in Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{\text{non fossil}}$ fuels $/ \Sigma P_{TOT}$

Where

$P_{\text{non fossil fuels}}$ = Nominal power of each power source not using fossil fuel [kW]

P_{TOT} = Nominal power of each power source independently from the utilized fuel [kW]

2.2.2 Second generation of bio-fuelss

Where second generation bio-fuels are partially or totally used on board, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{sgbf} / \Sigma P_{TOT}$

Where

P_{sgbf} = Nominal power of each user which utilizes second generation bio-fuel [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel [kW]

2.2.3 Tool to manage handling and consumption of fuels

The unit is to be provided with a system to monitor and record:

a) fuel supplies to the unit and

b) fuel consumption of the unit.

Data may be inserted manually.

2.2.4 Energy saving and energy conservation

The unit is to be provided with an operational manual, acceptable to the Society, indicating the procedures used on board to comply with energy saving and energy conservation criteria.

At least the following areas are to be considered in the manual:

- propulsion, if any
- electric production
- electric users for propulsion, if any
- electric users for hull services (bilge, ballast)
- electric users for navigation, if any
- electric users for accommodation services (galley, laundries, lighting and A/C etc)
- steam production and users
- process installations, if any.

2.2.5 Monitoring of fuel consumption

Engine room automation system or an independent computerised tool has to include means for continuous monitoring the fuel consumption at least of the following users:

- engines
- oil fired boilers
- other oil fired users (e.g. inert gas generators).

2.2.6 Optimization of Air Conditioning (AC) plant

Means are to be provided to optimize AC plant, including the use of passive means to decrease AC demand (e.g. reflective glazing).

2.2.7 Low energy consumption lights

At least 80% in power of the lighting fittings is to be of low consumption type.

2.3 Nitrogen Oxides

2.3.1 Compliance with limits as per Annex VI to MARPOL 73/78 as amended

Compliance with limits as per Reg. 13 of Annex VI to MARPOL 73/78 as amended is to be assured.

2.3.2 Gas to liquids (GTL) fuels

Where GTL fuels are partially or totally used on board, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{GTL} / \Sigma P_{TOT}$

Where

P_{sgbf} = Nominal power of each user which utilizes GTL fuel [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel [kW]

Diesel engines, which are not subject to Reg. 13 of MARPOL Annex VI, are not to be taken into account.

2.3.3 Fossil fuel pre-treatment (e.g. water emulsion), or water injection into combustion chamber, or scavenging air, or combination of these

Where fossil fuel pre-treatment (e.g. water emulsion), or water injection into combustion chamber, or scavenging air, or combination of these are partially used on board, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{FT} / \Sigma P_{TOT}$

Where

P_{FT} = Nominal power of each user which utilizes fuel treatment [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel [kW]

Diesel engines, which are not subject to Reg. 13 of Annex VI to MARPOL, are not to be taken into account.

2.3.4 Dual-fuel engines running with LNG

The fuel used on board is to be LNG (gasoil only used as back-up in emergency).

Diesel engines, which are not subject to Reg. 13 of Annex VI to MARPOL, are not to be taken into account.

Depending on installation a weighted index may be necessary.

2.3.5 Exhaust gas treatment

Each diesel engine subject to Reg. 13 of Annex VI to MARPOL is to be fitted with an exhaust gas treatment system which abates not less than 85% the total generated NOx and which does not increase total fuel consumption at the engine maximum continuous rating by more than an averaged 2%.

The system is to be acceptable to the Society in compliance with Sec 1, [8] as applicable.

Depending on installation a weighted index may be necessary.

2.3.6 NOx emissions monitoring and recording

The unit is to be fitted with system for monitoring and recording the NOx emissions from diesel engines and boilers.

Diesel engines, which are not subject to Reg. 13 of Annex VI to MARPOL are not to be taken into account.

The system is to be acceptable to the Society in compliance with Sec 1, [8] as applicable.

2.4 Sulphur Oxides

2.4.1 SOx limits (global 3,0 % and SECA 1,5 %)

The sulphur content of any fuel used on board is not to exceed 3,0 % by mass except within SOx emission control area where it is not to exceed 1,5% by mass.

2.4.2 SOx limits (1,0 %)

The sulphur content of any fuel oil used on board is not to exceed 1,0 % by mass.

2.4.3 SOx limits (0,1 %)

The sulphur content of any fuel oil used on board is not to exceed 0,1 % by mass.

2.4.4 Gas to liquids (GTL) fuels

Where GTL fuels are partially or totally used on board, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{GTL} / \Sigma P_{TOT}$

Where

P_{GTL} = Nominal power of each user which utilizes GTL fuel [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel [kW].

2.4.5 Blending fossil fuel with second-generation bio-fuels

Where blending (of fossil fuel with second generation bio-fuels), ensuring a sulphur content not exceeding 1,5% by mass, are partially or totally used on board, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{sgbf} / \Sigma P_{TOT}$

Where

P_{sgbf} = Nominal power of each user which utilizes blending [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel[kW]

2.4.6 Dual-fuel engines running with LNG

The fuel used on board is to be LNG (gas oil only used as back-up in emergency).

Diesel engines, which are not subject to Reg. 13 of Annex VI to MARPOL, are not to be taken into account.

Depending on installation a weighted index may be necessary.

2.4.7 Exhaust gas treatment

Each diesel engine subject to Reg. 13 of Annex VI to MARPOL is to be fitted with an exhaust gas treatment system which abates not less than 85% the total generated SOx and which does not increase total fuel consumption at the engine maximum continuous rating by more than an averaged 2%.

The system is to be acceptable to the Society in compliance with Sec 1, [8] as applicable.

Depending on installation a weighted index may be necessary.

2.4.8 SOx emissions monitoring and recording

The unit is to be fitted with system for monitoring and recording the SOx emissions from diesel engines and boilers.

Diesel engines, which are not subject to Reg. 13 of Annex VI to MARPOL, are not to be taken into account.

The system is to be acceptable to the Society in compliance with Sec 1, [8] as applicable.

2.5 Particulates

2.5.1 Gas to liquids (GTL) fuels

Where GTL fuels are partially or totally used on board the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{GTL} / \Sigma P_{TOT}$

Where

P_{GTL} = Nominal power of each user which utilizes GTL fuel [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel [kW]

Diesel engines, which are not subject to Reg. 13 of Annex VI to MARPOL, are not to be taken into account.

2.5.2 Fuel treatment

Where fossil fuel pre-treatment (e.g. water emulsion), or water injection into combustion chamber, or scavenging air, or blending of pre-treated fossil fuel with second-generation bio-fuels or combination of these are partially used on board, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{FT} / \Sigma P_{TOT}$

Where

P_{FT} = Nominal power of each user which utilizes fuel treatment [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel [kW]

Diesel engines, which are not subject to Reg. 13 of Annex VI to MARPOL, are not to be taken into account.

2.5.3 Lower PMs emission achieved by modifications in prime movers (e.g. common rail) that do not increase other pollutants and GHGs emissions

Where modification in prime movers are carried out, to achieve lower PMs emission without increasing other pollutant and GHG emissions, only partially, the environmen-

tal index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{mpm} / \Sigma P_{TOT}$

Where

P_{mpm} = Nominal power of modified prime movers [kW]

P_{TOT} = Nominal power of each prime mover independently if modified or not [kW]

Diesel engines, which are not subject to Reg. 13 of Annex VI to MARPOL, are not to be taken into account.

2.5.4 Dual-fuel engines running with LNG

The fuel used on board is to be LNG (gasoil only used as back-up in emergency).

Diesel engines, which are not subject to Reg. 13 of Annex VI to MARPOL, are not to be taken into account.

Depending on installation a weighted index may be necessary.

2.5.5 Exhaust gas treatment

Each diesel engine subject to Reg. 13 of Annex VI to MARPOL is to be fitted with an exhaust gas treatment system which abates not less than 85% the total generated PMs and which does not increase total fuel consumption at the engine maximum continuous rating by more than an averaged 2%.

The system is to be acceptable to the Society in compliance with Sec 1, [8] as applicable.

Depending on installation a weighted index may be necessary.

2.6 Carbon Dioxide (CO_2)

2.6.1 Gas to liquids (GTL) fuels

Where GTL fuels are partially or totally used on board for CO_2 reduction, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{GTL} / \Sigma P_{TOT}$

Where

P_{GTL} = Nominal power of each user which utilizes GTL fuel [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel [kW]

Diesel engines, which are not subject to Reg. 13 of Annex VI to MARPOL, are not to be taken into account.

2.6.2 Blending fossil fuel with second-generation bio-fuels

Where blending (of fossil fuel and second generation bio-fuels) are partially or totally used on board for CO_2 reduction, the environmental index in Sec 1, Tab 2 is weighted multiplying by R, defined as follows:

$R = \Sigma P_{sgbf} / \Sigma P_{TOT}$

Where

P_{FT} = Nominal power of each user which utilizes blending [kW]

P_{TOT} = Nominal power of each user independently from the utilized fuel [kW]

2.6.3 Dual-fuel engines running with LNG

The fuel used on board is to be LNG (gas oil only used as back-up in emergency).

Diesel engines, which are not subject to Reg. 13 of Annex VI to MARPOL, are not to be taken into account.

Depending on installation a weighted index may be necessary.

2.6.4 CO_2 emissions monitoring and recording

The unit is to be fitted with system for monitoring and recording the CO_2 emissions from diesel engines and boilers.

Diesel engines, which are not subject to Reg. 13 of Annex VI to MARPOL, are not to be taken into account.

The system is to be acceptable to the Society in compliance with Sec 1, [8] as applicable.

2.7 Unit Recycling

2.7.1 General

The unit has to comply with the following requirements and is to be provided with a green passport as indicated hereinafeter.

2.7.2 Some of the problems associated with unit recycling might be addressed at the design and construction stage, not only in relation to the units themselves but also in respect of their units equipment.

The first step is to identify any potentially hazardous materials which might be incorporated, as a matter of routine, in the structure of units and their equipment and, where practicable, consider using less hazardous alternatives.

2.7.3 The initial stages might include an evaluation of:

a) the type, amount and potential hazard of materials utilised and their location on board;

b) the activities expected during the operation of the unit and any potentially hazardous wastes which might be generated; and

c) the feasibility of addressing the potential for hazardous waste generation by considering:

   1) product reformulation - installing components utilising less potentially hazardous materials;

   2) cleaner production technologies - which generate less waste;

   3) process modification - to generate less waste;

   4) input substitution - utilising less potentially hazardous consumables or those which generate less waste; and

   5) on-site, closed-loop recycling - systems that recycle wastes on board.

2.7.4 When designing and constructing a unit, due account is to be taken of the unit's ultimate disposal, by:

a) using materials which can be recycled safely and in an environmentally sound manner; and

b) minimising the use of materials known to be potentially hazardous to health and the environment.

2.7.5 In order to contribute towards minimising potential problems related to protection of the environment in the recycling of units, guidelines on ship recycling have been adopted by IMO with Resolution A.962(23) to give guidance to all stakeholders in the unit recycling process.

The Green Passport is to be developed according to the above mentioned Resolution A.962(23) - IMO Guidelines on Ship Recycling, paragraph 5.

The Green Passport for units is a document facilitating the application of these Guidelines providing information with regard to materials known to be potentially hazardous utilised in the construction of the unit, its equipment and systems. This is to accompany the unit throughout its operating life. Successive Owners of the unit are to maintain the accuracy of the Green Passport and incorporate into it all relevant design and equipment changes, with the final Owner delivering the document, with the unit, to the recycling facility.

Part F
Additional Class Notations

Chapter 5
HELIDECK

SECTION 1 GENERAL

SECTION 2 STRUCTURE

SECTION 3 REFUELING AND HANGAR FACILITIES

SECTION 4 FIRE SAFETY

SECTION 1 GENERAL

1 General

1.1 Application

1.1.1 -

The additional class notations:

- **HELIDECK-H**
- **HELIDECK**

are assigned in accordance with Pt A, Ch 1, Sec 2, [6.10.12] to units which have been assigned the service notation **MODU**, **FSO**, **FPSO**, **FSRU** or **FLNG** fitted with helicopter facilities (i.e. platforms specifically built for the landing of helicopters or areas of open decks intended for the same purpose).

1.1.2 The requirements set out in this Chapter 5 are applied by the Society for the purposes of the class notations in [1.1.1]. Compliance with these requirements does not absolve the interested parties from obligations regarding different and/or more stringent regulations issued by Flag Administration, International Organizations or other concerned Parties, if applicable.

1.2 Documents to be submitted

1.2.1 The documents in Tab 1 are required.

Table 1 : Documentation to be submitted -

No	I/A **(1)**	Document **(2)**
1	I	General arrangement plan
2	I	Main characteristics of the helicopter intended to use the helideck (main dimensions and weight)
3	A	General plan showing the markings to be fitted on the helideck
4	A	Structural plans of the helideck showing also the connection of the helideck with the unit's hull
5	A	Diagram of the fuel supply system
6	A	Structural fire protection, showing the purpose of the various adjacent spaces and the fire rating of relevant bulkheads and decks
7	A	Natural and mechanical ventilation systems (including ventilation systems serving hazardous spaces) showing: • position of vent inlets and outlets • penetrations on "A" class divisions; • location of dampers; • means of closing; • arrangements of air conditioning rooms; • location of fan controls; • air changes per hour (where requirements for air changes per hour are set)
8	A	Automatic fire detection systems
9	A	Fire pumps and fire main including pump head and capacity, hydrant and hose locations
10	A	Arrangement of fixed fire-extinguishing systems

(1) A : to be submitted for approval, in four copies
I : to be submitted for information, in duplicate.

(2) Plans are to be schematic and functional and to contain all information necessary for their correct interpretation and verification, such as:

- structural scantling
- service pressures
- capacity and head of pumps and compressors, if any
- materials and dimensions of piping and associated fittings
- volumes of protected spaces, for gas and foam fire-extinguishing systems
- surface areas of protected zones for automatic sprinkler and pressure water-spraying, low expansion foam and powder fire-extinguishing systems

All or part of the information may be provided, instead of on the above plans, in suitable operating manuals or in specifications of the system,

No	I/A **(1)**	Document **(2)**
11	A	Fire-fighting equipment and firemen's outfits (or fire control plans)
12	A	Electrical diagram of the fixed gas fire-extinguishing systems
13	A	Plan of hazardous areas relevant to hangar and refuelling installations
14	A	Documents giving details of types of cables and safety characteristics of the equipment installed in the hazardous areas mentioned in 13 above

(1) A : to be submitted for approval, in four copies

I : to be submitted for information, in duplicate.

(2) Plans are to be schematic and functional and to contain all information necessary for their correct interpretation and verification, such as:

- structural scantling
- service pressures
- capacity and head of pumps and compressors, if any
- materials and dimensions of piping and associated fittings
- volumes of protected spaces, for gas and foam fire-extinguishing systems
- surface areas of protected zones for automatic sprinkler and pressure water-spraying, low expansion foam and powder fire-extinguishing systems

All or part of the information may be provided, instead of on the above plans, in suitable operating manuals or in specifications of the system,

SECTION 2 STRUCTURE

1 General

1.1 Application

1.1.1 -

Items [2] and [3] apply to units which have been assigned the service notation **FSO**, **FPSO**, **FSRU** or **FLNG**.

Item [4] applies to units which have been assigned the service notation **MODU**.

2 Helideck layout for FSO, FPSO, FSRU and FLNG

2.1 General

2.1.1 -

The construction of the helidecks is to be of steel or other equivalent metallic materials, i.e. any non-combustible metallic material which, by itself or due to insulation provided (e.g. aluminium alloy with appropriate insulation), has structural and integrity properties equivalent to steel at the end of the applicable exposure to the standard fire test (see Note 1). Where the Society permits aluminium or other low melting point metal construction, items [4.2.1] a) to c) are also to be taken into account.

Note 1: Refer to the "International Code for Application of Fire Test Procedures" (FTP Code), as adopted by the Maritime Safety Committee of IMO by Resolution MSC.61 (67), as may be amended by IMO.

2.2 Definitions

2.2.1 -

a) ″Helicopter landing area″ means an area on a ship designed for emergency landing of helicopters.

b) ″Diameter (d)″ means the overall length of the helicopter with the rotors turning. The maximum value of ″d″ will depend on the type and size of the helicopter. This is to be agreed by the Society taking into account the particulars of the ship and its area of operation.

2.3 Landing area

2.3.1 Positioning of landing area -

Helicopter landing areas are to be located on a weather deck or on a platform permanently connected to the hull structure. The landing areas are to consist of an outer manoeuvring zone and a clear zone. Whenever possible, the clear zone is to be close to the ship's side.

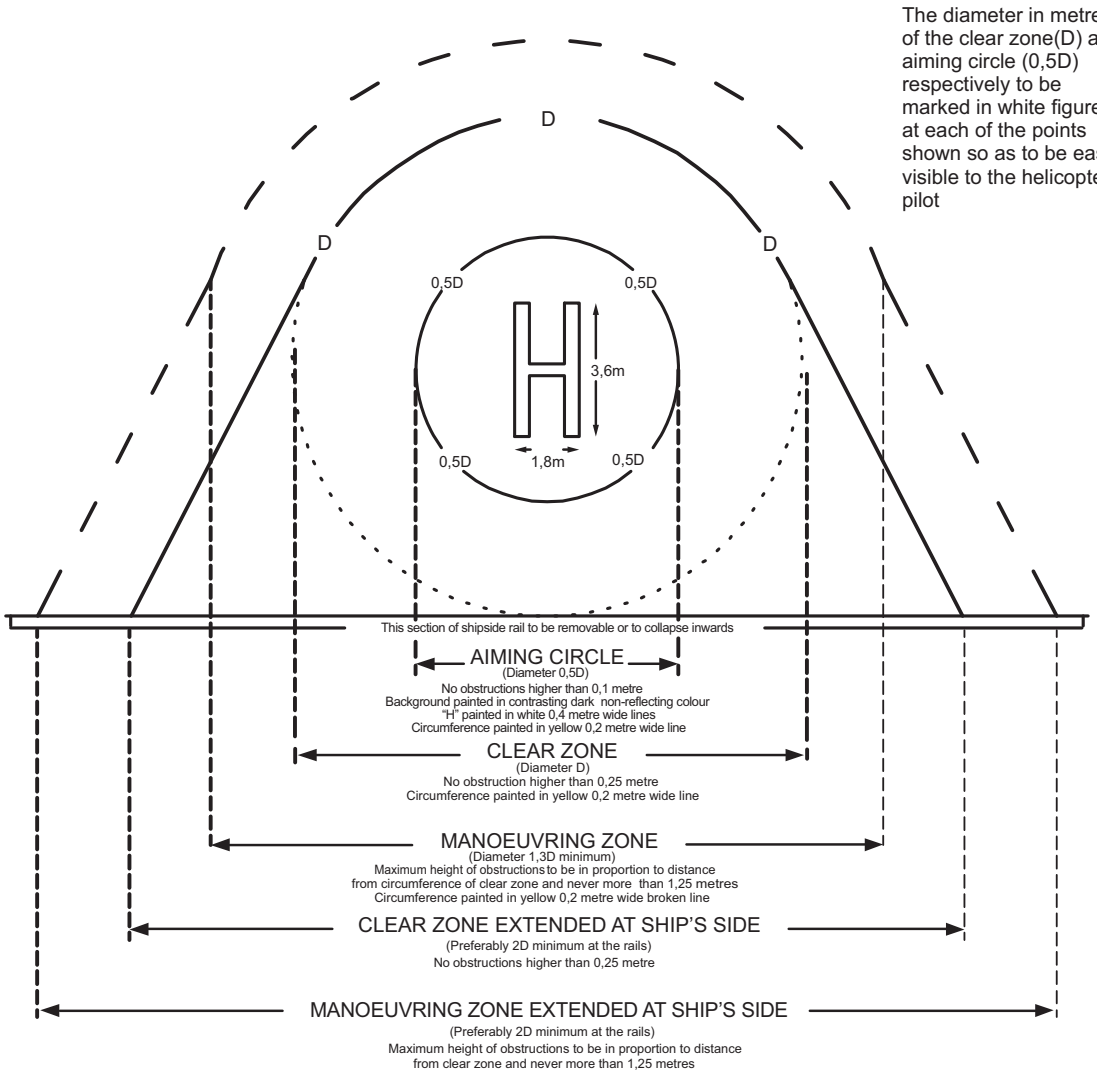
2.3.2 Landing area at ship's side -

The landing area is to be as large as possible and set out to provide safe access for helicopters from the ship's side. Due account must be taken of possible helicopter slippage and wind and ship movement. Where the boundary of the clear zone is close to or in line with the ship's side, and where the height of fixed obstructions so permits (see item [2.3.8]), helicopter safety is to be improved by extending the clear and manoeuvring zones to the ship's side symmetrically, thereby widening the approach to the landing area (see Fig 1).

