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MSC.1/Circ.1212/Rev.2
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REVISED GUIDELINES ON ALTERNATIVE DESIGN AND ARRANGEMENTS FOR SOLAS CHAPTERS II-1 AND III

1 The Maritime Safety Committee, at its eighty-second session (29 November to 8 December 2006), approved *Guidelines on alternative design and arrangements for SOLAS chapters II-1 and III* (MSC.1/Circ.1212), developed to provide further guidance on SOLAS regulations II-1/55 and III/38, which were adopted by resolution MSC.216(82) and entered into force on 1 January 2009.

2 The Guidelines serve to outline the methodology for the engineering analysis required by SOLAS regulations II-1/55 and III/38 on Alternative design and arrangements, applying to a specific engineering or life-saving system, design or arrangements for which the approval of an alternative design deviating from the prescriptive requirements of SOLAS chapters II-1 and III is sought.

3 The Maritime Safety Committee, at its 101st session (5 to 14 June 2019), approved amendments to the *Revised guidelines on alternative design and arrangements for SOLAS chapters II-1 and III* (MSC.1/Circ.1212/Rev.1), prepared by the Sub-Committee on Ship Systems and Equipment, at its sixth session.

4 The Maritime Safety Committee, at its 108th session (15 to 24 May 2024), approved amendments to the *Revised guidelines on alternative design and arrangements for SOLAS chapters II-1 and III* (MSC.1/Circ.1212/Rev.2), prepared by the Sub-Committee on Ship Design and Construction, at its tenth session.

5 Member Governments are invited to bring the revised Guidelines set out in the annex to the attention of shipowners, shipbuilders and designers for the facilitation of design within the framework of SOLAS regulations II-1/55 and III/38.

6 This circular revokes MSC.1/Circ.1212 and MSC.1/Circ.1212/Rev.1.

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ANNEX

REVISED GUIDELINES ON ALTERNATIVE DESIGN AND ARRANGEMENTS FOR SOLAS CHAPTERS II-1 AND III

1 Application

1.1 These Guidelines are intended for application of safe engineering design to provide technical justification for alternative design and arrangements to SOLAS chapters II-1 (parts C, D and E) and III. The Guidelines serve to outline the methodology for the engineering analysis required by part F (Alternative design and arrangements) of SOLAS chapter II-1 and part C (Alternative design and arrangements) of SOLAS chapter III, applying to a specific safety system, design or arrangements for which the approval of an alternative design deviating from the prescriptive requirements of SOLAS chapters II-1 and III is sought.

1.2 These Guidelines are not intended to be applied to the type approval of individual materials, components or portable equipment.

1.3 These Guidelines are not intended to serve as a stand-alone document, but should be used in conjunction with the appropriate engineering design guides and other literature.

1.4 For the application of these Guidelines to be successful, all interested parties, including the Administration or its designated representative, owners, operators, designers and classification societies, should be in continuous communication from the onset of a specific proposal to utilize these Guidelines. This approach usually requires significantly more time in calculation and documentation than a typical regulatory prescribed design because of increased engineering rigour. The potential benefits include more options, cost effective designs for unique applications and an improved knowledge of loss potential.

2 Definitions

For the purpose of these Guidelines, the following definitions apply:

2.1 *Alternative design and arrangements* means measures which deviate from the prescriptive requirement(s) of SOLAS chapters II-1 or III, but are suitable to satisfy the intent of that chapter. The term includes a wide range of measures, including alternative shipboard structures and systems based on novel or unique designs, as well as traditional shipboard structures and systems that are installed in alternative arrangements or configurations.

2.2 *Design casualty* means an engineering description of the development and severity of a casualty for use in a design scenario.

2.3 *Design casualty scenario* means a set of conditions that defines the development and severity of a casualty within and through ship space(s) or systems and describes specific factors relevant to a casualty of concern.

2.4 *Functional requirements* explain, in general terms, what function the system under consideration should provide to meet the safety objectives of SOLAS.

2.5 *Performance criteria* are measurable quantities to be used to evaluate the adequacy of trial designs.

2.6 *Prescriptive based design or prescriptive design* means a design of safety measures which comply with the regulatory requirements set out in parts C, D and E of SOLAS chapter II-1 and/or chapter III, as applicable.

2.7 *Safety margin* means adjustments made to compensate for uncertainties in the methods and assumptions used to evaluate the alternative design, e.g. in the determination of performance criteria or in the engineering models used to assess the consequences of a casualty.

2.8 *Sensitivity analysis* means an analysis to determine the effect of changes in individual input parameters on the results of a given model or calculation method.

2.9 *SOLAS* means the International Convention for the Safety of Life at Sea, 1974, as amended.

3 Engineering analysis

3.1 The engineering analysis used to show that the alternative design and arrangements provide the equivalent level of safety to the prescriptive requirements of SOLAS chapters II-1 and III should follow an established approach to safety design. This approach should be based on sound science and engineering practice incorporating widely accepted methods, empirical data, calculations, correlations and computer models as contained in engineering textbooks and technical literature.

3.2 Other safety engineering approaches recognized by the Administration may be used.

4 Design team

4.1 A design team acceptable to the Administration should be established by the owner, builder or designer and may include, as the alternative design and arrangements demand, a representative of the owner, builder or designer, and expert(s) having the necessary knowledge and experience in safety, design and/or operation as necessary for the specific evaluation at hand. Other members may include marine surveyors, ship operators, safety engineers, equipment manufacturers, human factors experts, naval architects and marine engineers.

4.2 The level of expertise that individuals should have to participate in the team may vary depending on the complexity of the alternative design and arrangements for which approval is sought. Since the evaluation, regardless of complexity, will have some effect on a particular field of safety, at least one expert with knowledge and experience in that appropriate safety field should be included as a