2.3.3 Landing area without unobstructed access from ship's side -

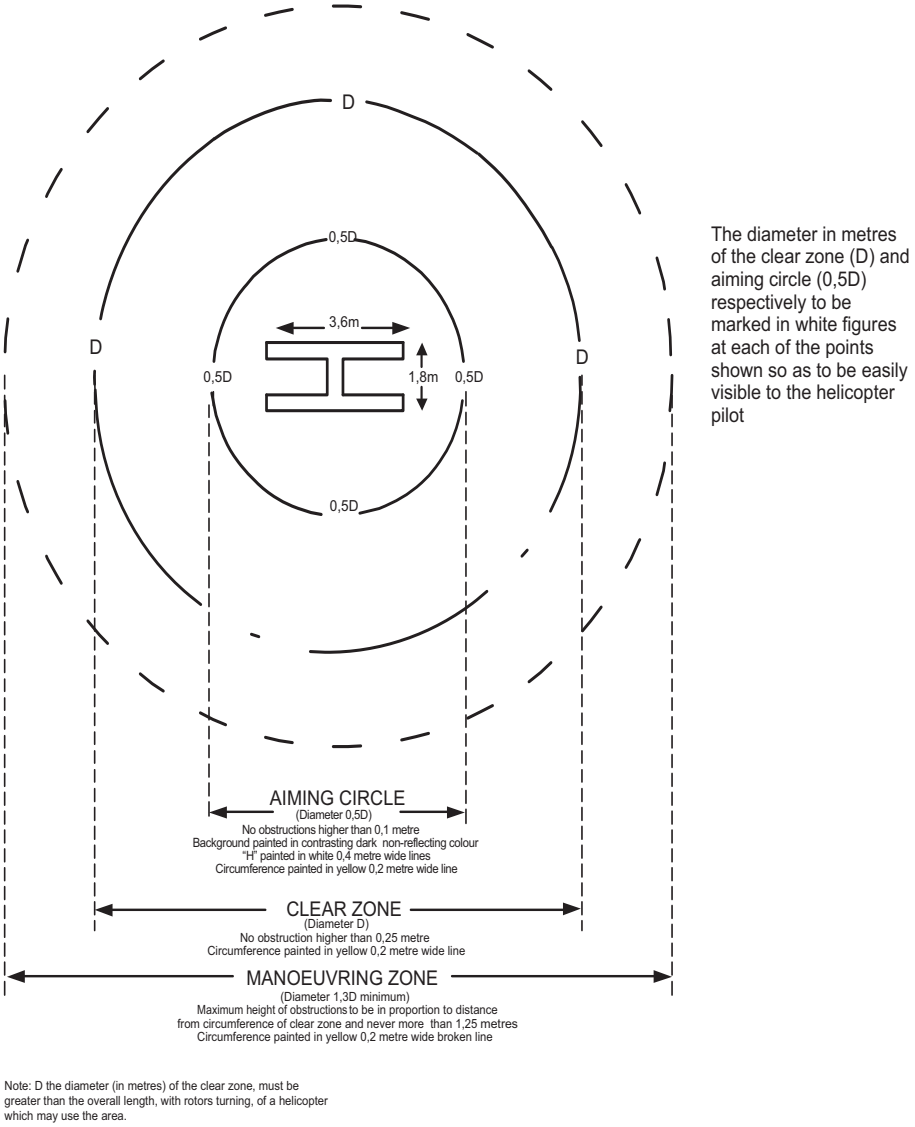
Where it is not possible to provide an operating area with clear access from the ship's side, the landing area is be set out as shown in Fig 2 and, if practicable, placed on the ship's centreline.

Figure 1 : Landing area at the ship's side -



Note: D the diameter (in metres) of the clear zone, must be greater than the overall length, with rotors turning, of a helicopter which may use the area.

Figure 2 : Landing area without unobstructed access from ship's side -



Note: D the diameter (in metres) of the clear zone, must be greater than the overall length, with rotors turning, of a helicopter which may use the area.

2.3.4 Dimension of the landing area -

In establishing a landing area, it is essential to ensure a safe correlation between:

- the dimensions of the aiming circle, clear zone and manoeuvring zone and the maximum permitted height of obstructions in these zones; and
- the sizes of helicopters expected to use the facility.

The dimensions of the landing area are to be in proportion to the diameter of the clear zone, as illustrated in Fig 1 and Fig 2 (see [2.3.6]).

2.3.5 Aiming circle (touchdown zone) - The aiming circle is an area concentric to the centre of the clear zone and has a diameter half that of the clear zone itself. The circle is to accommodate with safety the landing gear of helicopters for which it is intended and, if possible, be completely obstruction-free. If there are unavoidable obstructions, they are to have rounded edges capable of being traversed without damaging the landing gear of a helicopter, and are to be no higher than 0,1 m.

The aiming circle is to be completely covered with a matt anti-slip surface painted in a dark non-reflecting colour which contrasts with the other deck surfaces. Its circumference is to be marked with a yellow line 0,2 m wide, with the diameter in metres of the aiming circle clearly indicated in white figures at four points in the circumference line as shown in Fig 1 and Fig 2.

The letter 'H' is to be painted at the centre of the aiming circle in 0,4 m wide white lines forming a letter of dimensions 3,6 x 1,8 m.

2.3.6 Clear zone -

The diameter of the clear zone will depend upon the available landing area. The clear zone is, however, to be as large as practicable recognising that its diameter D is to be greater than the overall length, with rotors turning, of a helicopter able to use the landing area (d). Where the landing area is at the ship's side, safe helicopter access will be enhanced by widening, where possible, the boundaries of the obstacle free clear zone at the ship's side to a dimension of at least 1,5D (see Fig 1).

The circumference of the clear zone is to be marked by a yellow line of 0,2 m width, with the diameter D in metres indicated in white figures at points in the circumference line as shown in Fig 1 and Fig 2.

There are to be no fixed obstructions in the clear zone higher than 0,25 m.

2.3.7 Manoeuvring zone -

The manoeuvring zone of the landing area extends the area in which a helicopter may manoeuvre with safety by enlarging, to a diameter of at least 1,3D, the area over which the rotors of the helicopter may overhang without danger from high obstructions. When the landing area is at the ship's side, safe helicopter access will be enhanced by widening, where possible, the boundaries of the obstruction-free manouvring zone at the ship's side to a dimension of at least 2D (see Fig 1).

If it is impossible to remove all obstructions from the manoeuvring zone, a graduated increase in the permitted height of obstructions, from 0,25 m at the circumference of the clear zone to a maximum of 1,25 m at the circumference of the manoeuvring zone, is acceptable. However, such height above 0,25 m is not to exceed a ratio of one to two in relation to the horizontal distance of the obstruction from the edge of the clear zone (see Fig 3). So, for example, an obstruction of 1 m in height (0,75 m more than the maximum obstruction height in the clear zone) is to be at least 1,5 m outside the circumference of the clear zone. All obstructions in the manoeuvring zone are to be clearly marked in contrasting colours.

To assist the helicopter pilot in his positioning, the circumference of the manoeuvring zone is to be indicated by a broken yellow line of 0,2 m width (see Fig 1 and Fig 2).

2.3.8 Use of landing area for other purposes -

It is considered that helicopter landing areas may be used for other purposes in normal circumstances. In the event of need, it is to be possible to clear this area readily.

2.3.9 Night operations: Lighting -

The following general remarks apply in all cases:

a) lighting is to be arranged so as to illuminate the operating area and is not to be directed towards the helicopter; and

b) a wind pennant or flag is to be illuminated.

For a helideck located on an ad hoc platform, a safety net is to be provided at the sides of the platform. The requirements of this item [2.3.9] may be not met if the position and arrangement of the helicopter platform facilities are such that, in the opinion of the Society, they provide an equivalent standard of safety.

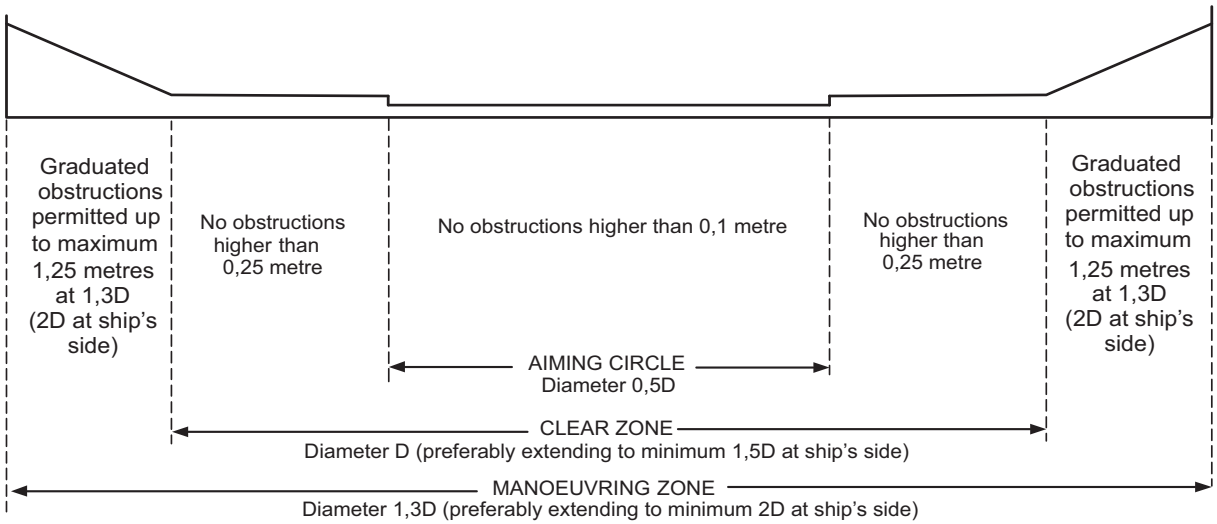
2.3.10 Drainage system -

Gutter-ways of adequate height and a drainage system are to be provided on the periphery of the helideck.

Drainage facilities are to be constructed of steel, lead directly overboard independent of any other system and to be designed so that drainage does not fall onto any part of the ship.

The requirements of this item [2.3.10] may be not met if the position and arrangement of the helicopter facilities are such that, in the opinion of the Society, they provide an equivalent standard of safety.

Figure 3 : Landing area - permitted height of obstructions (elevation) -



3 Structural design and scantling applicable to FSO, FPSO, FSRU and FLNG

3.1 General and symbols

3.1.1 General -

Local deck strengthening is to be fitted at the connection of diagonals and pillars supporting the platform where an ad hoc platform is fitted for the helideck.

3.1.2 Symbols -

W_H : Maximum weight of the helicopter, in t

g : Gravity acceleration, in m/s^2

Ry : Minimum yield stress, in N/mm^2, of the material, to be taken equal to $235/k$ N/mm^2, unless otherwise specified

k : material factor for steel, defined in Pt B, Ch 4, Sec 1, [2.3] of the Rules for the Classification of Ships.

3.2 Design loads

3.2.1 Landing area located on a weather deck -

The following loads are to be considered for the scantlings of the helicopter deck:

- landing load defined in [3.4],
- garage load, if any, defined in [3.5],
- loads due to ship accelerations and wind defined in [3.6].

3.2.2 Landing area located on a platform -

The loads defined in [3.2.1], and in addition the sea pressure defined in [3.3], are to be considered for the scantlings of the helicopter deck.

3.2.3 Helicopter having landing devices other than wheels -

In the case of a deck or a platform intended for the landing of helicopters having landing devices other than wheels (e.g. skates), the landing load, the emergency landing load and the garage load, if any, will be examined by the Society on a case-by-case basis.

3.3 Sea pressure

3.3.1 -

The sea pressure acting on a landing platform is to be obtained according to Pt B, Ch 5, Sec 5, [2.1.2].

3.4 Landing load

3.4.1 -

The landing load transmitted through one tyre to the deck or the platform is to be obtained, in kN, from the following formula:

$F_{CR} = 0,75gW_H$

3.4.2 -

Where the upper deck of a superstructure or deckhouse is used as a helicopter deck and the spaces below are quarters, the bridge, control room or other normally manned service spaces, the value of the landing load defined in [3.4.1] is to be multiplied by 1,15.

3.5 Garage load

3.5.1 -

Where a garage zone is fitted in addition to the landing area, the still water and inertial forces transmitted through the tyres to the deck or the platform in the garage zone are to be obtained, in kN, as specified in Pt B, Ch 5, Sec 6, [6.1.2], where M is to be taken equal to 0,5 W_H.

3.6 Forces due to ship accelerations and wind

3.6.1 -

The still water and inertial forces applied to the deck or the platform are to be determined on the basis of the forces obtained, in kN, as specified in Tab 1.

3.7 Net scantling

3.7.1 -

As specified in Pt B, Ch 4, Sec 2, [1], all scantlings referred to in this Section are net, i.e. they do not include any margin for corrosion.

The gross scantlings are obtained as specified in Pt B, Ch 4, Sec 2, [1].

3.8 Plating

3.8.1 Load model for landing area located on a weather deck -

The following loads transmitted by tyre prints are to be considered:

- landing load, as defined in [3.4],
- garage load, if any, as defined in [3.5].

Table 1 : Still water and inertial forces -

Ship condition	Load case	Still water force F_S and inertial force F_W, in kN
Still water condition		$F_S = (W_H + W_P)g$
Upright condition	"a"	No inertial force
	"b"	$F_{W,X} = (W_H + W_F)\, a_{X1} + 1,2\, A_{HX}$ in x direction $F_{W,Z} = (W_H + W_P)\, a_{Z1}$ in z direction
Inclined condition (negative roll angle)	"c"	$F_{W,Y} = C_{FA}(W_H + W_P)\, a_{Y2} + 1,2\, A_{HY}$ in y direction
	"d"	$F_{W,Z} = C_{FA}(W_H + W_P)\, a_{Z2}$ in z direction

Note 1:

W_P : structural weight of the platform, in t, to be evenly distributed, and to be taken not less than the value obtained from the following formula:
$W_P = 0,2\, A_H$

A_H : area, in m^2, to be obtained projecting on A horizontal plane parallel to the summer load waterline the entire landing area considering also possible helideck supporting structures outside the landing area

a_{x1}, a_{z1} : accelerations, in m/s^2, determined at the helicopter centre of gravity for the upright ship condition, and defined in Ch 5, Sec 3, [3.4]

a_{Y2}, a_{Z2} : accelerations, in m/s^2, determined at the helicopter centre of gravity for the inclined ship condition, and defined in Ch 5, Sec 3, [3.4]

A_{HX} : area, in m^2, to be obtained projecting on a transversal plane perpendicular to the summer load waterline the helideck supporting structures (including the helideck platform)

A_{HY} : area, in m^2, to be obtained projecting on a longitudinal plane parallel to the centreline plane of the ship the helideck supporting structures (including the helideck platform)

C_{FA} : Combination factor, to be taken equal to:
- $C_{FA} = 0,7$ for load case "c"
- $C_{FA} = 1,0$ for load case "d"

3.8.2 Load model for landing area located on a platform -

The following loads are to be considered independently:

- sea pressure, as defined in [3.3],
- loads transmitted by tyre prints,
- landing load, as defined in [3.4],
- garage load, if any, as defined in [3.5].

3.8.3 Plating subjected to sea pressure - The net thickness of the landing area plating subjected to sea pressure is to be not less than that obtained from the formulae in Pt B, Ch 7, Sec 1, [3] of the Rules for the Classification of Ships.

3.8.4 Plating subjected to landing load or garage load -

The net thickness of the landing area plating subjected to landing load or garage load, if any, transmitted by tyre prints, is to be not less than that obtained from the following formulae:

$t = C_{WL}\,(nP_0k)^{0,5} - t_c$

where:

C_{WL} : Coefficient to be taken equal to:

$$C_{WL} = 2,15 - \frac{0,05l}{s} + 0,02\left(4 - \frac{l}{s}\right)\alpha^{0,5} - 1,7\alpha^{0,25}$$

l : Length, in m, of the longer side of the plate panel

s : Length, in m, of the shorter side of the plate panel

α : A_t / l_s where l is to be taken not greater than 5s

A_t : Tyre print area, in m^2. In the case of double or triple wheels, the area is that corresponding to the group of wheels.

n : Number of wheels on the plate panel, taken equal to:
- 1 in the case of a single wheel
- the number of wheels in a group of wheels in the case of double or triple wheels

P_0 : wheeled force, in kN calculated according to [3.8.1] or [3.8.2], as applicable.

3.9 Ordinary stiffeners

3.9.1 Load model for landing area located on a weather deck -

The following loads are to be considered independently:

- landing load defined in [3.4],
- garage load, if any, defined in [3.5],
- loads due to ship accelerations and wind defined in [3.6].

3.9.2 Load model for landing area located on a platform -

The following loads are to be considered independently:

- sea pressure, as defined in [3.3],

- loads transmitted by tyre prints,
- landing load defined in [3.4],
- garage load, if any, as defined in [3.5],
- loads due to ship accelerations and wind defined in [3.6].

3.9.3 Normal and shear stresses - Normal and shear stresses induced by loads and pressures in an ordinary stiffener are to be obtained according to:

- Pt B, Ch 7, Sec 2, [3.4] of the Rules for the Classification of Ships for an ordinary stiffener subjected to sea pressure,
- direct calculations, for an ordinary stiffener subjected to loads transmitted by tyre prints.

3.9.4 Checking criteria -

It is to be checked that the normal stress σ and the shear stress τ calculated according to [3.9.3], are in compliance with the following formulae:

$$\frac{R_y}{\gamma_R \gamma_m} \geq \sigma$$

$$0,5 \frac{R_y}{\gamma_R \gamma_m} \geq \tau$$

where:

γ_m : partial safety factor covering uncertainties on the material, to be taken equal to 1,02

γ_R : partial safety factor covering uncertainties on the resistance:

- γ_R = 1,3 for landing area located above accommodation spaces,
- γ_R = 1,05 for landing area located outside a zone covering accommodation spaces,
- γ_R = 1,0 for emergency condition.

3.10 Primary supporting members

3.10.1 Load model for landing area located on a weather deck -

The following loads are to be considered independently:

- loads transmitted by tyre prints,
- landing load defined in [3.4],
- garage load, if any, defined in [3.5],
- loads due to ship accelerations and wind defined in [3.6].

3.10.2 Load model for landing area located on a platform -

The following loads are to be considered independently:

- sea pressure, as defined in [3.3],
- loads transmitted by tyre prints,
- landing load defined in [3.4],
- garage load, if any, defined in [3.5],
- loads due to ship accelerations and wind defined in [3.6].

3.10.3 Normal and shear stresses - Normal and shear stresses induced by loads and pressures in a primary supporting member are to be obtained accord-ing to Pt B, Ch 7, App 1, [5] of the Rules for the Classifica-tion of Ships, considering:

- $\sigma = \max(\sigma_1, \sigma_2)$ and $\tau = \tau_{12}$, for analyses based on finite element models,
- $\sigma = \sigma_1$ and $\tau = \tau_{12}$, for analyses based on beam models.

3.10.4 Checking criteria -

It is to be checked that the normal stress σ and the shear stress τcalculated according to [3.9.3], are in compliance with the following formulae:

$$\frac{R_y}{\gamma_R \gamma_m} \geq \sigma$$

$$0,5 \frac{R_y}{\gamma_R \gamma_m} \geq \tau$$

where:

γ_m : partial safety factor covering uncertainties on the material, to be taken equal to 1,02

γ_R : partial safety factor covering uncertainties on the resistance:

- γ_R = 1,3 for landing area located above accommodation spaces,
- γ_R = 1,05 for landing area located outside a zone covering accommodation spaces,
- γ_R = 1,0 for emergency condition.

4 Structural design and scantling applicable to MODU

4.1 Design loads, load model and allowable stresses

4.1.1 -

Scantlings of helidecks and supporting structure shall be determined on the basis of the following design loading conditions in association with the allowable stresses shown in Tab 2.

a) Overall distributed loading: a minimum uniformly distributed loading of 2 KN/m^2 is to be taken over the entire helideck.

b) Helicopter Landing Impact Loading: a load of not less than 75% of the helicopter maximum take-off weight is to be taken on each of two square areas, 0,3 m x 0,3 m, on which the helicopter is assumed to land. The deck is to be designed for the helicopter landings at any location within the designated landing area. For the design of girders, stanchions, truss supports, etc., the structural weight of the helideck is to be considered in addition to the helicopter impact loading. Where the upper deck of a superstructure or deckhouse is used as helideck and the spaces below are normally manned (quarters, bridge, etc.) the impact loading is to be multiplied by a factor of 1,15.

c) Stowed Helicopter Loading (Applicable only to units for which **HELIDECK-H** notation is requested).

If provision is made to accommodate helicopters secured to deck in a predetermined position, the structure of the relevant area is to be designed for a local loading equal to the wheel loading at the maximum take-off weight plus dynamic loads obtained taking into account the vertical acceleration a_{z1} calculated in accordance with the requirements of Pt B, Ch 5, Sec 3, [3.4]. In addition, a uniformly distributed loading of 0,5 KN/m^2, representing wet snow or ice, is to be considered, if applicable. For the design of girders, stanchions, truss supports, etc., the structural weight of the helideck is also to be considered.

Table 2 : Allowable stresses -

Loading condition	Structural members		
	Deck plating	Beams	Girders, Stanchions, Truss supports, etc.
Overall distributed loading	0,6 σ_s (see **Note 1**)	0,6 σ_s	0,6 σ_s **(1)**
Helicopter landing impact loading	σ_s	σ_s	0,9 σ_s **(1)**
Stowed helicopter loading	σ_s	0,9 σ_s	0,8 σ_s **(1)**

σ_s = specified minimum tensile yield stress of material

(1) For members subjected to axial compression, the yield stress or critical buckling stress, whichever is the lesser, shall be considered.

Note 1:

- The thickness of plating for the overall distributed loading condition shall be not less than the minimum net thickness required by Pt B, Ch 7, Sec 1 of the Rules for the Classification of Ships for accommodation deck.

Note 2:

- Helicopters fitted with landing gear other than wheels will be specially considered by the Society.
- Wind loadings and possible wave impact loadings on helidecks shall be considered in a realistic manner, to the satisfaction of the Society.
- Corrosion addition in accordance with Pt B, Ch 4, Sec 2 is to be taken into account.

SECTION 3 REFUELING AND HANGAR FACILITIES

1 General

1.1 Application

1.1.1 The requirements of this section are applicable only to units for which **HELIDECK-H** notation is requested.

2 Storage of fuel

2.1 Location

2.1.1 A designated area is to be provided for the storage of fuel tanks which is to be:

- as remote as is practicable from accommodation spaces, escape routes and embarkation stations; and
- isolated from areas containing a source of vapour ignition

2.1.2 The fuel storage area is to be provided with arrangements whereby fuel spillage may be collected and drained to a safe location.

2.1.3 "NO SMOKING" signs are to be displayed at appropriate locations.

2.2 Tanks and associate equipment

2.2.1 Tanks and associated equipment are to be protected against physical damage and from a fire in an adjacent space or area.

2.2.2 Fuel storage tanks are to be of an approved metallic construction and are to be adequate to the installation.

2.2.3 Vent heads of an approved type with flame arrestors are to be fitted to vent pipes.

2.2.4 Where portable fuel storage tanks are used, special attention is to be given to:

- design of the tank for its intended purpose;
- mounting and securing arrangements;
- electric bonding; and
- inspection procedures.

2.2.5 Storage tank fuel pumps are to be provided with means which permit shutdown from a safe remote location in the event of a fire. Where a gravity fuelling system is installed, equivalent closing arrangements are to be provided to isolate the fuel source.

2.2.6 The fuel pumping unit is to be connected to one tank at a time. The piping between the tank and the pumping unit is to be of steel or equivalent material, as short as possible, and protected against damage.

2.2.7 Electrical fuel pumping units and associated control equipment are to be of a type suitable for the location and potential hazards.

2.2.8 Fuel pumping units are to incorporate a device which will prevent over-pressurization of the delivery or filling hose.

2.2.9 Equipment used in refueling operations is to be electrically bonded.

2.2.10 Electric equipment and wiring in enclosed hangar or enclosed spaces containing refueling installations are to comply with the following:

- electrical equipment and wiring are to be of a type suitable for use in an explosive petrol and air mixture (zone 1). See Note 1;
- electrical equipment and wiring, if installed in an exhaust ventilation duct, are to be of a type approved for use in explosive petrol and air mixtures (zone 1) and the outlet from any exhaust duct are to be sited in a safe position, having regard to other possible sources of ignition; and
- other equipment which may constitute a source of ignition of flammable vapours are not to be permitted.

Note 1: Refer to the recommendations of the International Electrotechnical Commission, in particular publication 60079.

SECTION 4 FIRE SAFETY

1 Structural fire protection

1.1 Fire integrity of decks and bulkheads

1.1.1 Helidecks are to be constructed in steel, aluminum alloy or other equivalent materials

1.1.2 -

The construction of the helidecks is to be of steel or other equivalent materials. If the helideck forms the deckhead of a deckhouse or superstructure, it is to be insulated to "A-60" class standard. If the Administration permits aluminium or other low melting point metal construction that is not made equivalent to steel, the following provisions are to be satisfied:

a) if the helideck is cantilevered over the side of the unit, after each fire that may have an effect on the structural integrity of the helideck or its supporting structures, the helideck is to undergo a structural analysis to determine its suitability for further use; and

b) if the helideck is located above the unit's deckhouse or similar structure, the following conditions are to be satisfied:

   1) the deckhouse top and bulkheads under the helideck are to have no openings;

   2) windows under the helideck are to be provided with steel shutters; and

   3) after each fire on the helideck or supporting structure the helideck is to undergo a structural analysis to determine its suitability for further use.

1.1.3 Enclosed hangar, refueling and maintenance facilities are to be treated as category 'A' machinery spaces with regard to structural fire protection requirements.

1.2 Ventilation

1.2.1 Requirements of [1.2] are applicable only to units for which **HELIDECK-H** notation is requested.

1.2.2 Enclosed hangar facilities or enclosed spaces containing refueling installations are to be provided with mechanical ventilation complying with the requirement of this item [1.2].

1.2.3 The system is to be capable of:

a) providing 6 air changes per hour;

b) preventing air stratification and the formation of air pockets;

c) being controlled from a position outside the served spaces.

1.2.4 Ventilation fans are to be of non-sparking type in accordance with Pt C, Ch 4, Sec 2, [3.5.2] and are normally to be run continuously whenever helicopters are on board. Where this is impracticable, they are to be operated for a limited period daily as weather permits and in any case for a reasonable period prior to discharge, after which period the hangar facilities or enclosed spaces containing refueling installations are to be proved gas-free. At least one portable combustible gas detecting instruments is to be carried for this purpose.

1.2.5 Means are to be provided on the navigation bridge to indicate any loss of the required ventilating capacity.

1.2.6 Ventilation ducts, including dampers are to be made of steel and are to be capable of being effectively sealed for each served space.

1.2.7 Arrangements are to be provided to permit a rapid shutdown and effective closure of the ventilation ducts and openings from outside of the served space in case of fire, taking into account the weather and sea conditions.

2 Fire-fighting appliances and rescue equipment

2.1 Helidecks

2.1.1 -

The following fire-fighting appliances are to be provided and stored near the means of access to the helideck:

- at least two dry powder extinguishers having a total capacity of not less than 45 kg;
- a foam application system consisting of monitors or foam-making branch pipes capable of delivering foam to all parts of the helideck in all weather conditions in which the helideck is intended to be available for helicopter operations. The rate of the foam production system is to be not less than 6 l/m^2 for at least 5 min for each square meter of the area within a circle having a diameter equal to the D-value. Foam delivery at the minimum application rate is to start within 30 s of system activation; the Society may accept other fire-fighting systems which provide a fire extinguishing capability at least as effective as the required foam application system
- the principal agent is to meet the applicable performance standards of the International Civil Aviation Organization - Airport Services Manual, Part 1 - Rescue and Firefighting, Chapter 8 - Extinguishing Agent Characteristics,Paragraph 8.1.5 - Foam Specifications Table 8-1, Level B foam, and be suitable for use with salt water

- carbon dioxide extinguishers of a total capacity of not less than 18 kg or equivalent; one of these extinguishers being so equipped as to to enable it to reach the engine area of any helicopter using the deck
- at least two nozzles of an approved dual-purpose type (jet/spray) and hoses sufficient to reach any part of the helideck
- in addition to the provisions of section Pt C, Ch 4, Sec 2, [5.7.2], two fire-fighter's outfits.

2.1.2 At least the following equipment are to be stored in a manner that provides for immediate use and protection from the elements:

- adjustable wrench;
- blanket, fire resistant;
- cutters, bolt 60 cm;
- look, grab or salving;
- hacksaw, heavy duty complete with 6 spare blades;
- ladder;
- lift line 5 mm diameter x 15 m in length;
- pliers, side cutting;
- set of assorted screwdrivers; and
- harness knife complete with sheath.

2.1.3 In lieu of meeting item [2.1.1] and [2.1.2], for units for which class notation **HELIDECK** is requested, fire-fighting equipment fitted on board may be used, at the satisfaction of the Society. This equipment is to be made readily available in close proximity to the landing or winching areas during helicopter operations.

2.2 Hangars, refueling and maintenance facilities

2.2.1 Requirements of [2.2] are applicable only to units for which **HELIDECK-H** notation is requested.

2.2.2 Hangars, refueling and maintenance facilities are to be provided with:

a) one of the following fixed fire extinguishing systems:

   1) a fixed gas fire-extinguishing system complying with Chapter 5 of the Fire Safety Systems Code as defined under Pt C, Ch 4, Sec 2, [2.10] of these Rules; or

   2) a fixed high expansion foam installation complying with Chapter 6 of the Fire Safety Systems Code; or

   3) a fixed pressure water-spraying system complying with Chapter 7 of the Fire Safety Systems Code.

b) an automatic fire detection and alarm system complying with this item and Chapter 9 of the Fire Safety Systems

c) one portable foam applicator unit of capacity of 20 l with a spare charge;

d) foam-type fire extinguishers, each of at least 45 l capacity or equivalent, sufficient in number to enable foam or its equivalent to be directed on to any part of the space,

e) a sufficient number of portable foam extinguishers or equivalent which are to be so located that no point in the space is more than 10 m walking distance from an extinguisher and that there are at least two such extinguishers in each such space.

2.3 Means of escape

2.3.1 A helideck is to be provided with both a main and an emergency means of escape and access for fire fighting and rescue personnel. These are to be located as far apart from each other as is practicable and preferably on opposite sides of the helideck

2.4 Drainage facilities

2.4.1 -

Drainage facilities in way of helidecks are to be:

a) constructed of steel or other arrangements providing equivalent fire safety;

b) lead directly overboard independent of any other system; and

c) designed so that drainage does not fall onto any part of the unit.

2.4.2 -

Where the unit has helicopter refuelling, the following provisions are to be complied with:

a) a designated area is to be provided for the storage of fuel tanks which are to be:

   1) as remote as is practicable from accommodation spaces, escape routes and embarkation stations; and

   2) isolated from areas containing a source of vapour ignition;

b) the fuel storage area is to be provided with arrangements whereby fuel spillage may be collected and drained to a safe location;

c) tanks and associated equipment are to be protected against physical damage and from a fire in an adjacent space or area;

d) where portable fuel storage tanks are used, special attention is to be given to:

   1) design of the tank for its intended purpose;

   2) mounting and securing arrangements;

   3) electric bonding; and

   4) inspection procedures;

e) storage tank fuel pumps are to be provided with means which permit shutdown from a safe remote location in the event of a fire. Where a gravity-fuelling system is installed, equivalent closing arrangements are to be provided to isolate the fuel source;

f) the fuel pumping unit is to be connected to one tank at a time. The piping between the tank and the pumping

unit is to be of steel or equivalent material, as short as possible, and protected against damage;

g) electrical fuel pumping units and associated control equipment are to be of a type suitable for the location and potential hazards;

h) fuel pumping units are to incorporate a device which will prevent over-pressurization of the delivery or filling hose;

i) equipment used in refuelling operations is to be electrically bonded; and

j) "NO SMOKING" signs are to be displayed at appropriate locations.

Part F
Additional Class Notations

Chapter 6
OTHER ADDITIONAL CLASS NOTATIONS

SECTION 1 IN-WATER SURVEY ARRANGEMENTS (INWATERSURVEY)

SECTION 2 DYNAMIC POSITIONING (DYNAPOS)

SECTION 3 VAPOUR CONTROL SYSTEM (VCS)

SECTION 4 CENTRALISED CARGO AND BALLAST WATER HANDLING INSTALLATIONS (CARGOCONTROL)

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SECTION 6 PROTECTIVE COATINGS IN WATER BALLAST TANKS (COAT-WBT)

SECTION 7 CREW ACCOMMODATION AND RECREATIONAL FACILITIES ACCORDING TO THE MARINE LABOUR CONVENTION, 2006 (MLCDESIGN)

SECTION 8 ALTERNATIVE REGIME SURVEY (ARS)

APPENDIX 1 TEST PROCEDURES FOR COATING QUALIFICATION FOR WATER BALLAST TANKS OF ALL TYPES OF UNIT AND DOUBLE-SIDE SKIN SPACES OF BULK CARRIERS

SECTION 1 IN-WATER SURVEY ARRANGEMENTS (INWATERSURVEY)

1 General

1.1 Application

1.1.1 The additional class notation **INWATERSURVEY** is assigned, in accordance with Pt A, Ch 1, Sec 2, [6.10.1].

1.2 Documentation to be submitted

1.2.1 Plans

Detailed plans of the hull and hull attachments below the water line are to be submitted to the Society in triplicate for approval. These plans are to indicate the location and/or the general arrangement of:

- all shell openings
- stem
- sternpost
- anodes, including securing arrangements
- bilge keels
- welded seams and butts
- mooring system
- import/export system (when requested for classification).

The plans are also to include the necessary instructions to facilitate the divers' work, especially for taking clearance measurements.

1.2.2 Photographs

As far as practicable, a photographic documentation, used as a reference during the in-water surveys, of the following hull parts is to be submitted to the Society:

- typical connections to the sea
- directional propellers, if any
- other details, as deemed necessary by the Society on a case by case basis.

1.2.3 Documentation to be put on board

The Owner is to put on board of the unit the plans and documents given in [1.2.1] and [1.2.2], and they are to be made available to the Surveyor and the divers when an in-water survey is carried out.

2 Structure design principles

2.1

2.1.1 Marking

Identification marks and system are to be supplied to facilitate the in-water survey. In particular, the positions of transverse watertight bulkheads are to be marked on the hull.

2.1.2 Mooring system

Turret and bearings below water level, chain stoppers, chain tables and anchor lines are to be inspectable during in water surveys.

Where it is required that clearance measurements are to be taken, appropriate gauging arrangements are to be provided.

2.1.3 Import/Export system (when requested for classification)

Import/export system are to be inspectable during in water surveys.

Where it is required that clearance measurements are to be taken, appropriate gauging arrangements are to be provided.

SECTION 2 DYNAMIC POSITIONING (DYNAPOS)

1 General

1.1 Application

1.1.1 The additional class notation **DYNAPOS** is assigned, in accordance with Pt A, Ch 1, Sec 2, [6.10.2], to units fitted with dynamic positioning installations complying with the requirements of this Section.

This notation is completed by additional symbols defined in [1.3], according to the operational mode of the installation.

1.1.2 These requirements are additional to those applicable to the classification of the corresponding mobile offshore units. Attention is drawn to the fact that dynamic positioning installations may have to comply with the existing national regulations.

1.2 Definitions

1.2.1 Dynamically positioned unit (DP-unit): a unit which automatically maintains its position (fixed location or predetermined track) exclusively by the action of its thrusters (including shaft-lines); the dynamic positioning system (DP-system) comprises all means necessary for this purpose.

1.2.2 Active failure concerns all failures which have an immediate effect either on the operation of the installations or on the monitoring circuits.

1.2.3 Passive failure has no immediate effect on the operating conditions of the installations and moreover is not detected by the monitoring circuits, which could lead, in certain conditions, to a failure of the system.

1.2.4 Position reference system: a system measuring the position and heading of the unit.

1.2.5 Position keeping: maintaining a desired position within the normal operating range of the control system and the environmental conditions.

Therefore, active compensation of the dynamic effects of environment (waves, wind, current) is considered.

1.2.6 Redundancy: the ability of a component or system to maintain or restore its 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.

1.2.7 Environment: environmental conditions include wind, current and waves. Ice loads are not taken into account.

1.2.8 Alarm devices: visual and audible signals enabling the operator to immediately identify any failure of the positioning system.

1.2.9 Computer based system: system of one or more computers, associated software, peripherals and interfaces, computer network with their protocol.

1.3 Dynamic positioning sub-systems

1.3.1 The installation necessary for dynamically positioning a unit comprises the following sub-systems:

- Power system, i.e.: all components and systems necessary to supply the DP-system with power.
- Thruster system, i.e.: all components and systems necessary to supply the DP-system with thrust force and direction.
- DP-control system, i.e.: all control components and systems, hardware and software necessary to dynamically position the unit.

1.3.2 The power system includes:

- prime movers with necessary auxiliary systems including piping
- generators
- switchboards, and
- distributing system (cabling and cable routing).

1.3.3 The thruster system includes:

- thrusters with drive units and necessary auxiliary systems including piping
- main propellers and rudders if these are under the control of the DP-system
- thruster control electronics
- manual thruster controls, and
- associated cabling and cable routing.

1.3.4 The DP-control system consists of the following:

- computer system / joystick system, sensor system
- display system (operator panels)
- autopilot
- position reference system, and
- associated cabling and cable routing.

1.4 Additional and optional class notation

1.4.1 Notation **DYNAPOS** is completed by one or more of the following optional additional symbols according to the operational mode of the installation:

a) **SAM** (semi-automatic mode). The operator's manual intervention is necessary for position keeping.
   - The control system of installations receiving notation **SAM** is to achieve automatic conversion of the instructions issued by the operator in thruster commands.
   - The control system is to indicate the position and heading of the unit to the operator. Control settings are to be displayed.
   - The control device handle is to have a well-defined neutral position (no thrust).
   - Any dynamic positioning installation provided with an automatic control is to be additionally fitted with a manual manoeuvring control complying with the requirements of **SAM** notation.

b) **AM** (automatic mode): position keeping is automatically achieved.

c) **AT** (automatic tracking): the unit is maintained along a predetermined path.

Note 1: the notation **AM/AT** used in the remaining part of this section corresponds to **AM** or **AT**.

1.4.2 Installations intended to be granted with the notation **DYNAPOS AM/AT** are to be provided with a calculation unit including, besides the computer, a reference clock and peripheral equipment for visualisation and printing.

The computer type and features are to comply with the requirements regarding performance in environmental conditions to the satisfaction of the Society.

Calculation cycle fulfilment is to be automatically monitored. Any failure of the computer is to activate a visual and audible alarm.

1.4.3 For **DYNAPOS AM/AT** notation, the unit is to be fitted with an automatic control and a stand-by manual control, the latter being equivalent to the control system required for **SAM** notation.

1.4.4 The optional additional notation **DYNAPOS AM/AT** can be completed by the following symbols:

- **R**, when the dynamic positioning is provided with redundancy means, as defined in [1.2.6]. In this case, class 2 equipment, as per [6] is to be used.
- **RS**, when in addition to symbol **R**, the redundancy is achieved by using two systems or alternative means of performing a function physically separated as defined in [4.8.6]. Equipment class 3, as per [3] is to be used for installations to be granted the **RS** symbol.

1.4.5 The above mentioned notations may be supplemented with an environmental station keeping number (ESKI) which indicates the station keeping capability of the unit (as a percentage of time) under given environmental conditions.

1.4.6 Association of DP system with position mooring system

The present Rules do not cover the association of the dynamic positioning system together with a position mooring system, in that case a special examination of the installations is to be carried by the Society, technical consideration about this type of installation are given in [4.1.4] for information.

1.5 Installation survey during construction

1.5.1 Installations built under special survey are subject to:

- document examination with consideration of those specified in [1.6]
- surveys during fabrication and component testing carried out at the supplier's works and at the yard
- dock and sea trials with a Society's surveyor in attendance.

1.6 List of documents to be submitted

1.6.1 In addition to the drawings and specifications required by the Rules, the following documents are to be submitted.

1.6.2 For approval:

a) functional block diagram of the sensor and reference systems (position / environmental conditions)

b) functional block diagram of the control unit

c) one line diagram and specification of the cables between the different equipment unit (power, control, display)

d) balance of power

e) list of the equipment units with, for each of them, manufacturer's identification, type and model

f) type test reports of the sensors of the measurement systems, or equivalent

g) test report of the computer units; checking of the behaviour of the installation when submitted to the radiated and conducted electromagnetic interferences

h) estimation of reliability figures when required by the **DYNAPOS** classifications, specially for symbols **R** and **RS**, (see [2]). The document, to be submitted, is to demonstrate the reliability of the system. This is to be achieved with appropriate analysis such as:
   - a failure mode analysis describing the effects due to failures leading to the destruction of the automation system. In addition,this document is to show the consequences on other systems, if any. It is to be detailed up to a level which allows the society to evaluate the necessity of redundancy. This analysis is to be presented in accordance with IEC 60812, or any recognised standard
   - test report / life test
   - MTBF calculation
   - any other document which prove to the Society, the reliability of the system

i) for approval of propulsion, based on rotary azimuth thrusters:
   - layout drawings of thrust units, thrust shafts and blocks,
   - arrangement of hull passages
   - thrust curves of each propulsion unit

j) electrical power management layout drawings and specification if provided on board

k) internal communication system description

l) description of the control stations (onboard layout, descriptive diagrams of the display consoles)

m) alarm list and parameter values displayed on the consoles

n) program of tests alongside quay and at sea.

And, for **R** and **RS** symbols only:

- simulation report of the behaviour of the unit
- failure mode effect analysis using as far as possible the fault tree method
- study of possible interaction between thrusters.

1.6.3 For information:

a) diagram of the environmental limit conditions (foot print) for the conditions defined in the specification (wind speed, current and waves)

b) technical specification of the positioning system

c) operator manual of the positioning system including:
   - description of the equipment
   - maintenance guide
   - emergency procedures.

2 Performance analysis

2.1 General

2.1.1 A performance analysis of the dynamic positioning installation is normally required in order to justify design options and limiting allowable environmental conditions. This analysis is to consider the main features of DP installation:

- characteristics of control laws
- installed power
- sizing and location of thrusters,

with regard to the required station keeping stability and accuracy in the specified environmental conditions.

2.2 Condition of analysis

2.2.1 The environmental conditions to be taken into account in the analysis are to be defined for the contemplated service of the unit. However, for symbol **R** assignment, the following situations are to be considered:

- Normal environmental conditions: those environmental conditions in which nominal position holding performances are attained, while the unit is in normal working situation
- Safety environmental conditions: environmental conditions such that any single failure of a thruster or generator unit occurring in service does not impair position keeping nor operational safety
- Limiting environmental conditions: those environmental conditions in which position keeping is possible with all thrusters running, installations essential for safety only being in service.

When symbol **R** assignment is not required, the analysis may be limited to normal environmental conditions, single failure of a generating set being however considered. The required analysis may be performed either:

- by a mathematical model of the behaviour of the unit, possibly associated with tank test results, or
- on the basis of previous operational experience gained upon similar installations.

2.3 Modelling and simulations

2.3.1 A simulation of the unit displacements in relation to applied environmental forces is normally required for symbol **R** assignment.

2.3.2 The simulation required in [2.3.1] is notably to include suitable modelling of the following:

- environmental forces, wind
- hyrodynamical behaviour of the unit
- dynamic action of thrusters
- control loop.

Simulation results are to include displacements of the unit as well as power determination for each case under consideration.

Note 1: The simulation is to take account of the response of the unit to oscillating forces of positive average (waves, wind, possible external links) likely to have a resonant action upon the dynamic system composed of the unit together with its DP-system.

2.4 Risk analysis

2.4.1 A qualitative risk analysis of the DP installation may be required for symbol **R** or **RS** assignment. Analysis is to be carried out according to the fault-tree method, the FMECA (failure mode effect critical analysis), the RBD (reliability block diagram) or a similar method.

2.4.2 The risk analysis required for symbol **R** and **RS** assignment is to take into account the frequency and duration of planned maintenance tasks.

2.4.3 The analysis is to show the level of redundancy of each sub-system as well as the consequences of possible common mode failures.

3 Equipment class

3.1 General

3.1.1 It is a provision of the present Rules that the DP-unit is operated in such a way that the worst case failure, as determined in [3.2], can occur at any time without causing a significant loss of position.

3.1.2 Based on the single failure definitions in [3.2], the worst case failure is to be determined and used as the criterion for the consequence analysis, see [4.8.4].

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

3.2 Equipment class according to single failure

3.2.1 For **DYNAPOS AM/AT**, the equipment class 1 are required. In that case, loss of position may occur in the event of a single failure.

3.2.2 For **DYNAPOS AM/AT R**, the equipment class 2 are required. A loss of position is not to occur in the event of a single failure in any active component or system. Single failure criteria includes:

- any active component or system (generators, thrusters, switchboards, remote controlled valves, etc.)
- any normally static component (cables, pipes, manual valves, etc.) which is not properly documented with respect to protection and reliability.

3.2.3 For equipment **DYNAPOS AM/AT RS**, the equipment class 3 are required. A loss of position is not to occur in the event of a single failure in any active component or system., as above for class 2. In that case, a single failure includes:

- items listed above for class 2, and any normally static component is assumed to fail
- all components in any one watertight compartment, from fire or flooding
- all components in any one fire sub-division, from fire or flooding. For cables, see [6.1.3].

3.2.4 For equipment classes 2 and 3, a single inadvertent act is to be considered as a single failure if such an act is reasonably probable.

4 Functional requirements

4.1 General

4.1.1 All components in a DP-system are to comply with the relevant Rules.

4.1.2 In order to meet the single failure criteria given in [3.2], redundancy of components will normally be necessary as follows:

- for equipment class 2 (for **R** symbol), redundancy of all active components
- for equipment class 3 (for **RS** symbol), redundancy of all components and physical separation of the components.

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

4.1.3 Redundant components and system are to be immediately available 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 is to be automatic, as far as possible, and operator intervention is to be kept to a minimum. The transfer is to be smooth and within acceptable limitations of operation.

4.1.4 When associated with position mooring equipment and when this system is used to assist the main dynamic positioning in special circumstances of operation, for instance in the vicinity of an offshore platform, this system is to be designed in such a way to remote control the length and tension of individual anchor lines.

The analysis of the consequences of anchor line breaks or thruster failure, according to the operational situation, is to be carried out.

4.2 Power system

4.2.1 The electrical installations are to comply with applicable requirements of the Rules.

4.2.2 The power system is to have an adequate response time to power demand changes.

4.2.3 For equipment class 1, the power system needs not to be redundant.

4.2.4 For equipment class 2, the power system (generators, main bus bars, etc.) is to 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 is to be arranged with bus-tie breakers to separate them automatically upon failures, to prevent the transfer of failure of one system to the other.

4.2.5 For equipment class 3, the power system (generators, main bus bars, etc.) is to 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 is to be located in different spaces separated by A-60 class division, or equivalent. Where the power systems are located below the operational waterline, the separation is also to be watertight. Bus-tie breakers are to be open during equipment class 3 operations.

4.2.6 For equipment classes 2 and 3, the following applies:

a) The power available for position keeping is to be sufficient to maintain the unit in position after worst case

failure to [3.2.1].The automatic management system is to be capable of:

- enabling quick supply of active power to consumers in all operating conditions including generator failure or change of thruster configuration
- monitoring power sources and informing the operator about desirable configuration changes such as starting or stopping of generators
- providing automatic change-over of a generating set in case of detected failure
- this required capability mainly applies to normal operating conditions. It is to be possible to maintain a proper balance between power demand and power generating configuration, in view of achieving efficient operation with sufficient reserve to avoid black-out
- limitation of absorbed power, appropriate devices are to allow for automatic reduction of power demands in case of emergency.

b) For **R** or **RS** symbols an adequate redundancy or a suitable reliability of the power management system is to be provided.

c) In addition, the following provisions may be required:

- assessment of priority criteria as regards load shedding
- suitable automatic power limitations. For instance, gradation may be required to allow safe achievement of essential functions before circuit breaker opening. Proportional cut backs may be adequately implemented: static rectifiers tripping, thrust command limits, etc.
- proportional limitation is to activate warning devices. Override arrangements are to be fitted at the operator's disposal
- implementation of suitable delay in connecting load consumers so as to enable additional power source switching on or load shedding.

4.3 Monitoring of the electricity production and propulsion

4.3.1 As a general rule, the monitoring level of electrical generators, their prime movers and power supply equipment, main propulsion diesel engines, electrical propulsion is to be granted at least with the requirements of additional classification notation **AUT-CCS**. For the installations granted with **DYNAPOS AM-AT RS** class notation, the requirements of **AUT-UMS** could be contemplated.

4.3.2 A possibility to integrate the dynamic positioning system and the automation system could be considered, the computerized system configuration used in that case is to be submitted to the Society. In addition, the consequences of a failure of the communication network and programmable controller units included in the systems is to be documented and included in the FMEA analysis.

4.4 Thruster system

4.4.1 The thruster design and construction is to comply with the applicable requirements of the Rules.

4.4.2 The provisions of this section apply to fixed axis or orirentable thrusters using fixed or orientable pitch propeller installed below the hull and tunnel thrusters. The use of other thruster types (cycloidal propeller for example) is subject to a special examination.

4.4.3 The electrical motors driving the thrusters are to be approved. The use of other types of thruster prime mover such as direct coupling to diesel engines or hydraulic motors is specially examined by the Society.

4.4.4 Electrical propulsion installations are to comply with the requirements of Pt E, Ch 4, Sec 5.

4.4.5 For symbol **R** assigment, attention is drawn to the requirements stated in [3.2.2].

Table 1 : System configuration for main power supply and propulsion systems

Equipment class	No requirement	1	2	3
Class Notation **DYNAPOS**	**SAM**	**AM/AT**	**AM/AT R**	**AM/AT RS**
Distribution system	non redundant	non redundant	redundant	redundant in separate rooms
Electrical generators	minimum number of generators see **(1)**	minimum number of generators see **(1)**	redundant	redundant in separate rooms
Main switchboard	1	1	1 with bus tie 2 circuits equally distributed	2 bus bars circuit breakers normally open located in separate rooms
Electrical propulsion	at least 1 azimuthal thruster driven by 1 electrical motor	at least 1 thruster driven by 1 electrical motor	redundant	redundant in separate rooms
Thruster driven by diesel engines	at least one thruster	at least one thruster	redundant	redundant in separate rooms
Power management system	non redundant	non redundant	redundant	redundant in separate rooms
(1) Concerning the electrical production for the minimum number of generators, it is to be considered that a spare generator is to be provided in order to maintain the electrical supply continuity in case of failure of the generator on duty.				

4.4.6 Uninterruptible power supply (U.P.S.)

For **DYNAPOS SAM** and **DYNAPOS AM/AT**, an U.P.S. is to be provided for the control of power and propulsion system defined above. Concerning the system granted with **R** and **RS** symbols, the number of U.P.S. is to be in accordance with the result of the FMEA analysis. Unless otherwise justified, 2 U.P.S. are to be provided for **R** symbol. For **RS** symbol, 2 U.P.S. are to be installed, one being located in a separate room.

4.5 Thruster control

4.5.1 General

The following requirements apply to the thruster control.

4.5.2 Closed loop command of thruster pitch, azimuth and RPM is to be provided from the controller. Feedback signals are to be provided by independent sensors connected to the controlled device.

4.5.3 Controllers are to incorporate features for avoiding commands likely to overload mechanical gearing or prime movers. Control is preferably to be performed using active power measurements.

4.5.4 Thrusters are to be capable of being easily stopped.

4.6 Thruster monitoring and protection

4.6.1 Thruster monitoring is to be provided by the controller unit. Thruster monitoring is to enable:

- detection of equipment failures
- monitoring of the correlation between set and achieved values of control parameters.

The following parameters are to be regularly monitored:

- status of thrusters (on-line / off-line)
- pitch, RPM, azimuth
- thruster load level
- electrical motor stator winding temperature
- temperature of main bearings (except roller type)
- lube oil and hydraulic fluid pressure and temperature.

4.6.2 Failure of thruster system including pitch, azimuth or speed control is to trigger an alarm, and must not make the thruster rotate or go to uncontrolled full pitch and speed.

4.6.3 Provisions for automatic stop of a thruster are to be restricted to circumstances liable to bring about immediate plant damage and are to be submitted for approval.

4.7 DP Control system

4.7.1 In general, the DP-control system is to be arranged in a DP-control station where the operator has a good view of the unit's exterior limits and the surrounding area.

4.7.2 The DP-control station is to 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 is to be visible at all times. Other information is to be available upon operator request.

4.7.3 Display systems, and the DP-control station in particular, are to be based on sound ergonometric principles. The DP-control system is to provided for easy selection of control mode, i.e. manual, joystick, or computer control of thrusters, and the active mode is to be clearly displayed. The following principles apply to display system:

- segregation of redundant equipment to reduce the possibility of common mode failure occurrence
- ease of access for maintenance purposes
- protection against adverse effects from environment and from electric and electromagnetic disturbances.

4.7.4 For equipment classes 2 and 3, operator controls are to be designed so that no single inadvertent act on the operator's panel can lead to a critical condition.

4.7.5 Alarms and warnings for failures in 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 is to be provided together with any necessary explanations. The alarm list is given for information in Tab 3.

4.7.6 The DP-control system is to prevent failures being transferred from one system to another. The redundant components are to be so arranged that a failure of one component should be isolated, and the other component activated.

4.7.7 It must 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.

4.7.8 The software is to be produced in accordance with an appropriate international quality standard recognised by the Society.

4.7.9 Regarding control stations, the following requirements are to be met:

- Where several control stations are provided, control is to be possible from one station only at the same time, adequate interlocking devices are to be fitted, and indication of the station in control is to be displayed at each control station.
- Alarm and control systems concerning a same function are to be grouped together (position reference system, propulsion, power generation).
- Where inadvertent activation of commands may jeopardise the unit's safety, these commands are to be protected (light cover, double triggering or other equivalent devices or procedures).
- A two-way voice communication facility, independent of the unit general system, is to be provided between the main control station and the following spaces: navigating bridge, engine room and engine control station, other control stations, responsible officer's accommodation, other control locations specific to the task of the unit.

4.8 Computers

4.8.1 For equipment class 1, the DP-control system needs not be redundant.

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

4.8.3 For equipment class 3 (symbol **RS**), the DP-control system is to 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 are not to be capable of causing failure at both/all systems. In addition, one back-up DP-control system should be arranged. An alarm should be initiated if any computer fails or is not ready to take control.

4.8.4 For equipment classes 2 (symbol **R**) and 3 (symbol **RS**), the DP-control system is to include a software function, normally known as "consequence analysis", which continuously verifies that the unit will remain in position even if the worst case failure occurs. This analysis is to verify that the thrusters 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 is to provide an alarm if the occurrence of a worst case failure would lead to a loss of position due to insufficient thrust for the prevailing environmental conditions. For operations which will take a long time to safely terminate, the consequence analysis is to include a function which simulates the thrust and power remaining after the worst case failure, based on manual input of weather trend.

4.8.5 Redundant computer systems are to 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 is to be smooth, and within the acceptable limitations of the operation.

4.8.6 For equipment class 3 (symbol **RS**), the back-up DP-control system is to be in a room, separated by A-60 class division from the main DP-control station. During DP-operation, this back-up control system is to be continuously updated by input from the sensors, position reference system, thruster feedback, etc., and be ready to take over control. The switch-over of control to the back-up system is to be manual, and can be operated either from the main or back-up systems. This occurs when the main system is affected by failure, fire or explosion at the main DP-control system.

4.8.7 An uninterruptable power supply (U.P.S.) is to be provided for each DP-computer system to ensure that any power failure will not affect more than one computer. U.P.S. battery capacity is to provide a minimum of 30 minutes operation following a main supply failure.

4.8.8 For dynamic positioning control system based on computer, it must be demonstrated that the control systems work properly in the environmental conditions prevailing on board units. To this purpose, the DP-control systems are to be submitted to the environmental tests defined in Pt C, Ch 3, Sec 6 of the Rules for the Classification of Ships, with a special consideration for E.M.I. (Electromagnetic interferences).

5 Position reference system

5.1 General

5.1.1 As a general rule, a dynamic positioning installation is to include at least two independent reference systems.

- For **SAM** notation assignment, one reference system is required.
- For equipment classes 2 and 3, at least three position reference systems are to be installed and simultaneously available to the DP-control system during operation.
- Position reference systems are to 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.
- When two or more position reference systems are required, they are not all to be of the same type, but based on different principles and suitable for the operating conditions.

5.1.2 As a general rule, the system is to allow for smoothing and mutual adjustment of the inputs originating from various position reference systems and transfer between reference is to be bumpless. Other arrangement is subject to special examination by the Society. Change over is preferably to take place automatically in case of failure of the reference system in use.

5.1.3 Meteorological reports, suitable for the operation of the unit are to be made available to the personel onboard.

5.2 Arrangement and performance of reference systems

5.2.1 The position reference systems are to produce data with adequate accuracy for the intended DP-operation.

5.2.2 Visual and audible alarms are to be activated when the unit deviates from the set heading or from the working area determined by the operator. The performance of position reference system is to be monitored and warnings provided when the signals from the position reference systems are either incorrect or substantially degraded.

5.2.3 Indication of the reference system in operation is given to the operator.

5.2.4 For equipment class 3, at least one of the position reference system is to be connected directly to the back up control system and separated by A-60 class division from other position reference system.

5.3 Type of position reference systems

5.3.1 When acoustical reference systems are used, hydrophone is to be chosen for minimising influence of mechanical and acoustical disturbance on the transmission

channels, such as propeller noise, spurious reflection on the hull, interference of riser, bubble or mud cluster on the acoustic path.

The directivity of transponders and hydrophones is to be compatible with the availability of the transmission channels in all foreseeable operational conditions. It is to be possible to select the frequency range and the rate of interrogation according to prevailing acoustical conditions, including other acoustical system possibly in service in the area.

5.3.2 When taut wire system is used, materials used for wire rope, tensioning and auxiliary equipment are to be appropriate for marine service. The anchor weight is to be designed to avoid dragging on the sea floor and is not to induce, on recovery, a wire tension exceeding 60% of its breaking strength, and the capacity of the tensioner is to be adapted to the expected movement amplitude of the unit.

5.3.3 When the signals from position reference system are likely to be altered by the movement of the unit (rolling, pitching), a correction of the position is to be made. For this purpose, a vertical reference unit of appropriate characteristics with regard to the expected accuracy of position measurement is to be provided. The VRS is to be duplicated for symbol **R** assignment.

5.4 Other reference systems

5.4.1 Other reference systems such as short to medium range radio positioning system, global positioning system may be used. Whatever the chosen principle (for example, hyperbolic or polar determination), the accuracy of the position measurement is to be satisfactory in the whole operational area.

5.4.2 The list of the reference systems is not exhaustive. It is possible to interface the DP-system with Syledis, Arthemis, Loran, GPS, DGPS etc.

5.4.3 When a GPS or DGPS is used, it is reminded that this equipment is to be designed in accordance with the following resolutions IMO A525 (13), A 694 (17), A 813 (19). This equipment is to be approved, at least by a national competent authority, and the relevant certificate is to be submitted to the Society. For other reference systems the same procedure is to be applied when the system is covered by an IMO resolution, this document is to be considered.

5.4.4 System needing periodical updating such as those based upon inertial navigation, Doppler effect, deep taut-wire with riser angle detection are to be integrated with an other reference system giving continuous output without appreciable offset. These systems are subject to a special examination by the Society, and are normally not taken into consideration for complying with [5.1.1], unless otherwise justified.

5.4.5 Location of the receiving equipment is to be chosen so as to minimise as far as practicable masking effects and interferences.

5.5 Unit sensors

5.5.1 Unit sensors are to be at least measure of unit heading, unit motion, wind speed and direction.

5.5.2 Arrangement of sensors and monitoring

Sensors are to be as far as possible provided with failure monitors (overheating, power loss).

- Inputs from sensors are to be monitored in order to detect possible faults, notably relative to temporal evolution of the signal. Concerning the analogue sensors, an alarm is to be triggered in case of connecting line wire break, short-circuit or low insulation.
- Inputs from simultaneously in use sensors are to be compared in order to detect significant discrepancy between them.
- Any failure of automatic change-over between sensors are to activate visual and audible alarms at the control room.
- Sensors for class 2 and 3 equipment,sensors used for the same purpose, connected to redundant systems are to be arranged independently so that failure of one does not affect the others.
- For equipment class 3 (symbol **RS**), one of each type of sensors is to be connected directly to the back-up control system and separated by A-60 class division from the other sensors.
- When an equipment class 2 or 3 (for **R** and **RS** symbols), DP-control system is fully dependent on correct signals from unit sensors, then these signals are to be based on three systems serving the same purpose (i.e., this will result in at least three gyrocompasses being installed).

5.5.3 For equipment class 3 (symbol **RS**), one of each type of sensors is to be connected directly to the back up control system and separated by A-60 class division from the other sensors.

5.5.4 When an equipment class 2 or 3 (for **R** and **RS** symbols), DP-control system is fully dependent on correct signals from unit sensors, then these signals are to be based on three systems serving the same purpose (i.e., this will result in at least three gyrocompasses being installed).

5.5.5 Heading

For **DYNAPOS SAM**, one gyrocompass or another heading measurement unit of equivalent accuracy is to be provided. For the assignment of notation **DYNAPOS AM/AT**, two gyrocompasses or other sensors of equivalent accuracy are required. For **DYNAPOS AM/AT R** or **RS**, see [5.5.4] and Tab 2.

5.5.6 Wind speed and direction are to be recorded by suitably located wind sensors, due consideration being given to superstructure influence.

5.5.7 The alarms to be triggered and indication to be displayed are detailed in Tab 3. This list is given for information and can be completed taking into consideration of the installation configuration. This list does not include the alarms which are required by the automated notation granted to the unit.

6 Installation requirements

6.1 Cables and piping systems

6.1.1 The following requirements are to be applied to hydraulic pneumatic and electrical circuits.

6.1.2 For equipment class 2, the piping systems for fuel, lubrication, hydraulic oil, cooling water, pneumatic circuits and the cabling of the electrical circuits essential for a proper running of the DP-system are to be located with due regard to fire hazards and mechanical damages.

6.1.3 For equipment class 3:

- Redundant piping system (i.e., piping for fuel, cooling water, lubrication oil, hydraulic oil, pneumatic circuits etc.) are not to be routed together through the same compartments. Where this is unavoidable, such pipes could run together in ducts of A-60 class.
- Cables for redundant equipment or systems are not to be routed together through the same compartments. Where this is unavoidable such cables may run together in cable ducts of A-60 class. Cable connection boxes are not allowed in such ducts.

6.1.4 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 (common fire suppression systems, engine ventilation systems, shut-down systems, etc.) are also to comply with relevant requirements of these Rules.

6.2 Thruster location

6.2.1 The thruster location, operational modes and design are to comply with the following requirements.

6.2.2 The thruster location and operational modes are to be chosen so as to minimise interference between thrusters as well as disturbance brought to proper operation of sensor systems or specific equipment the unit is provided with.

6.2.3 Thrusters intake depth is to be sufficient to reduce the probability of ingesting floating debris and of vortex formation.

Table 2 : Configuration for reference systems, unit sensors and computers

Equipment class	No requirement	1	2	3
DYNAPOS class notations	**SAM**	**AM/AT**	**AM/AT R**	**AM/AT RS**
Number of control computers	1	1	2	3, 1 of them connected to back up control station
Manual control joystick with automatic heading	may be fitted	Yes	**(1)**	**(1)**
One man operating the DP system	Yes	Yes	Yes	Yes
Position reference system	1	2	3	3, 1 of them connected to back up control station
Vertical reference system	1	2	2	2, 1 of them connected to back up control station
Wind sensor	1	2	2	2, 1 of them connected to back up control station
Gyro	1	2	2	3, 1 of them connected to back up control station
(1) Not required.				

Table 3 : Alarm and warning system

Parameters and equipment	Alarms or group of alarms	Signalling
Unit coodinates and desired position		x
Actual position		x
Maximum deviation required		x
Deviation from the desired operating area out of the a.m. limits	x	
Thruster availability ready for operation		x
Thruster in operation		x
Thruster in failure	x	
Vectorial thrust ouput out of limit	x	
Note 1: Depending upon the DP classification notation required, the above mentioned list could be simplified. **Note 2:** Instead of individual alarm, when it is possible to discriminate the cause of the alarm on the unit which is concerned, it is possible to display an alarm group		

Parameters and equipment	Alarms or group of alarms	Signalling
Total output of all thrusters		x for class 2 and class 3 equipment
Thrust limitation by available power	x	
Power supply failure	for group of alarms x	
Power management failure	x for class 2 and class 3 equipment	
Desired heading		x
Actual heading		x
Deviation from desired heading out of limit	x	
Status of heading reference system connected or not		x
Failure of any heading reference system	x	
Automatic switching to stand by heading reference system	x	
Failure of the vertical reference sensor measuring the pitching and rolling of the unit	x	
Operational status of each vertical reference sensor		x
Automatic switching to vertical stand by reference sensor	x	
Indication of wind speed and direction sensor		x
Operational status of wind sensors, speed and direction		x
Wind sensor failure, speed and direction	x	
Automatic switching of wind speed and direction sensor	x	
Computer failures	for group of alarms x	
Automatic switching to stand by computer	x	
Abnormal input signals to the computer, analogue input failures	x	
Number of generators available		x
Sea state conditions		x for class 2 and class 3 equipment
Note 1: Depending upon the DP classification notation required, the above mentioned list could be simplified. **Note 2:** Instead of individual alarm, when it is possible to discriminate the cause of the alarm on the unit which is concerned, it is possible to display an alarm group		

6.2.4 The integrity of the hull is not to be adversly affected by thruster installation, particularly where retractable or tunnel thruster are provided.

6.2.5 Bow thrusters are to be located aft of the collision bulkhead.

6.2.6 The thruster system is to provide adequate thust in longitudinal and lateral directions and provid yawing moment for heading control.

6.2.7 As regard **AM/AT** notation, transverse fixed axis thrusters, if used, are to be capable of providing sufficient thrust in the contemplated range of speed of the unit.

6.2.8 The values of the thruster forces used in the consequence analysis (see [4.8.4]) are to be corrected for interference between thrusters and other effects which will reduce the effective force.

6.2.9 For equipment classes 2 and 3, the thruster system is to be connected to the power system in such way that the requirement stated in [6.2.6] can be complied with, even after failure of one of the constituent power systems and one of the thrusters connectected to that system.

7 Operational requirements

7.1 General

7.1.1 The following operation conditions are to be fulfilled.

7.1.2 Before every DP-operation, the DP-system is to be checked according to a unit specific "location" checklist to make sure that the DP-system is functioning correctly and that the system has been set up for the appropriate equipment class.

7.1.3 During DP-operations, the system should be checked at regular intervals according to a unit specific watch-keeping checklist.

7.1.4 DP-operations necessitating equipment class 2 or 3 should be terminated when the environmental conditions are such that the DP-unit will no longer be able to keep position if the single failure criterion applicable to the equipment class occured. In this context, deterioration of environmental conditions and the necessary time to safely terminate the operation is 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 with equipment class 2 or 3. The necessary operating instructions, etc., are to be placed on board as far as practicable.

7.1.5 The following checklist, test procedures and instructions are to be incorporated into the DP-operating manuals for the unit:

- location checklist, see [7.1.2]
- watch-keeping checklist, see [7.1.3]
- DP-operation instructions, see [7.1.4]
- initial and periodical (5-year) tests and procedures, see [8]
- annual tests and procedures, see [8]
- example of tests and procedures after modifications and non-conformities, see [8].

7.1.6 Reports of tests and record of modification or equivalent are to be kept on board and made available during periodical inspections.

8 Test and trials

8.1 Inspection at works

8.1.1 Inspection at work of items subject to classification are to be carried out at the attending surveyor's satisfaction, in accordance with a programme previously agreed.

8.1.2 Thruster and electrical installation tests are to be conducted in accordance with the requirements for electrical propulsion of Pt E, Ch 4, Sec 5.

8.2 Trials

8.2.1 Before a new installation is put into service and after modification of an existing installation, port and sea trials are to be carried out to check the DP-system proper functioning and performances.

8.2.2 The programme of these trials is to be previously submitted to the Society.

8.2.3 Such trials are to verify:

- functioning of equipment
- shielding efficiency of sources of electrical and electromagnetic interferences
- functioning of alarms
- functioning of change-over arrangements.

8.2.4 Tests are to be performed in order to assess the appropriate function of the system in case of single failure (controller, position reference system, gyrocompass, alternator, thruster, etc) and in case of worst case failure.

8.2.5 Sea trials are to be of sufficient duration to confirm satisfactory operation.

8.2.6 Final report of dock and sea trials is to be submitted for information.

9 Environmental station keeping index ESKI

9.1 Definition

9.1.1 An environmental station keeping index (ESKI) may be associated with each of the class notation defined in [1.4.2] and [1.4.4].

9.1.2 This ESKI indicates the station keeping capability of the unit (as a percentage of time) under given environmental conditions.

9.2 Environmental conditions

9.2.1 The ESKI is based on environmental conditions consistent with the geographical area of unit operation.

9.2.2 For unlimited service, a set of standard North Sea Environmental Conditions is to be used.

9.2.3 For restricted service, a long term distribution of environmental conditions prevailing where the unit is in operation, is to be considered.

9.3 Condition of ESKI estimation

9.3.1 The ESKI indicates the allowable environmental conditions for three system configurations:

- with all thrusters operating
- with one single failure
- with most critical single failure.

9.3.2 The ESKI reflects the capability to maintain position with the most unfavourable heading.

9.3.3 Environmental forces (wind, wave drift and current loads) and thrust are to be evaluated through tunnel and tank model tests or other recognised methods.

9.4 Documentation to be submitted

9.4.1 The following documentation are to be submitted in order to derive ESKI:

- General arrangement (including deck superstructure)
- Line plan
- Design environmental conditions
- Documentation of environmental conditions long term distribution (restricted service)
- Basin and tunnel test results
- Details of waves drift loads on unit
- Details of current load on unit
- Details of thruster layout
- Details of thrust power (including polar distribution of thrust as a function of heading for both intact and one thruster failure mode). This should take into consideration the interaction between thrusters, thrusters and hull, thrusters and current
- Thruster management logic.

SECTION 3 VAPOUR CONTROL SYSTEM (VCS)

1 General

1.1 Application

1.1.1 The additional class notation **VCS** is assigned, in accordance with Pt A, Ch 1, Sec 2, [6.10.3], to **FSO** and **FPSO** fitted with systems for control of vapour emission from cargo tanks during loading operation, complying with the requirements of this Section.

1.2 Definitions

1.2.1 Diluted

A flammable gas or mixture is defined diluted when its concentration in air is less than 50% of its lower explosive limit.

1.2.2 Flammable cargoes

Flammable cargoes are crude oils, petroleum products and chemicals having a flashpoint not exceeding 60 °C (closed cup tests) and other substances having equivalent fire risk.

1.2.3 Inerted

Inerted is the condition in which the oxygen content in a flammable gas/air mixture is 8% or less by volume.

1.2.4 Independent

Two electrical systems are considered independent when anyone system may continue to operate with a failure of any part of the other system, except power source and electrical feeder panels.

1.2.5 Maximum allowable transfer rate

Maximum allowable transfer rate is the maximum volumetric rate at which a unit may receive cargo.

1.2.6 Unit vapour connection

The unit vapour connection is the point of interface between the unit's fixed vapour collection system and the collection system of another unit. Hoses or loading arms on board, carried for the purpose of these rules, are considered part of the vapour control system of the unit.

1.2.7 Vapour balancing

Vapour balancing is the transfer of vapour displaced by incoming cargo from the tank of a unit receiving cargo into a tank of a facility delivering cargo via a vapour collection system.

1.2.8 Vapour collection system

The vapour collection system is an arrangement of piping and hoses used to collect vapour emitted from a unit's cargo tank and to transport the vapour to a vapour processing unit.

1.3 Documentation to be submitted

1.3.1 Tab 1 lists the documents which are to be submitted.

Table 1

No.	A/I **(1)**	Document
1	A	Diagrammatic plan of the vapour piping system including: • material specifications • dimensions, scantlings and sizes • ratings (temperature / pressure) • joining details • fittings and standards used • etc.
2	A	Diagrammatic drawing of the gauging system and overfill protection including: • manufacturer and type of the instruments • plan of hazardous area locations • location of electrical equipment in gas dangerous spaces and safe certificates of the electric instruments intended to be used in hazardous locations • electrical schemes concerning the alarm system supply • electrical schemes concerning the intrinsically safe circuits • etc.
3	A	Diagrammatic drawings of the venting system, including necessary data for verifying the venting capacity of the pressure/vacuum valves
4	I	Pressure drop calculations comparing cargo transfer rates versus pressure drops from the farthest tanks to the vapour connection, included any possible hoses

No.	A/I (1)	Document
5	I	Calculations showing the time available between alarm setting and overfill at maximum loading rate for each tank
6	A	Instruction manual
7	I	Information on the antidetonation devices, including manufacturer and type of the device employed as well as documentation on any acceptance test carried out
(1) A = to be submitted for approval in quadruplicate I = to be submitted for information in duplicate		

2 Vapour system

2.1 General

2.1.1 Installation of vapour collection system

Each unit is to have vapour collection piping permanently installed, with the unit vapour connection located as close as practical to the loading manifolds.

2.1.2 Liquid condensate disposal

Means are to be provided to eliminate liquid condensate which may collect in the system.

2.1.3 Electrical bonding

Vapour collection piping is to be electrically bonded to the hull and is to be electrically continuous.

2.1.4 Inert gas supply isolation

When inert gas distribution piping is used for vapour collection piping, means to isolate the inert gas supply from the vapour collection system are to be provided. The inert gas main isolating valve required in Part C, Chapter 4 may be used to satisfy this requirement.

2.1.5 Prevention of interference between vapour collection and inert gas systems

The vapour collection system is not to interfere with the proper operation of the cargo tank venting system. However, a vapour collection piping may be partly common with the vent piping and/or the inert gas system piping.

2.2 Vapour manifold

2.2.1 Isolation valve

a) An isolation valve capable of manual operation is to be provided at the unit vapour connection.

b) The valve is to have an indictor to show clearly whether the valve is in the open or closed position, unless the valve position can be readily determined from the valve handle or valve stem.

2.2.2 Labelling

The vapour manifold is to be:

- for the last 1 m painted red/yellow/red, with the red bands 0,1 m wide and the yellow band 0,8 m wide;
- labelled “VAPOUR” in black letters at least 50 mm high.

2.3 Vapour hoses

2.3.1 Hoses

Each hose used for transferring vapour is to have:

- a design burst pressure of at least 0,175 MPa;
- a maximum working pressure of at least 0,035 MPa;
- the capability of withstanding at least 0,014 MPa vacuum without collapsing or constricting;
- electrical continuity with a maximum resistance of 10000 Ω;
- resistance to abrasion and kinking;
- the last 1 m of each end of the hose marked in accordance with [2.2.2].

2.3.2 Handling equipment

Vapour hose handling equipment are to be provided with hose saddles which provide adequate support to prevent kinking or collapse of hoses.

2.4 Vapour overpressure and vacuum protection

2.4.1 General

The cargo tank venting system is:

a) to be capable of discharging cargo vapour at 1,25 times the maximum transfer rate in such a way that the pressure in the vapour space of each tank connected to the vapour collection system does not exceed:

1) the maximum working pressure of the tank;

2) the operating pressure of a safety valve or rupture disk, if fitted;

b) not to relieve at a pressure corresponding to a pressure in the cargo tank vapour space of less than 0,007 MPa;

c) to prevent a vacuum in the cargo tank vapour space, that exceeds the maximum design vacuum for any tank which is connected to the vapour collecting system, when the tank is discharged at the maximum rate;

d) not to relieve at a vacuum corresponding to a vacuum in the cargo tank vapour space less than 0,0035 MPa below the atmospheric pressure.

2.4.2 Pressure/vacuum safety valves

a) Pressure/vacuum safety valves are to be fitted with means to check that the device operates freely and does not remain in the open position.

b) Pressure relief valves are to be fitted with a flame screen at their outlets, unless the valves are designed in such a way as to ensure a vapour discharge velocity of not less than 30 m/second.

3 Instrumentation

3.1 Cargo tank gauging equipment

3.1.1 Each cargo tank that is connected to a vapour collection system is to be equipped with a cargo gauging device which:

- provides a closed gauging arrangement which does not require opening the tank to the atmosphere during cargo transfer;
- allows the operator to determine the liquid level in the tank for the full range of liquid levels in the tank;
- indicates the liquid level in the tank, at the location where cargo transfer is located;
- if portable, is installed on tank during the entire transfer operation.

3.2 Cargo tank high level alarms

3.2.1 General

a) Each cargo tank that is connected to a vapour collection system is to be equipped with an intrinsically safe high level alarm system which alarms before the tank overfill alarm, but not lower than 95% of the tank capacity.

b) The high level alarm is to be identified with the legend "HIGH LEVEL ALARM" and have audible and visible alarm indications that can be seen and heard where the cargo transfer is controlled.

3.2.2 Alarm characteristics

The high level alarm is:

- to be independent of the overfill alarm;
- to alarm in the event of loss of power to the alarm system or failure of the electrical circuits to the tank level sensors.
- to be able to be checked at the tank for proper operation prior to each transfer or contain an electronic self-testing feature which monitors the condition of the alarm circuits and sensors.

3.3 Cargo tank overfill alarms

3.3.1 General

a) Each cargo tank that is connected to a vapour collection system is to be equipped with an intrinsically safe overfill alarm which alarms early enough to allow the person in charge of transfer operation to stop the transfer operation before the cargo tank overflows.

b) The overfill alarm is to be identified with the legend "OVERFILL ALARM" and have audible and visible alarm indications that can be seen and heard where the cargo transfer is controlled and in the deck cargo area.

3.3.2 Alarm characteristics

The overfill alarm is:

- to be independent of both the high level alarm (see [3.2.1]) and the cargo gauging system (see [3.1]);
- to alarm in the event of loss of power to the alarm system or failure of the electrical circuits to the tank level sensors.
- to be able to be checked at the tank for proper operation prior to each transfer or contain an electronic self-testing feature which monitors the condition of the alarm circuits and sensors.

3.4 High and low vapour pressure alarms

3.4.1 Pressure alarms

Each vapour collection system is to be fitted with one or more pressure sensing devices that sense the pressure in the main collection line, which:

- have a pressure indicator located where the cargo transfer is controlled;
- alarm the high pressure of not more than 90% of the lowest relief valve setting in the tank venting system;
- alarm at a low pressure of not less than 0,98 kPa for an inerted tank, or the lowest vacuum relief valve setting in the cargo venting system for a non-inerted tank.

3.4.2 Equivalence

Pressure sensors fitted in each cargo tank are acceptable as equivalent to pressure sensors fitted in each main vapour collection line.

4 Equipment

4.1

4.1.1 The unit is to have means to inert the vapour transfer hose prior to transferring cargo vapour and an oxygen analyser with a sensor or sampling connection fitted within 3 m of the unit vapour connection which:

- activates an audible and visible alarm at a location on the service ship where cargo transfer is controlled when the oxygen content in the vapour collection system exceeds 8% by volume;
- has an oxygen concentration indicator located on the service ship where the cargo transfer is controlled;
- has a connection for injecting a span gas of known concentration for calibration and testing of the oxygen analyser.

The vapour collection line on the unit is to be fitted with a detonation arrester located within 3 m of the unit vapour connection.

4.2 Electrical insulating flange

4.2.1 An electrical insulating flange or one length of non-electrically conductive hose is to be provided between the vapour connection of the unit being lightered and the unit.

5 Instruction manual

5.1 General

5.1.1

a) Each unit utilising a vapour emission control system is to be provided with written operational instructions covering the specific system installed on the unit.

b) Instructions are to encompass the purpose and principles of operation of the vapour emission control system and provide an understanding of the equipment involved and associated hazards. In addition, the instructions are to provide an understanding of the operating procedures, piping connection sequence, start-up procedures, normal operations and emergency procedures.

5.2 Content

5.2.1 The instruction are to contain:

a) a line diagram of the unit's vapour collection piping including the location of each valve, control device, pressure-vacuum safety valve, pressure indicator, flame arresters and detonation arresters, if fitted;

b) the maximum allowable transfer rate for each group of cargo tanks having the same venting line, determined as the lowest of the following:

1) 80% of the total venting capacity of the pressure relief valves in the cargo tank venting systems;

2) the total vacuum relieving capacity of the vacuum relief valves in the cargo tank venting system;

3) the rate based on pressure drop calculations at which, for a given pressure at the vapour connection of the unit, the pressure in any cargo tank connected to the vapour collection system exceeds 80% of the setting of any pressure relief valve in the cargo tank venting system;

c) the initial loading rate for each cargo tank, to be determined in such a way as to minimise the development of a static electrical charge, when applicable;

d) tables or graphs of transfer rates and corresponding vapour collection system pressure drops including the vapour hoses, if foreseen) determined, from the most remote cargo tanks to the unit vapour connection, as follow:

1) for each cargo handled by the vapour collection system at the a maximum transfer rate and at the lesser transfer rates;

2) based on 50% cargo vapour and air mixture, and a vapour growth rate appropriate for the cargo being loaded;

e) the safety valve setting at each pressure-vacuum safety valve.

6 Testing and trials

6.1

6.1.1 General

Machinery and equipment which are part of the vapour collecting system are to be tested in compliance with the applicable requirements of the other Parts of the Rules.

6.1.2 Hydrostatic tests

Pressure parts are to be subjected to hydrostatic tests in accordance with the applicable requirements.

6.1.3 Pressure/vacuum valves

Pressure/vacuum valves are to be tested for venting capacity. The test is to be carried out with the flame screen installed if contemplated in accordance with [2.4.2].

6.2 On board trials

6.2.1 Upon completion of construction specific tests may be required at the Society's discretion in relation to the characteristics of the plant fitted on board.

SECTION 4 CENTRALISED CARGO AND BALLAST WATER HANDLING INSTALLATIONS (CARGOCONTROL)

1 General

1.1 Application

1.1.1 The additional class notation **CARGOCONTROL** is assigned, in accordance with Pt A, Ch 1, Sec 2, [6.10.4], to units with a centralised system for handling oil, gas and ballast fluids and complying with the requirements of this Section.

1.1.2 Compliance with these Rules does not exempt the Owner from the obligation of fulfilling any additional requirements issued by the Administration of the State whose flag the unit is entitled to fly.

1.2 Documents to be submitted

1.2.1 The documents listed in Tab 1 are to be sent to Society for approval.

The Society reserves the right to require additional plans or information in relation to the specific characteristics of the installations.

2 Design and construction requirements

2.1 Control station

2.1.1 Location of control station

a) The control station is to be located such as to allow visibility of the cargo tanks deck area, and in particular of the cargo loading and unloading ramps.

b) The station is preferably to be situated in the accommodation area; should this be impracticable, the control station is to be bounded by A-60 Class fire-resisting bulkheads and provided with two escapes.

2.1.2 Communications

It is to be possible from the control station to convey orders to crew members on deck and to communicate with the navigating bridge, with cargo handling spaces, with the engine room and, if separate, the cargo pump and compressor switchboard rooms.

2.1.3 Safety equipment

Where the control station is located within the cargo area, two complete sets of protective clothing in order to protect the skin from the heat radiating from a fire are always to be readily available together with three breathing apparatuses.

2.2 Remote control, indication and alarm systems

2.2.1 Remote control system

It is to be possible to carry out the following operations from the control station

a) opening and closing of valves normally required to be operated for loading, unloading and transfer of cargo and ballast (however, the opening and closing of valves is not required for the ends of cargo loading and unloading arrangements);

b) starting and stopping of cargo pumps, stripping pumps, gas compressors and ballast pumps (alternative solutions may be considered in the case of pumps and compressors powered by turbines);

c) regulation, if foreseen, of the number of revolutions of cargo pumps, stripping pumps, gas compressors and ballast pumps.

2.2.2 Indication system

The control station is to be fitted with indicators showing:

- (open/closed) position of valves operated by remote control;
- state (off/on) of cargo pumps, stripping pumps, gas compressors and ballast pumps;
- the speed of cargo pumps, stripping pumps, gas compressors and ballast pumps where they may be operated at adjustable speeds;
- the delivery pressure of the hydraulic plant for the operation of cargo , stripping ballast pumps and valves;
- the delivery and suction pressure of cargo pumps, stripping pumps, and ballast pumps;
- the delivery and suction pressure and temperature of gas compressors;
- the pressure and temperature of loading/unloading crossovers/bow or stern manifolds;
- oxygen level, temperature and pressure of the inert gas, where the operation of the inert gas system is required or envisaged at the same time as loading/unloading;
- the level in cargo and ballast tanks (relaxation of this requirement may be permitted for double bottom ballast tanks of reduced capacity and limited depth);
- the pressure and temperature in cargo tanks provided with heating or refrigeration, and for FSRUs the temperature of the inner hull around each cargo tank.

2.2.3 Alarm systems

The cargo control station is to be fitted with visual and audible alarms signalling the following:

- a high level, and where requested an independent very high level, in cargo tanks;
- a high pressure in cargo tanks, if required by the Rules and IGC code;
- a low delivery pressure of the hydraulic plant for the operation of pumps and valves;
- a low pressure in cargo tanks, if required by the Rules;
- a high pressure in the cargo and ballast lines;
- a high and low temperature for cargo tanks fitted with heating and refrigerating systems;
- a high oxygen level, high temperature, high and low pressure of inert gas, if foreseen;
- a high level in a bilge well in cargo and ballast pump rooms, compressor rooms and interbarrier and hold spaces;
- a high concentration of explosive vapours (exceeding 30% of the lower flammable limit) in spaces where cargo is handled;
- a high temperature of gas tight seals with oil/inert gas glands for runs of shafts, where these are foreseen through bulkheads or decks, for the operation of cargo and ballast pumps and gas compressors:
- a high or low pressure in a pressurised insulation space
- a low lubricating oil pressure and high temperature for equipment having an independent lubricating oil system
- a high discharge temperature and pressure on gas compressors
- a low suction temperature and pressure on gas compressors.

3 Inspections and testings

3.1 Equipment and systems

3.1.1 Equipment and systems are to be inspected and tested in accordance with the applicable requirements of the Rules relative at each piece of equipment or system used for the centralised control.

3.2 Testing on board

3.2.1 Following installation on board, remote control, indication and alarm systems are to be subjected to operational tests in the presence of the Surveyor.

Table 1

No.	A/I **(1)**	Item
1	I	Schematic drawing of the installations
2	I	Plan of the location and arrangements of the control station
3	A	List of remote control devices
4	A	List of alarms
5	I	List of the equipment (sensors, transducers, etc.) and automation systems (alarm systems, etc.) envisaged with indication of the manufacturer and of the type of equipment or system
6	A	Line diagram of power supply circuits of control and monitoring systems, including • circuit table, in the case of electrical power supply • specification of service pressures, diameter and thickness of piping, materials used, etc. in the case of hydraulic or pneumatic power supply
(1) A = to be submitted for approval in quadruplicate I = to be submitted for information in duplicate		

SECTION 5 DAMAGE STABILITY (DMS)

1 General

1.1 Application

1.1.1 The additional class notation DMS is assigned, in accordance with Pt A, Ch 1, Sec 2, [6.10.5], to units to which Service Notations **FSO**, **FPSO** or **FSRU** are assigned and complying with the damage stability requirements given in this section.

1.1.2 Units to which Service Notation **MODU** is assigned, and complying with the damage stability requirements of Pt E, Ch 4, Sec 3 of these Rules, may also be assigned with the additional class notation **DMS**.

1.2 Documents to be submitted

1.2.1 The stability documentation to be submitted for approval is as follows:

- damage stability calculations,
- damage control documentation.

1.2.2 A copy of the documentation as per [1.2.1] is to be available on board for the attention of the Master.

2 Damage stability requirements

2.1 Subdivision and damage stability

2.1.1 The unit is to have sufficient freeboard and be subdivided in such a way to ensure sufficient buoyancy and stability to withstand flooding of the compartments between the transverse watertight bulkheads affected by damage to the extent set out in [2.2].

2.1.2 The unit in a damaged condition is to have sufficient reserve stability to withstand the wind heeling moment based on a transverse wind velocity of 25,8 m/s (50 knots). In this condition, the final waterline after flooding, taking into account sinkage, heel and trim, is to be above the lowest edge of any opening through which progressive flooding may take place.

2.1.3 The requirements of [2.1.1] and [2.1.2] is to be assessed by calculations taking into account the loading conditions foreseen for the unit.

2.1.4 The possibility of relaxing the above-mentioned requirements by considering the ability to reduce the heeling angles by pumping out, ballasting or applying mooring forces is not accepted.

2.1.5 In flooding checks, tanks with vents or overflows located in spaces assumed to be flooded or which terminate on open decks and in a position below the final waterline after flooding are to be taken into consideration.

2.1.6 All piping, ventilation systems, tanks etc. affected by the damage referred to in [2.2] are to be considered damaged. Effective means of closure are to be provided at watertight boundaries to preclude the progressive flooding of the other spaces which are considered to be intact.

2.2 Extent of damage

2.2.1 In assessing the damage stability, it is to be assumed that damage can occur to the following extent between effective watertight bulkheads:

a) horizontal penetration: 1,5 m; and

b) vertical extent: from the base line up without limit.

2.2.2 The distance between effective watertight bulkheads or their nearest stepped portions which are positioned within the assumed extent of horizontal penetration should be not less than 3,0 m; where there is a lesser distance, one or more of the adjacent bulkheads should be disregarded.

2.2.3 Where damage of a lesser extent than in [2.2.1] results in a more severe condition, such lesser extent should be assumed.

2.3 Watertight integrity

2.3.1 The number of openings in the watertight bulkheads is to be kept to a minimum compatible with the design and proper working of the unit.

Where it is necessary to penetrate the watertight bulkheads for access or piping, ventilation, electrical cables etc., arrangements are to be made to maintain the watertight integrity of the enclosed compartments.

When the watertight boundaries are provided with valves to maintain watertight integrity, it is to be possible to operate these valves from a pump room or other normally manned space, an open deck or a deck situated above the bulkhead deck.

Valve position indicators are to be provided in the remote control room.

2.4 Closing appliances

2.4.1 Internal openings

a) The closing appliances which are to ensure the watertight integrity of internal openings used during the operation of the unit are to comply with the following requirements:

   1) it is to be possible to operate the closing appliances both by remote control from a central position on the deck which is above the final waterline after flooding, and locally from each side of the bulkhead. The control rooms are to be supplied with

indicators which show whether the closing appliances are open or closed.

2) the requirements concerning remote control in (1) may be dispensed with for those closing appliances which are normally closed while the unit is afloat, provided an alarm system (for example light signals) is arranged both locally and in a central position telling the personnel whether the closing appliances in question are open or closed. A notice is to beaffixed to each side of the closing appliance stating that it is not to be left open while the unit is afloat.

3) the closing appliances are to be strong and to possess securing devices and enough packing to maintain watertightness when they are subjected to the design water pressure pertaining to the boundary of the flooded subdivision on which they are placed.

b) The closing appliances to ensure the watertight integrity of internal openings which are kept permanently closed during the operation of the unit are to comply with the following:

1) a notice is to be affixed to each side of the closing appliance stating that it is to be kept closed while the unit is operating. Manholes fitted with closed bolted covers are not subject to this requirement

2) the closing appliances are to be strong and to possess securing devices and enough packing to maintain watertightness when they are subjected to the design water pressure pertaining to the boundary of the flooded subdivision on which they are placed.

2.4.2 External openings

a) Where the watertight integrity of the unit depends on external openings which are used during the operation of the unit, these openings are to comply with the following requirements:

1) the openings whose lower edge is not to be below the waterline in the final condition of equilibrium after flooding, taking into account the effects of the wind, include: air pipes (without any consideration of their closing appliances), ventilators, ventilation intakes and outlets, non-watertight hatches and doorways not fitted with watertight closing appliances

2) the openings which may be submerged include: manholes fitted with closed bolted covers, small hatches and sidescuttles of the non-opening type.

b) The requirements of item [2.4.1] b) are to be applied where the watertight integrity depends on the external openings which are kept permanently closed during the operation of the unit.

SECTION 6 PROTECTIVE COATINGS IN WATER BALLAST TANKS (COAT-WBT)

1 General

1.1 Application

1.1.1 This Section provides the criteria for the assignment of the additional class notation **COAT-WBT**, in accordance with Pt A, Ch 1, Sec 2, [6.10.6], to units of new construction whose water ballast tanks have been provided with protective coatings complying with the requirements of this Section.

The criteria for retaining the additional class notation **COAT-WBT**, which is subject to the coating system being maintained in or restored to GOOD condition, according to the definition given in Pt A, Ch 2, Sec 2, [2.2.11], during intermediate or class renewal surveys, are dealt with in Pt A, Ch 5, Sec 6, [5].

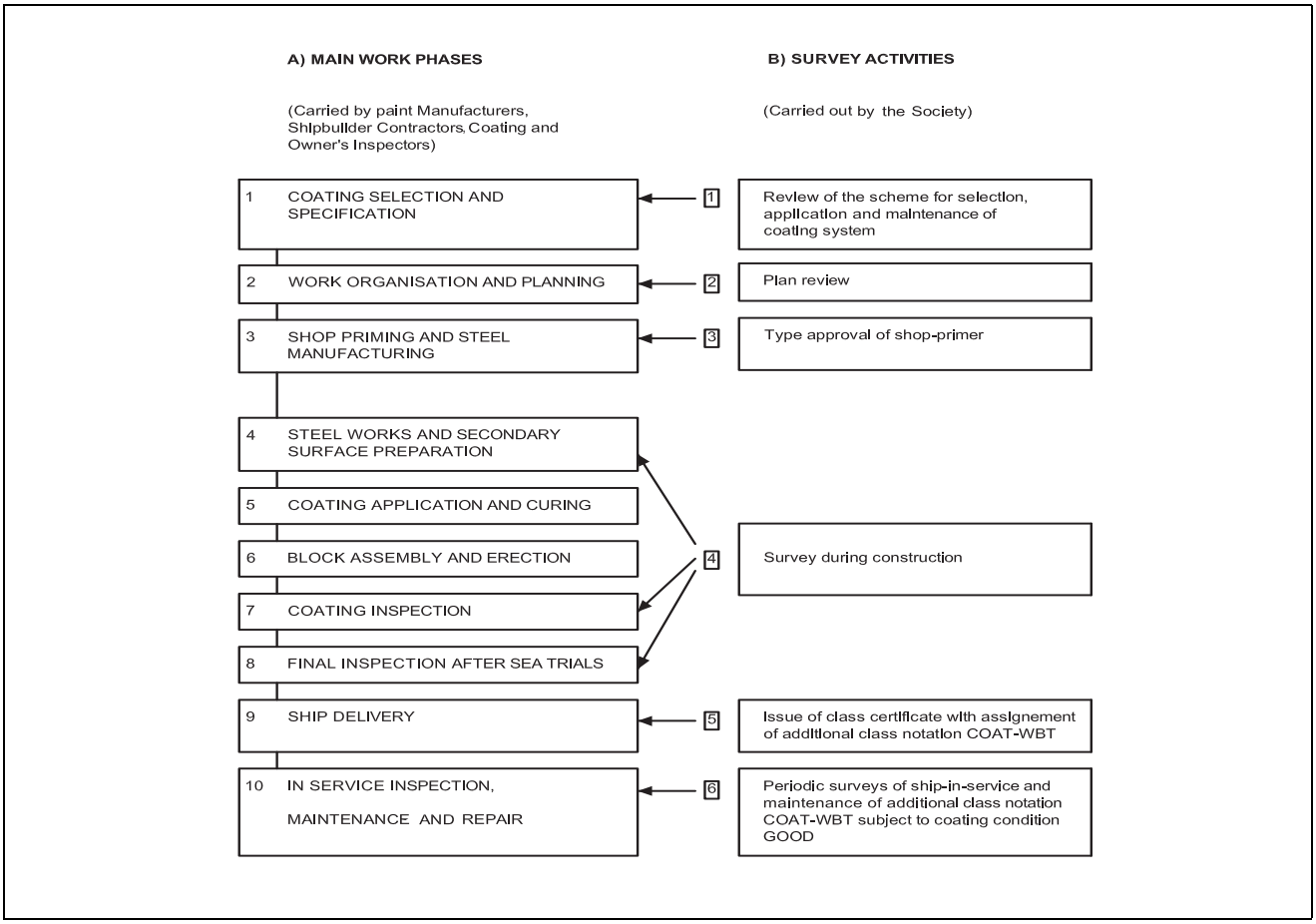
1.1.2 The criteria for the selection, application and maintenance of protective coatings in water ballast tanks, provided in this Section, are based on IMO resolution MSC.215(82) "Performance standard for protective coatings for dedicated seawater ballast tanks in all types of ships and double-side skin spaces of bulk carriers". The basic coating system requirements are indicated in Tab 2.

A different "coating performance standard", which may have been chosen in the agreement between the shipyard and the Owner, may be accepted as a reference standard provided that the Society deems it at least equivalent to the above-mentioned standard.

The reference "coating performance standard" will be appended as an enclosure to the Certificate of Classification of those units to which the notation is assigned.

1.1.3 The assignment of the notation **COAT-WBT** is subject to the verification of the "main work phases" indicated in Tab 1, schedule A) by means of the "survey activities" identified at the milestones indicated in Tab 1, schedule B), as described in [3].

Table 1 : Main work phases and survey activities for the assignment of the notation COAT-WBT



1.2 Definitions

1.2.1 For the purpose of this Section the following definitions apply:

a) **Ballast spaces:** are spaces that can be used for storing ballast water. They normally include, but are not limited to, ballast tanks as defined in Resolution A.798(19) and Resolution A.744(18) and tanks which, according to the unit's loading manual, can be used for both cargo and ballast;

b) **Cathodic protection:** is a technique to prevent corrosion of a metal surface by making an electrochemical contact between the substrate and a metal easier to be corroded, i.e. zinc, magnesium, which in this case is sacrificed to preserve the less noble metal such as steel;

c) **Curing:** is a complex of chemical phenomena which cause the polymerisation of the binder of the paint with formation of a three-dimensional molecular structure insoluble in the original solvents of the binder;

d) **Curing time:** is the time required by a coating to reach its complete properties and mechanical characteristic;

e) **Dew point:** is the temperature at which air is saturated with moisture;

f) **Dust:** is loose particle matter present on a surface prepared for painting arising from blast-cleaning or other surface preparation processes, or resulting from the action of the environment;

g) **Edge grinding:** is the treatment of edges before secondary surface preparation;

h) **Hard coating:** is a coating that chemically converts during its curing process or a non-convertible air drying coating which may be used for maintenance purposes. It can be either inorganic or organic;

i) **NDFT:** is the nominal dry film thickness of coating. 90/10 practice means that 90% of all thickness measurements are to be greater than or equal to NDFT and none of the remaining 10% measurements is to be below 0,9 x NDFT;

j) **Primer coat:** is the first coating applied in the shipyard (to differentiate it from shop primer);

k) **Shop primer:** is the prefabrication primer coating applied to steel plates and profiles in thin film, often in an automatic painting shop;

l) **Solvent:** is a volatile liquid capable of completely dissolving a given binder;

m) **Stripe coating:** is an application, normally by brush or roller, of one or more coating layers on locations where it is not easy to achieve the final total dry film coating thickness with the simple spray application;

n) **Target useful life:** is the target value, in years, of the durability for which the coating system is designed. It is noted that the design of a coating system includes criteria for selection of the coating and for its proper application;

o) **Technical Data Sheet:** is the paint Manufacturer's Product Data Sheet, which contains detailed technical instructions and information relevant to the coating and its application;

p) **Thinner:** is a volatile liquid that does not necessarily dissolve the binder, but which is capable of reducing the viscosity of the binder solution (vehicle), for example by reducing the viscosity of a paint spraying consistency.

2 Coating selection and specification

2.1 General Principles

2.1.1 The ability of the coating system to reach its target useful life depends on the selected type of coating system, steel preparation, application and coating inspection and maintenance. All these aspects contribute to the good performance of the coating system.

2.1.2 Inspections of surface preparation and coating processes are to be agreed upon between the Owner, the shipyard and the coating Manufacturer and submitted to the Society for review, prior to the commencement of the shipbuilding process, in order to check that they contain at least the information shown in Tab 7 and that it complies with the basic coating system requirements shown in Tab 2. Clear evidence of these inspections is to be reported and be included in the Coating Technical File (see [2.2]).

2.1.3 The following aspects are to be taken into account for achieving the required coating performance:

a) it is essential that the agreed technical specifications, procedures and various different steps in the coating application process (including but not limited to surface preparation) are strictly followed by the shipbuilder, in order to prevent premature decay and/or deterioration of the coating system;

b) the effectiveness of these Rule requirements can be improved by adopting measures at the unit design stage such as reducing scallops, using rolled profiles, avoiding complex geometric configurations and ensuring that the structural configuration permits easy access for tools and to facilitate cleaning, drainage and drying of the space to be coated;

c) these Rule requirements are based on experience from Manufacturers, shipyards and unit operators and are not intended to exclude suitable alternative systems or innovative approaches that might be developed and applied in the future, provided that they demonstrate a level of performance at least equivalent to that specified in this Section. Acceptance criteria for alternative systems are given in [2.8].

2.1.4 The class notation **COAT-WBT** is not intended to be and shall not amount to a warranty of good performance of the coating nor does it replace the contractor warranty granted by the shipyard and/or paint Manufacturer or Supplier.

2.2 Coating Technical File

2.2.1 Specification of the coating system applied to the seawater ballast tanks, records of the shipyard's and Owner's coating work, and detailed criteria for coating selection, job specifications, inspection, maintenance and repair are to be documented in the Coating Technical File, which is to be reviewed by the Society.

2.2.2 The Coating Technical File is to contain at least the following items relating to this standard and is to be delivered by the shipyard at new unit construction stage:

a) copy of Statement of Compliance or Type Approval Certificate;

b) copy of Technical Data Sheet, including:
- product name and identification mark and/or number;
- materials, components and composition of the coating system, colours;
- minimum and maximum dry film thickness;
- application methods, tools and/or machines;
- condition of surface to be coated (de-rusting grade, cleanness, profile, etc.); and
- environmental limitations (temperature and humidity);

c) shipyard work records of coating application, including:
- applied actual space and area (in square metres) of each compartment;
- applied coating system;
- time of coating, thickness, number of layers, etc.;
- ambient condition during coating; and
- method of surface preparation;

d) procedures for inspection and repair of coating system during unit construction;

e) coating log issued by the coating inspector - stating that the coating was applied in accordance with the specifications to the satisfaction of the coating supplier representative and specifying deviations from the specifications (examples of a Daily Log and Non-conformity Report are given in Tab 4 and Tab 5, respectively);

f) shipyard's verified inspection report, including:
- completion date of inspection;
- result of inspection;
- remarks (if given); and
- inspector's signature; and

g) procedures for in-service maintenance and repair of coating system.

2.2.3 Maintenance, repair and partial re-coating activities are to be recorded in the Coating Technical File. For coating maintenance and repair, reference is to be made to IACS Recommendation 87 "Guidelines for Coating Maintenance and Repair for Ballast tanks and Combined Cargo/Ballast tanks on Oil Tankers".

2.2.4 If full re-coating is carried out, the items specified in [2.2.2] are to be recorded in the Coating Technical File.

2.2.5 The Coating Technical File is to be kept on board and maintained throughout the life of the unit.

2.3 Health and safety

2.3.1 The shipyard is responsible for implementation of national regulations to ensure the health and safety of individuals and to minimise the risk of fire and explosion.

2.4 Coating Standard

2.4.1 Performance Standard

This coating performance standard is based on specifications and requirements which intend to provide a target useful life of 15 years, which is considered to be the time period, from initial application, over which the coating system is intended to remain in "GOOD" condition. The actual useful life will vary, depending on numerous variables including actual conditions encountered in service.

2.4.2 Permanent means of access

It is recommended that this standard is to be applied, to the extent possible, to those portions of permanent means of access provided for inspection, not integral to the unit structure, such as rails, independent platforms, ladders, etc. Other equivalent methods of providing corrosion protection for the non-integral items may also be used provided they do not impair the performance of the coatings of the surrounding structure. Access arrangements that are integral to the vessel structure, such as increased stiffener depths for walkways, stringers, etc., are to fully comply with this standard.

2.4.3 Other items within ballast tanks

It is also recommended that supports for piping, measuring devices, etc., should be coated in accordance with the non-integral items indicated in [2.4.2].

2.4.4 Basic coating requirements

The requirements for protective coating systems to be applied at unit construction for water ballast tanks meeting the performance standard specified in [2.4.1] are listed in Tab 2.

Coating Manufacturers are to provide a specification of the protective coating system to satisfy the requirements of Tab 2.

The Society will verify the Technical Data Sheet and Statement of Compliance or Type Approval Certificate for the protective coating system.

The shipyard is to apply the protective coating in accordance with the verified Technical Data Sheet and its own verified application procedures.

Table 2 : Basic coating system requirements for the notation COAT-WBT

Item	Requirement	Reference standard
1 - Design of coating system		
a) Selection of the coating system	The selection of the coating system is to be considered by the parties involved with respect to the service conditions and planned maintenance. The following aspects, among other things, should be considered: (i) location of space relative to heated surfaces; (ii) frequency of ballasting and deballasting operations; (iii) required surface conditions; (iv) required surface cleanliness and dryness; (v) supplementary cathodic protections, if any (where coating is supplemented by cathodic protection, the coating is to be compatible with the cathodic protection system). Coating Manufacturers are to have products with documented satisfactory performance records and technical data sheets. The Manufacturers are also to be capable of rendering adequate technical assistance. Performance records, technical data sheets and technical assistance (if given) are to be recorded in the Coating Technical File. Coatings for application underneath sun-heated decks or on bulkheads forming boundaries of heated spaces are to be able to withstand repeated heating and/or cooling without becoming brittle.	
b) Coating type	Epoxy based systems Other coating systems are to have performance according to the test procedure in. A multi-coat system with each coat of contrasting colour is recommended. The top coat is to be of a light colour in order to facilitate in-service inspection.	
c) Coating pre-qualification test	Epoxy based systems tested in a laboratory prior to the date of entry into force of this standard, by a method corresponding to the test procedure in Ch 13, App 5 or equivalent, meeting at least the requirements for rusting and blistering, or which have documented field exposure for 5 years with a final coating condition of not less than "GOOD", may also be accepted. For all other systems, testing according to the procedure in Ch 13, App 5, or equivalent, is required.	
Job specification	There are to be a minimum of two stripe coats and two spray coats, except that the second stripe coat, by way of welded seams only, may be reduced in scope where it is proven that the NDFT can be met by the coats applied in order to avoid unnecessary over thickness. Any reduction in scope of the second stripe coat is to be fully detailed in the Coating Technical File. Stripe coats are to be applied by brush or roller. A roller is to be used for scallops, ratholes, etc. only. Each main coating layer is to be appropriately cured before application of the next coat, in accordance with the coating Manufacturer's recommendations. Surface contaminants such as rust, grease, dust, salt, oil, etc. are to be removed prior to painting with a proper method according to the paint Manufacturer's recommendation. Abrasive inclusions embedded in the coating are to be removed. Job specifications are to include the dry-to-recoat times and walk-on time given by the Manufacturer.	

Item	Requirement	Reference standard
NDFT (nominal total dry film thickness)	NDFT 320 µm with 90/10 rule for epoxy based coatings, other systems to coating Manufacturer's specifications. Maximum total dry film thickness according to Manufacturer's detailed specifications. Care is to be taken to avoid increasing the thickness in an exaggerated way. Wet film thickness is to be regularly checked during application. Thinner is to be limited to those types and quantities recommended by the Manufacturer.	Type of gauge and calibration in accordance with SSPC-PA2
2. Primary surface preparation		
a) Blasting and profile	Sa 2½, with profiles between 30-75 µm Blasting is not to be carried out when: (i) the relative humidity is above 85%; or (ii) the surface temperature of steel is less than 3°C above the dew point. Checking of the steel surface cleanliness and roughness profile is to be carried out at the end of the surface preparation and before the application of the primer, in accordance with the Manufacturer's recommendations.	ISO 8501-1 ISO 8503-1/3
b) Water soluble salt limit equivalent to NaCl	≤ 50 mg/ m^2 of sodium chloride (NaCl)	ISO 8502-6 Extraction Conductivity measured in accordance with ISO 8502-9
c) Shop primer	Zinc containing inhibitor free zinc silicate based or equivalent. Compatibility with main coating system is to be confirmed by the coating Manufacturer.	
3. Secondary surface preparation		
a) Steel condition	The steel surface is to be prepared so that the coating selected can achieve an even distribution at the required NDFT and have an adequate adhesion by removing sharp edges, grinding weld beads and removing weld spatter and any other surface contaminant in accordance with ISO 8501-3 grade P2. Edges are to be treated to a rounded radius of minimum 2 mm, or subjected to three pass grinding or at least equivalent process before painting.	ISO 8501-3
b) Surface treatment	Sa 2½ on damaged shop primer and welds. Sa 2 removing at least 70% of intact shop primer which has not passed a pre-qualification certified by test procedures specified in 1.c) of this Table. If the complete coating system comprising epoxy based main coating and shop primer has passed a pre-qualification certified by test procedures specified in 1.c) of this Table, intact shop primer may be retained provided the same epoxy coating system is used. The retained shop primer is to be cleaned by sweep blasting, high-pressure water washing or equivalent method. If a zinc silicate shop primer has passed the pre-qualification test specified in 1.c) of this Table, as part of an epoxy coating system, it may be used in combination with other epoxy coatings certified under the same test, provided that the compatibility has been confirmed by the Manufacturer by the test in accordance with Ch 13, App 5.	ISO 8501-1

Item	Requirement	Reference standard
c) Surface treatment after erection	Butts St 3 or better or Sa $2^{1/2}$ where practicable. Small damage up to 2% of total area: St 3. Contiguous damage over 25 m^2 or over 2% of the total area of the tank, Sa $2^{1/2}$ is to be applied. Coating in overlap to be feathered.	ISO 8501-1
d) Profile requirements	In the case of full or partial blasting 30-75 µm, otherwise as recommended by the coating Manufacturer.	ISO 8501-1/3
e) Dust	Dust quantity rating "1" for dust size class "3", "4" or "5". Lower dust size classes are to be removed if visible on the surface to be coated without magnification.	ISO 8502-3
f) Water soluble salts limit equivalent to NaCl after blasting/grinding	≤ 50 mg/ m^2 of sodium chloride (NaCl)	ISO 8502-6 Extraction Conductivity measured in accordance with ISO 8502-9
g) Oil contamination	No oil contamination.	
4. Miscellaneous		
a) Ventilation	Adequate ventilation is necessary for the proper drying and curing of coating. Ventilation is to be maintained throughout the application process and for a period after application is completed, as recommended by the coating Manufacturer.	
b) Environmental conditions	Coating is to be applied under controlled humidity and surface conditions, in accordance with the Manufacturer's specifications. In addition, coating is not to be applied when: (i) the relative humidity is above 85%; or (ii) the surface temperature is less than 3°C above the dew point.	
c) Testing of coating	Destructive testing is to be avoided. Dry film thickness is to be measured after each coat for quality control purposes and the total dry film thickness is to be confirmed after completion of final coat, using appropriate thickness gauges.	ISO 19840 Annex 3
d) Repair	Any defective areas, e.g. pin-holes, bubbles, voids, etc,. are to be marked up and appropriate repairs effected. All such repairs are to be re-checked and documented.	

2.5 Coating system approval

2.5.1 Results from prequalification tests of the coating system (see 1.c) of Tab 2) are to be documented, and a Statement of Compliance or Type Approval Certificate is to be issued if found satisfactory by a third party, independent of the coating Manufacturer.

2.6 Coating inspection requirements

2.6.1 Inspector qualification

The inspections indicated in the following paragraphs are to be carried out by qualified coating inspectors certified to NACE Level 2 or FROSIO level III, or equivalent as verified by the Society.

2.6.2 Records of inspections

Results from the inspections indicated in [2.6.3] are to be recorded by the inspector, made available to the Interested Parties, including the attending Surveyor of the Society. and included in the Coating Technical File (refer to Tab 4 - Example of Daily Log and Tab 5 - Non-conformity Report).

2.6.3 Inspection items

Coating inspectors are to inspect surface preparation and coating application during the coating process by carrying out, as a minimum, those inspection items listed in Tab 3. Emphasis is to be placed on initiation of each stage of surface preparation and coating application, as improper work is extremely difficult to correct later in the coating progress. Representative structural members are to be non-destructively examined for coating thickness. The inspector is to verify that appropriate collective measures have been carried out.

2.7 Verification requirements

2.7.1 Prior to reviewing the Coating Technical File for the particular unit under construction, the Society is to carry out the following:

a) check that the Technical Data Sheet and Statement of Compliance or Type Approval Certificate comply with the requirements of this Section;

b) check that the coating identification on representative containers is consistent with the coating identified in the Technical Data Sheet and Statement of Compliance or Type Approval Certificate;

c) check that the inspector is qualified in accordance with the qualification standards, as indicated in [2.6.1];

d) check that the inspector's reports of surface preparation and the coating's application indicate compliance with the Manufacturer's Technical Data Sheet and Statement of Compliance or Type Approval Certificate; and

e) monitor implementation of the coating inspection requirements.

2.8 Alternative systems

2.8.1 All systems that are not an epoxy based system applied according to Tab 2 are defined as an alternative system.

2.8.2 The requirements of this Section are based on recognised and commonly used coating systems. It is not meant to exclude other, alternative, systems with proven equivalent performance, for example non-epoxy based systems.

2.8.3 Acceptance of alternative systems will be subject to documented evidence that they ensure a corrosion prevention performance at least equivalent to that indicated in this Section.

2.8.4 As a minimum, the documented evidence is to consist of satisfactory performance corresponding to that of a coating system, which conforms to the requirements, indicated in [2.4], a target useful life of 15 years in either actual field exposure for 5 years with final coating condition not less than "GOOD" or laboratory testing. Laboratory test is to be conducted in accordance with the test procedure given in Ch 13, App 5.

Table 3 : Inspection items to be carried out during unit construction

Construction stage	Inspection items
Primary surface preparation	a) The surface temperature of steel, the relative humidity and the dew point are to be measured and recorded before the blasting process starts and at times of sudden changes in weather. b) The surface of steel plates is to be tested for soluble salt and checked for oil, grease and other contamination. c) The cleanliness of the steel surface is to be monitored in the shop primer application process. d) The shop primer material is to be confirmed as meeting the requirements of 2.c of Tab 2.
Thickness	If compatibility with the main coating system has been declared, then the thickness and curing of the zinc silicate shop primer are to be confirmed as conforming to the specified values.
Block assembly	a) After completing construction of the block and before secondary surface preparation starts, a visual inspection for steel surface treatment, including edge treatment, is to be carried out. Any oil, grease or other visible contamination is to be removed. b) After blasting/grinding/cleaning and prior to coating, a visual inspection of the prepared surface is to be carried out. On completion of blasting and cleaning and prior to the application of the first coat of the system, the steel surface is to be tested for levels of remaining soluble salts in at least one location per block. c) The surface temperature, the relative humidity and the dew point are to be monitored and recorded during the coating application and curing. d) Inspection is to be performed of the steps in the coating application process mentioned in Tab 2. e) DFT measurements are to be taken to prove that the coating has been applied to the thickness as specified and outlined in Tab 6.
Erection	a) Visual inspection for steel surface condition, surface preparation and verification of conformance to other requirements in Tab 2 and the agreed specification is to be performed. b) The surface temperature, the relative humidity and the dew point are to be measured and recorded before coating starts and regularly during the coating process. c) Inspection is to be performed of the steps in the coating application process mentioned in Tab 2.

Table 4 : Example of a Daily Log

DAILY LOG					**Sheet No**:			
Hull no.:			**Tank/Hold no.:**			**Database:**		
Part of structure:								
SURFACE PREPARATION								
Method:					Rounding of edges:			
Abrasive:					Area (m^2):			
Surface temperature:					Grain size:			
Relative humidity (max):					Air temperature:			
Standard achieved:					Dew point			
COMMENTS:								
Job no.:			**Date:**		**Signature:**			
COATING APPLICATION **Method:**								
Coat no.	System	Batch no.	Date	Air temp.	Surface temp.	RH%	Dew point	DFT meas. (1)
(1) Measured minimum and maximum WFT (Wet Film Thickness) and DFT readings to be attached to Daily Log.								
COMMENTS:								
Job no.:			**Date:**		**Signature:**			

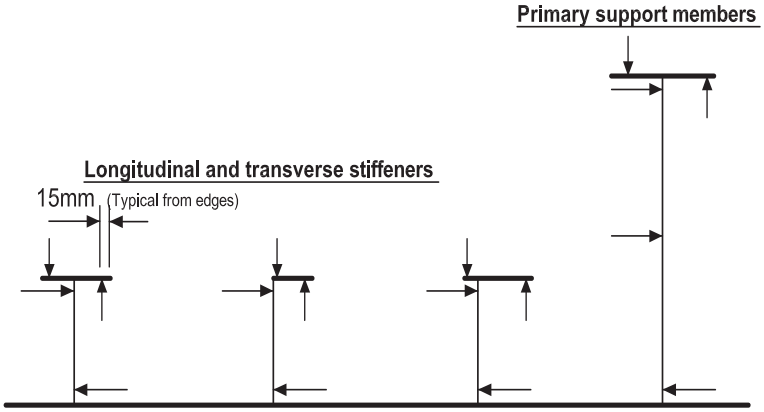
Table 5 : Example of Non-conformity Report

NON-CONFORMITY REPORT	**Sheet No:**	
Hull no.:	**Tank/Hold no.:**	**Database:**
Part of structure:		
DESCRIPTION OF THE INSPECTION FINDINGS		
Description of findings		
Reference document (daily log):		
Action taken:		
Job no.:	**Date:**	**Signature:**

Table 6 : Dry Film Thickness measurements

The following verification checkpoints of DFT are to be taken:	
(i)	one gauge reading per 5 m^2 of flat surface areas;
(ii)	one gauge reading at 2 to 3 metre intervals and as close as possible to tank boundaries, but not further than 15 mm from edges of tank boundaries;
(iii)	longitudinal and transverse stiffening members: one set of gauge readings as shown in Fig 1, taken at 2 to 3 metres run and not less than two sets between primary support members;
(iv)	three gauge readings for each set of primary support members and 2 gauge readings for each set of other members as indicated by the arrows in Fig 1;
(v)	for primary support members (girders and transverses) one set of gauge readings for 2 to 3 metres run as shown in Fig 1, but not less than three sets;
(vi)	around openings one gauge reading from each side of the opening;
(vii)	five gauge readings per square metre (m^2) but not less than three gauge readings taken at complex areas (i.e. large brackets of primary support members); and
(viii)	additional spot checks to be taken to verify coating thickness for any area considered necessary by the coating inspector.

Figure 1



Note: Arrows of diagram indicate critical areas and are to be understood to mean indication for both sides.

Table 7 : Documentation to be included in the "Coating Selection, Application and Maintenance Scheme"

1. GENERAL
1.1 Evidence of explicit agreement between Owner, shipyard and paint Manufacturer on the scheme and its contents
1.2 Manufacturer's evidence of product quality and ability to meet the agreed coating requirements
1.3 Evidence of shipyard's and /or its subcontractor's experience in coating application
2. TANKS TO BE COATED
2.1 List of seawater ballast tanks to be coated identifying the coating system for each tank, including colour
2.2 Identification of tanks whose surfaces to be coated are underneath sun-heated decks or are part of bulkheads forming boundaries of heated cargo or heated bunker spaces
2.3 Identification of tanks where a cathodic protection system is foreseen in addition to a coating system
3. COATING SELECTION
3.1. Paint Manufacturer's technical product data sheet for each product (hard coating or equivalent)
3.2 Paint Manufacturer's documentation of satisfactory service performance
3.3 Paint Manufacturer's data on laboratory tests carried out, and related standard adopted, to verify the suitability for the intended product
3.4 Paint Manufacturer declaration that the coating is able to withstand repeated heating (for tanks listed under 2.2 above)
3.5 Paint Manufacturer's declaration of coating compatibility with the cathodic protection system (for tanks listed under 2.3 above)
4. COATING APPLICATION
4.1 Surface preparation procedures and standards, selected in accordance with paint Manufacturer's recommendations and including inspection points and methods
4.2 Procedures for coating application, including inspection points and methods
4.3 Range of humidity, surface temperature and ventilation conditions during and after coating application
4.4 Number of coats and minimum/maximum limits in dry film thickness (DFT) of each coat; DFT measuring method
4.5 Over-coating time at different temperatures
4.6 Criteria agreed upon for inspection and acceptance of surface preparation and coating application. Agreed format for the inspection reports
4.7 Paint Manufacturer's Material Safety Data Sheet (MSDS) for each selected product.
4.8 Owner's, paint Manufacturer's and shipyard's explicit agreement to take all safety precautions to reduce health and other safety risks
5. MAINTENANCE OF THE COATING SYSTEM
5.1 Maintenance scheme for the coating system
5.2 Indications on replacement of the sacrificial anodes and the inspection of coating around anodes (only when the coating is supplemented with cathodic protection)

3 Survey activities

3.1 Review of the scheme for selection and application of coating system

3.1.1 The selection of a coating system on water ballast tanks is to take into consideration several factors affecting corrosion of steel structures, including frequency of ballasting/deballasting, partial or complete filling, temperature of cargo in adjacent cargo tanks, etc. All these factors, separately or in combination, can considerably affect the effectiveness of the corrosion protection system during unit life.

3.1.2 The coating selection is to take into account that:

a) epoxy (or other equivalent hard coating) is only to be used for ballast tanks of new buildings;

b) multi-coat layers of contrasting colour are recommended (the top coat layer is to be of a light colour in order to facilitate in-service inspection).

3.1.3 To comply with the requirements of this Section, the following aspects are to be taken into due account:

a) the contractual coating specifications and the procedures and related working steps for its application as well as the paint Manufacturer's recommendations are to be agreed between the shipyard and Owner taking account of the reference standard and any changes thereto coming from the construction procedures and standards of the shipyard. The above-mentioned aspects will be dealt with during a pre-job meeting, to which the Society is to be invited as an observer;

b) the coating specifications are to be made known to all Interested Parties, including the Society;

c) all work is to be performed by skilled operators in a safe and workmanlike manner, in accordance with the agreed specifications;

d) the coating inspections during the unit's construction are to be performed by qualified coating inspectors, who are to verify that the reference standard agreed between shipyard and Owner is complied with;

e) coating damage, if any, during unit construction is to be properly repaired in order to avoid premature decay and deterioration of the coating system.

3.2 Plan review

3.2.1 The Shipbuilder is to provide the Society with additional drawings of the internal water ballast tank structures showing compliance with the following aspects:

a) internal structures, stiffeners and piping are to be designed to avoid, as far as possible, any entrapped areas not subject to coating application, inspection and maintenance;

b) burrs and sharp edges are to be rounded off, in accordance with the basic coating system requirements (e.g. three pass edge grinding of sharp edges) and any steel defects removed as listed in Tab 2;

c) hollow components which are not accessible are to be sealed off completely and permanently, e.g. by welding them closed and leaving them filled with inert material (plastic foam or similar);

d) if a cathodic protection system is installed, the number and position of sacrificial anodes are to be consistent with the specifications in the agreed scheme for coating selection, application and maintenance;

e) the structural configuration of internal spaces is to be such as to permit easy access with tools for cleaning, drainage, ventilation and drying of the tanks necessary for coating inspection and repair during the unit life.

3.3 Type approval of shop primer

3.3.1 Shop primers applied to steel plates and profiles are to be approved by the Society or another recognised organisation, in accordance with the requirements in Pt D, Ch 5, Sec 3 of the Rules for the Classification of Ships.

3.3.2 The shipyard is to provide the Society with information confirming that all parameters of shop primer application are consistent with the paint Manufacturer's recommendations.

3.4 Inspection and testing

3.4.1 The shipyard is to provide the Society with daily reports containing the results of the inspections carried out by representatives of the shipyard, Owner and paint Manufacturer during surface preparation and coating application.

3.4.2 At any time during construction the attending Surveyor is to be allowed to take samples of the coating material used for coating the ballast tanks, which may be analysed for verifying conformity with agreed coating specifications.

3.5 Surface preparation survey

3.5.1 At any time during construction the attending Surveyor is to be allowed to carry out an inspection of surface preparation (e.g. blasting and grinding profiles) in order to verify on the spot compliance with the requirements given in Tab 2.

This survey may be carried out by the attending Surveyor concurrently with the inspection carried out by the shipyard, Owner or paint Manufacturer Inspectors, or with the survey carried out on the fabricated blocks to check their correspondence to the approved plans, or on any other appropriate occasion.

3.6 Coating application survey

3.6.1 After the completion of coating application in a compartment and before staging has been removed, the attending Surveyor is to be allowed to carry out spot checks of the coating application (e.g. after spray and stripe coats) to verify on the spot that it complies with the requirements given in Tab 2.

This survey may be carried out by the attending Surveyor concurrently with the inspection carried out by the shipyard, Owner or paint Manufacturer Inspectors, or with the survey carried out on the assembled blocks to check their correspondence to the approved plans, or on any other appropriate occasion.

3.6.2 After the staging has been removed, the attending Surveyor is to be allowed to carry out a visual inspection to check that there is no damage caused by mechanical and/or welding work. Any damage found to the coating is to be repaired in accordance with the technical coating specifications and paint Manufacturer's recommendations.

3.6.3 After the repairs have been completed, a final space inspection is to be carried out for acceptance. If the result is satisfactory, the space is to be closed immediately afterwards.

3.7 Final inspection after sea trials

3.7.1 The attending Surveyor is to be allowed to carry out a final inspection of the ballast tanks emptied after sea trials. Should any damage to coating be found, appropriate repairs are to be performed in accordance with the technical coating specifications and paint Manufacturer's recommendations before the unit is delivered. This survey may be concurrent with the final acceptance inspection carried out by shipyard, Owner and paint Manufacturer's Inspectors.

SECTION 7 CREW ACCOMMODATION AND RECREATIONAL FACILITIES ACCORDING TO THE MARINE LABOUR CONVENTION, 2006 (MLCDESIGN)

1 General

1.1 Applications

1.1.1 The additional class notation MLCDESIGN is assigned, in accordance with Pt A, Ch 1, Sec 2, [6.10.11], to units having crew accommodation and recreational facilities complying with the Marine Labour Convention, 2006 - Title 3 and with the requirements of this Section.

1.2 Documentation to be submitted for approval

1.2.1 Plans

Detailed plans of the on board crew accommodation and recreational facilities are to be submitted to the Society in triplicate for approval. These plans are to indicate the general arrangements and dimensions of:

- Rooms and other accommodation spaces;
- Heating and ventilation;
- Noise and vibration and other ambient factors;
- Sanitary facilities;
- Lighting;
- Hospital accommodation.

1.2.2 Documentation to be put on board

The Owner is to put on board the unit the plans given in [1.2.1], and they are to be available to the Surveyor when a shipboard inspection is carried out.

2 Design requirements

2.1 Basic Standard Requirements to obtain the additional class notation MLCDESIGN

2.1.1 The minimum standards for shipboard accommodation and recreational facilities are set out in paragraphs 6 to 17 of the Marine Labour Convention, 2006 - Title 3 as summarised in Tab 1.

A plan approval and shipboard inspection is to be carried out when the accommodation has been substantially altered and the **MLCDESIGN** additional class notation is to be re-issued.

Table 1 : Basic Standard Requirements with reference to paragraphs 6 to 17 of the Marine Labour Convention, 2006 - Title 3

Accommodation and recreational facilities	Standard
General Insulation	6(a) minimum permitted headroom: 203 cm 6(b) the accommodation is to be adequately insulated 6(c) sleeping rooms are, in general. to be situated above the load line amidships or aft 6(d) not applicable 6(e) there are to be no direct openings into sleeping rooms from cargo and machinery spaces or from galleys, storerooms, drying rooms or communal sanitary areas; that part of a bulkhead separating such places from sleeping rooms and external bulkheads is to be efficiently constructed of steel or other approved substance and to be watertight and gas-tight
Ventilation and heating	7(a) sleeping rooms and mess rooms are to be adequately ventilated 7(b) except for those engaged in temperate climates, units are to be equipped with air conditioning for seafarer accommodation, for any separate radio room and for any centralised machinery control room 7(c) all sanitary spaces are to have ventilation to the open air, independently of any other part of the accommodation 7(d) an appropriate heating system is to be provided, except in units engaged exclusively in tropical climates
Lighting	8) Sleeping rooms and mess rooms are to be lit by natural light and provided with adequate artificial light

Accommodation and recreational facilities	Standard
Sleeping rooms	9(a) Not applicable 9(b) separate sleeping rooms are to be provided for men and women 9(d) a separate berth is to be provided for each seafarer in all circumstances 9(e) berth's minimum inside dimensions: 198 cm by 80 cm 9(f) Not applicable 9(k) Not applicable 9(i) floor area of sleeping rooms for seafarers not performing the duty of unit officers: • 7,5 m^2 rooms accommodating 2 persons • 11,5 m^2 rooms accommodating 3 persons • 14,5 m^2 rooms accommodating 4 persons 9(l) floor area of sleeping rooms for seafarers performing the duty of unit officers: • 7,5 m^2 per person for junior officers (operational level) • 8,5 m^2 per person for senior officers (management level) 9(n) for each occupant, the furniture is to include a clothes locker (minimum 475 litres) and a drawer (minimum 56 litres) 9(o) each sleeping room is to be provided with a table or desk
Mess rooms	10(a) located apart from sleeping rooms and as close as practicable to the galley (exemptions may be granted for ships of less than 3000 gt)
Sanitary facilities	11(a) separate for men and for women 11(b) easy access from the navigating bridge and the machinery space or near the engine room control centre (exemptions may be granted for ships of less than 3000 gt) 11(c) a minimum of one toilet, one washbasin and one tub or shower or both for every six persons who do not have personal facilities 11(d) one washbasin with hot and cold fresh running water in each sleeping room 11(e) hot and cold fresh running water in all wash places 11(f) Not applicable
Hospital	12) Units carrying 15 or more seafarers are to provide separate hospital accommodation to be used exclusively for medical purposes
Laundry facilities	13) Appropriately situated laundry facilities are to be provided
Open space	14) All units are to have a space or spaces on open deck to which the seafarers can have access when off duty, which are of adequate area having regard to the size of the unit and the number of seafarers on board
Office(s)	15) All units are to be provided with separate offices or a common unit's office for use by deck and engine departments (exemptions may be granted to ships of less than 3000 gt)
Recreational facilities	16) Units engaged in mosquito-infested ports are be fitted with appropriate devices 17) Appropriate seafarers' recreational facilities, amenities and services, as adapted to meet the special needs of seafarers who must live and work on ships, are to be provided on board for the benefit of all seafarers.

SECTION 8 ALTERNATIVE REGIME SURVEY (ARS)

1 General

1.1 Applications

1.1.1 *(1/1/2023)*

The additional class notation **ARS** is assigned in accordance with Pt A, Ch 1, Sec 2, [6.10.16] to floating offshore units operating at fixed location, having type B cargo tanks and complying with the requirements in this section to allow an extended period between two consecutive internal inspections of each cargo tank.

1.1.2 *(1/1/2023)*

The notation may also be assigned to units having cargo tanks of types other than type B based on the Society's evaluation on a case-by-case basis.

1.1.3 *(1/1/2023)*

When the **ARS** notation is withdrawn (e.g. if the unit resumes LNG carrier service), all cargo tanks whose last internal inspection was carried out more than 5 years before are to be subject to the internal cargo tank survey requirements in Pt A, Ch 4, Sec 4, [7.2].

1.1.4 *(1/1/2023)*

The extended period between two consecutive cargo tanks internal inspections requires acceptance by the flag Administration in case relevant statutory certificates are issued on their behalf.

1.2 Documents to be submitted

1.2.1 *(1/1/2023)*

The plans and documents to be submitted are listed in Tab 1.

Table 1 : Documents to be submitted *(1/1/2023)*

No.	I/A (1)	Documents
1	I	Description of the main principles for compliance with **ARS** notation: • Operational consideration (loading operations, emergency departure etc) • Site characterization (location, meta-ocean data, etc.)
2	A	Main system components specifications: gas detectors, Nitrogen consumption, temperature sensors, motion sensors (if any), etc.
3	I	Arrangement plans of main system components
4	A	Assessment report requested in [2.1.2], including at least: • sloshing study considering the site-specific conditions (this study may be simplified where there is no exposure to sloshing loads) • fatigue calculations for pump tower and pump tower supports of the unit for site specific operation
5	A	Cargo tank inspection plan requested in [2.1.4] and [2.1.5]
6	A	Piping diagram showing segregation principles to ensure safe entry of cargo tanks, as requested in [2.1.12]. Not applicable if there is intended to gas free all cargo tanks in case of tank entry
7	I	Risk assessment requested in [2.2]
8	A	Documentation on monitoring and recording instrumentation of main system components requested in [2.3], including: • Maintenance procedures • Backup procedures • Plan of recording and storing data
9	A	Control and monitoring system documentation of motion sensors requested in [2.4.1], if any
10	A	Plan of recording and storing data from motion sensors requested in [2.4.6], if any
11	I	Motion sensors reports requested in [2.4.6], if any
12	I	Testing procedure of main system components
13	I	Testing procedure for initial and periodical verification of the motion sensors, if any

(1) A : to be submitted for approval
I : to be submitted for information.

2 Requirements for the assignment of the ARS notation

2.1 General Requirements

2.1.1 *(1/1/2023)*

The unit is to operate on a fixed and specified location with limited exposure to sloshing impact loads.

2.1.2 *(1/1/2023)*

An assessment report is to be submitted confirming that the fatigue utilization when the unit is operated at the specified location during the extended internal inspections period - considering the combined effects of 1) sloshing impacts loads on the containment system and 2) design fatigue utilization of the unit, in particular for the pump tower and its support - is less than the design fatigue utilization assumed for the unit operated as a LNG carrier during five years.

2.1.3 *(1/1/2023)*

The time between internal inspections of each individual cargo tank is not to exceed the "maximum extended internal inspections interval" defined as the shorter between:

a) the extended internal inspections period defined in the assessment report requested in [2.1.2]; and

b) the inspection interval of the items to be surveyed by the Society (e.g. the equipment inside the cargo tanks).

2.1.4 *(1/1/2023)*

A cargo tank inspection plan covering the "maximum extended internal inspections interval" as defined in [2.1.3] is to be developed including the internal inspection of a selected number of cargo tanks.

The plan is to require the internal inspection of at least one cargo tank at renewal survey, that can be omitted when:

a) the probability of damage occurrence for the cargo containment system may be considered non-significant due to very limited exposure of the unit to fatigue loads and sloshing; and

b) the risk assessment analysis required in [2.2] covers the extended internal inspections interval for all cargo tanks.

Based on the above, an extended internal inspections interval for all cargo tanks can be allowed, if found acceptable by the Society.

2.1.5 *(1/1/2023)*

The cargo tank inspection plan is to address at least the following items:

- basic assumptions for the development of the plan (terminal arrangement, site meta-ocean data, mooring arrangement, operation, etc.)
- monitoring and reporting requirements to enable evaluation of compliance with the basic assumptions
- hazards inside the tank and how these shall be mitigated, shown in the risk assessment requested in [2.2]
- reporting schedule and data format for reporting
- maintenance intervals of equipment such as cargo/spray/production pumps, instrumentation, foot valve, safety relief valves and other equipment inside or related to the tank.

Any modifications to the plan are to be informed to the Society.

2.1.6 *(1/1/2023)*

In case the unit is equipped with motion sensors to allow verification of assumptions made for the extended internal inspections interval, the motion sensors are to comply with requirements in [2.4].

The cargo tank inspection plan is to include threshold values to identify when the actual data in the motion sensor report exceed them and an internal inspection of the cargo tanks is to be carried out.

2.1.7 *(1/1/2023)*

Filling of the cargo tanks is to be continuously recorded to allow its check against the records of both motion sensors (if fitted) and temperature sensors, as required in [2.2.10].

2.1.8 *(1/1/2023)*

The tightness of the primary barrier is to be continuously monitored and recorded by checking the gas detection in the inter-barrier space. Gas concentrations are to be kept within acceptance criteria when the system is operated in automatic regulation mode without forced nitrogen sweeping.

2.1.9 *(1/1/2023)*

The N_2 consumption to the cargo containment system is to be continuously recorded to monitor abnormal consumption which potentially indicate leakages.

a) For membrane cargo tanks, the N_2 consumption in the inter-barrier space and insulation space is to be continuously recorded.

b) For type B cargo tanks (Moss type), the N_2 consumption in the annular space between cargo tank and partial secondary barrier is to be continuously recorded.

2.1.10 *(1/1/2023)*

The readings of temperature sensors in the cargo containment system are to be continuously recorded to monitor low temperatures indications which may indicate potential leakages or deformation of the insulation.

2.1.11 *(1/1/2023)*

Arrangements are to be in place to allow for normal periodic survey of cargo handling equipment, valves, etc. while the cargo tanks remain in operation.

2.1.12 *(1/1/2023)*

In case it is required to carry out inspections inside the tanks while other tanks are loaded, the cargo handling system is to be designed to allow for segregation (i.e. two means of segregation) of the cargo tanks.

2.1.13 *(1/1/2023)*

In case of abnormal test results or damages and deformations observed during internal inspections of selected cargo tanks, internal cargo tank survey requirements in Pt A, Ch 4, Sec 4, [7.2] apply.

2.1.14 *(1/1/2023)*

The unit is to be subject to a complete initial survey as described in [3].

2.2 Risk assessment

2.2.1 *(1/1/2023)*

A risk assessment is to be carried out to:

- ensure that there are no impediments to the assignment of the **ARS**
- address items not covered by the requirements for the assignment of the **ARS**
- ensure that the alternative methods included in the requirements for the assignment of the **ARS** provide an equivalent safety as for a conventional internal inspection of cargo tanks.

All findings given from the risk assessment are to be implemented according to the ALARP principle.

a) The risk assessment is to identify measures (additional to the requirements of the IGC Code and HSSC Guidelines) which, together with the cargo tank inspection plan, justify that the alternative methods included in the requirements for the **ARS** assignment replace the normal cargo tank entry. Evidence of implementation of these measures may be requested as found necessary by the Society.

b) The risk assessment is to be developed to take in consideration (but not limited to) the following potential hazards:
   - accumulated fatigue life before arrival on site
   - structural deformation/damages to pump tower and tower supports
   - fatigue failure development of pump tower and supports
   - detachment of cable trays, platforms, and other relatively large parts from pump tower
   - corrosion
   - foreign objects left from construction/maintenance, potentially entering the tank through the piping
   - loose bolts and nuts used for fixation of pumps, pipes and other service equipment on pump tower
   - deformation due to expansion/contraction.
   - deformation of insulation/loss of membrane bearing (if applicable)
   - deformation of raised edges or corrugations on primary membrane (if/as applicable)
   - monitoring system items remain effective (like N_2 system, temperature, motion etc.). What kind of back up exists and potential repair
   - weather conditions exceeding what is assumed in the site characterization, how this will be handled
   - unforeseen disconnection from the jetty
   - leakages in the cargo containment system, how this will be handled and detected
   - testing of relevant equipment when not in gas free condition, like PRVs and control system items like level gauging, etc
   - failures of items that are not able to be surveyed, and what are the consequences of failure in these items
   - cargo tank safe entry segregation
   - other safety items not addressed in the cargo tank inspection plan, if any.

2.3 Handling of recorded data

2.3.1 *(1/1/2023)*

A plan of recording and storing data is to be submitted for approval.

Records and processed signals are to be stored according to the approved plan and submitted to the Society for annual evaluation.

2.3.2 *(1/1/2023)*

Backup of data are to be provided.

2.3.3 *(1/1/2023)*

Alarm is to be provided to notify when the recording system is out of operation.

2.3.4 *(1/1/2023)*

Data recording is to have a frequency of 30 min and the data are to be kept until next internal inspection of the cargo tank.

2.4 Requirements for motion sensors

2.4.1 *(1/1/2023)*

Control and monitoring system of motion sensors is to comply with the requirements in [2.4.2] to [2.4.9] and relevant documentation is to be submitted for approval.

2.4.2 *(1/1/2023)*

In case the unit is equipped with motion sensors, the sensors are to record motions in six degrees in freedom.

2.4.3 *(1/1/2023)*

Motion sensors are to be installed in locations of the unit where vibration levels are low, not necessarily within the cargo area.

2.4.4 *(1/1/2023)*

Sampling of the motion sensors signal is to be carried out based on the below principles:

- time series of acceleration (in m/s^2 or as a fraction of g) for a specified location on the unit are to be continuously sampled
- records shall be stored in agreed format for possible post processing/verification
- signal noise (e.g. caused by vibration) shall be removed by suitable filters
- sampling frequency shall be at least 10 Hz.

2.4.5 *(1/1/2023)*

Signal and data processing is to be carried out based on the following quantities and is to be typically calculated for every three-hour interval of time records:

- maximum value
- minimum value
- mean value
- significant response
- energy spectra for the six motion parameters.

2.4.6 *(1/1/2023)*

A plan of recording and storing data from motion sensors is to be submitted for approval.

Records and processed signals are to be stored according to the approved plan.

Reports of recorded data are to be submitted to the Society for annual evaluation against the design data.

2.4.7 *(1/1/2023)*

Reports, summarizing the records and processed signals during the period of maximum extended interval, is to have a format compatible with fatigue utilization assessment report to allow comparison between data.

2.4.8 *(1/1/2023)*

Data recording is to have a frequency of 30 minute and the data are to be kept until next internal inspection of the cargo tank.

2.4.9 *(1/1/2023)*

Alarm is to be provided to notify when the recording system is out of operation.

3 Initial survey for the assignment of the ARS notation

3.1

3.1.1 *(1/1/2023)*

The unit is to be subject to a complete internal inspection of all cargo tanks before entering the program. This inspection may be omitted based on service history of the unit since the previous internal inspection of cargo tanks.

3.1.2 *(1/1/2023)*

The following items are to be addressed in the initial survey of the cargo tanks:

- carry out integrity verification of cargo tanks as applicable in accordance with the requirements for renewal survey in Pt A, Ch 5, Sec 7, [9.2]
- verify implementation of mitigation actions raised during the risk assessment (if any)
- verify the filling monitoring system and its capability of recording filling data to be cross checked against motion records (if motion sensors are fitted)
- verify that gas detection system is working properly and capable of recording
- verify that N_2 consumption monitoring system is working properly and capable of recording
- verify that temperature sensors are working properly and capable of recording
- verify main components of cargo handling equipment
- verify cargo tanks inspection plan
- verify the procedures for data storage and backup
- verify the satisfactory conditions of equipment, sensors, machinery and piping installed inside the cargo tanks before the tanks are closed.

3.1.3 *(1/1/2023)*

The following items are to be checked for the motion sensor system, if fitted:

- functional test
- testing of warnings and alarms
- confirmation of data recording function
- confirmation of back up function
- confirmation of calibration certificates.

3.1.4 *(1/1/2023)*

Integrity of the cargo tank membrane is to be confirmed by applying the requirements in Pt A, Ch 4, Sec.4, [7.2] and in [2.1.9].

APPENDIX 1 TEST PROCEDURES FOR COATING QUALIFICATION FOR WATER BALLAST TANKS OF ALL TYPES OF UNIT AND DOUBLE-SIDE SKIN SPACES OF BULK CARRIERS

1 Scope

1.1

1.1.1 This Appendix provides details of the test procedures referred to in Sec 6, Tab 2 and Sec 6, [2.8.4].

2 Definitions

2.1

2.1.1 Coating specification: means the specification of coating systems, which includes the type of coating system, steel preparation, surface preparation, surface cleanliness, environmental conditions, application procedure, acceptance criteria and inspection.

3 Testing

3.1

3.1.1 Coating specification is to be verified by the following tests. The tests are to be carried out according to the procedures described in [4] - Test on simulated ballast tank conditions (see Fig 2) and [5] - Condensation chamber tests (see Fig 3).

3.1.2 Protective coatings for dedicated seawater ballast tanks are to comply with the requirements given in [4] and [5].

3.1.3 Protective coatings for double-side spaces of bulk carriers of 150 m in length and upwards, other than dedicated seawater ballast tanks, are to comply with the requirements given in [5].

Figure 1

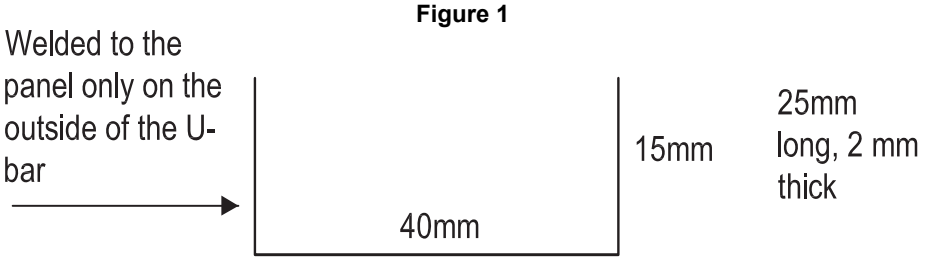
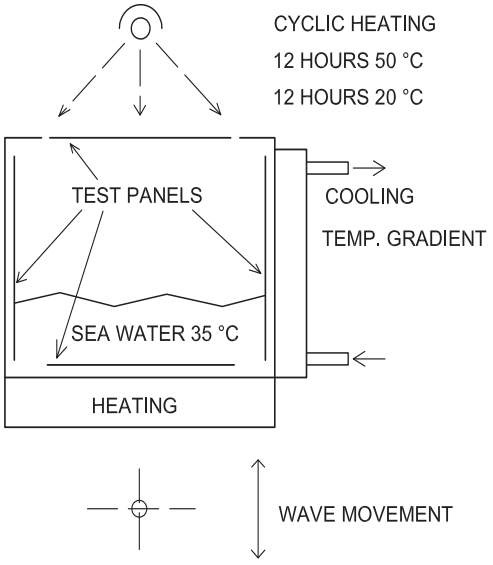


Figure 2 : Wave tank for testing of water ballast tank coating



4 Test on simulated ballast tank conditions

4.1 Test condition

4.1.1 The test on simulated ballast tank conditions is to satisfy each of the following conditions:

a) The test is to be carried out for 180 days.

b) There are to be 5 test panels.

c) The size of each test panel is 200 mm x 400 mm x 3 mm. Two of the panels (Panel 3 and 4 below) have a U-bar Fig 1 welded on. The U-bar is welded to the panel at a distance of 120 mm from one of the short sides and 80 mm from each of the long sides.

The panels are to be treated according to Sec 6, Tab 2, and the coating system applied according to items 1.d) and 1.e) of Sec 6, Tab 2. The shop primer is to be weathered for at least 2 months and cleaned by low pressure washing or other mild method. Blast sweep or high pressure washing or other primer removal methods are not to be used. The weathering method and extent are to take into consideration that the primer is to be the foundation for a 15-year target life system. To facilitate innovation, alternative preparation, coating systems and dry film thicknesses may be used when clearly defined.

d) The reverse side of the test piece is to be painted appropriately, in order not to affect the test results.

e) As simulating the condition of the actual ballast tank, the test cycle runs for two weeks with natural or artificial seawater and one week empty. The temperature of the seawater is to be kept at about 35°C.

f) Test Panel 1 is to be heated for 12 hours at 50°C and cooled for 12 hours at 20°C in order to simulate upper deck condition. The test panel is cyclically splashed with natural or artificial seawater in order to simulate a unit's pitching and rolling motion. The interval of splashing is 3 seconds or faster. The panel has a scribe line down to bare steel across width.

g) Test Panel 2 has a fixed sacrificial zinc anode in order to evaluate the effect of cathodic protection. A circular 8 mm artificial holiday down to bare steel is introduced on the test panel 100 mm from the anode in order to evaluate the effect of the cathodic protection. The test panel is cyclically immersed with natural or artificial seawater.

h) Test Panel 3 is to be cooled on the reverse side, so as to give a temperature gradient in order to simulate a cooled bulkhead in a ballast wing tank, and splashed with natural or artificial seawater in order to simulate a unit's pitching and rolling motion. The gradient of temperature is approximately 20°C, and the interval of splashing is 3 seconds or faster. The panel has a scribe line down to bare steel across width.

i) Test Panel 4 is to be cyclically splashed with natural or artificial seawater in order to simulate a unit's pitching and rolling motion. The interval of splashing is 3 seconds or faster. The panel has a scribe line down to bare steel across width.

j) Test Panel 5 is to be exposed to dry heat for 180 days at 70°C to simulate boundary plating between heated bunker tank and ballast tank in double bottom.

4.2 Test results

4.2.1 Prior to the testing, the following measured data of the coating system is to be reported:

a) infrared (IR) identification of the base and hardener components of the coating;

b) specific gravity, according to ISO 2811-74, of the base and hardener components of the paint; and

c) number of pinholes, low voltage detector at 90 Volt.

4.2.2 After the testing, the following measured data is to be reported:

a) blisters and rust according to ISO 4628/2 and ISO 4628/3;

b) dry film thickness (DFT) (use of a template) (see Sec 12, Tab 6);

c) adhesion value according to ISO 4624;

d) flexibility according to ASTM D4145, modified according to panel thickness (3 mm steel, 300 µm coating, 150 mm cylindrical mandrel gives 2% elongation) for information only;

e) cathodic protection weight loss/current demand/disbondment from artificial holiday;

f) undercutting from scribe. The undercutting along both sides of the scribe is measured and the maximum undercutting determined on each panel. The average of the three maximum records is used for the acceptance.

4.3 Acceptance criteria

4.3.1 The test results based on [4.2] are to satisfy the acceptance criteria indicated in Tab 1.

4.3.2 Epoxy based systems tested prior to the date of entry into force of Sec 6 are to satisfy only the criteria for blistering and rust in the table above.

4.3.3 Epoxy based systems tested when applied according to Sec 6, Tab 2 are to satisfy the criteria for epoxy based systems as indicated in the table above.

4.3.4 Alternative systems not necessarily epoxy based and/or not necessarily applied according to Sec 6, Tab 2 are to satisfy the criteria for alternative systems as indicated in the table above.

Table 1 : Acceptance criteria of the results of test on simulated ballast tank conditions

Item	Acceptance criteria for epoxy based systems applied according to Table 2 of Section 12	Acceptance criteria for alternative systems
Blisters on panel	No blisters	No blisters
Rust on panel	Ri 0 (0%)	Ri 0 (0%)
Number of pinholes	0	0
Adhesive failure	> 3.5 MPa Adhesive failure between substrate and coating or between coats for 60% or more of the areas	> 5.0 MPa Adhesive failure between substrate and coating or between coats for 60% or more of the areas
Cohesive failure	> 3.0 MPa Cohesive failure in coating for 40% or more of the area	> 5.0 MPa Cohesive failure in coating for 40% or more of the area
Cathodic protection current demand calculated from weight loss	< 5 mA/m^2	< 5 mA/m^2
Cathodic protection; disbondment from artificial holiday	< 8 mm	< 5 mm
Undercutting from scribe	< 8 mm	< 5 mm
U-beam	Any defects, cracking or detachment at the angle or weld will lead to system being failed.	Any defects, cracking or detachment at the angle or weld will lead to system being failed.

4.4 Test report

4.4.1 The test report is to include the following information:

a) name of the Manufacturer;

b) date of tests;

c) product name/identification of both paint and primer;

d) batch number;

e) data of surface preparation on steel panels, including the following:
- surface treatment;
- water soluble salts limit;
- dust; and
- abrasive inclusions;

f) application data of coating system, including the following:
- shop primed;
- number of coats;
- recoat interval (see Note 1);
- dry film thickness (DFT) prior to testing (see Note 1);
- thinner (see Note 1);
- humidity (see Note 1);
- air temperature (see Note 1); and
- steel temperature;

g) test results according to [4.2]; and

h) judgment according to [4.3].

Note 1: Both actual specimen data and Manufacturer's requirement/recommendation.

5 Condensation chamber test

5.1 Test condition

5.1.1 The condensation chamber test is to be conducted in accordance with ISO 6270. The conditions are the following:

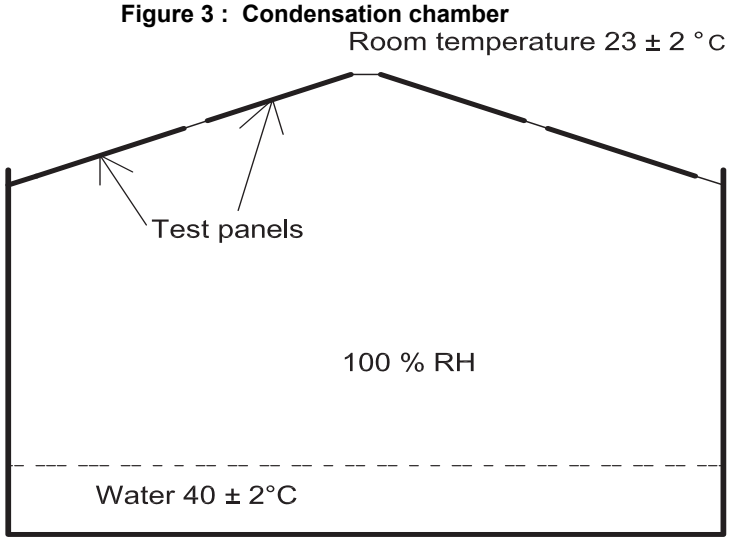
a) The exposure time is 180 days.

b) There are to be 2 test panels.

c) The size of each test panel is 150 mm x 150 mm x 3 mm. The panels are to be treated according to Sec 12, Tab 2, and the coating system applied according to items 1.d) and 1.e) of Sec 6, Tab 2. The shop primer is to be weathered for at least 2 months and cleaned by low pressure washing or other mild method. Blast sweep or high pressure washing or other primer removal methods are not to be used. The weathering method and extent are to take into consideration that the primer is to be the foundation for a 15-year target life system. To facilitate innovation, alternative preparation, coating systems and dry film thicknesses may be used when clearly defined.

d) The reverse side of the test piece is to be painted appropriately, in order not to affect the test results.

Figure 3 : Condensation chamber



5.2 Test results

5.2.1 Prior to the testing, the following measured data of the coating system is to be reported:

a) infrared (IR) identification of the base and hardener components of the coating;

b) specific gravity, according to ISO 2811-74, of the base and hardener components of the paint; and

c) number of pinholes, low voltage detector at 90 Volt.

5.2.2 After the testing, the following measured data is to be reported:

a) blisters and rust according to ISO 4628/2 and ISO 4628/3;

b) dry film thickness (DFT) (use of a template) (see Sec 6, Tab 6);

c) adhesion value according to ISO 4624;

d) flexibility according to ASTM D4145, modified according to panel thickness (3 mm steel, 300 µm coating, 150 mm cylindrical mandrel gives 2% elongation) for information only.

5.3 Acceptance criteria

5.3.1 The test results are to satisfy the acceptance criteria indicated in Tab 2.

5.3.2 Epoxy based systems tested prior to the date of entry into force of Sec 6 are to satisfy only the criteria for blistering and rust in the table above.

5.3.3 Epoxy based systems tested when applied according to Sec 6, Tab 2 are to satisfy the criteria for epoxy based systems as indicated in the table above.

5.3.4 Alternative systems not necessarily epoxy based and/or not necessarily applied according to Sec 6, Tab 2 are to satisfy the criteria for alternative systems as indicated in the table above.

5.4 Test report

5.4.1 The test report is to include the same information required in [4.4] for the test report of the test on simulated ballast tank conditions.

Table 2 : Acceptance criteria of the results of condensation chamber test

Item	Acceptance criteria for epoxy based systems applied according to Table 2 of Section 12	Acceptance criteria for alternative systems
Blisters on panel	No blisters	No blisters
Rust on panel	Ri 0 (0%)	Ri 0 (0%)
Number of pinholes	0	0
Adhesive failure	> 3.5 MPa Adhesive failure between substrate and coating or between coats for 60% or more of the areas	> 5 MPa Adhesive failure between substrate and coating or between coats for 60% or more of the areas
Cohesive failure	> 3.0 MPa Cohesive failure in coating for 40% or more of the area	> 5.0 MPa Cohesive failure in coating for 40% or more of the area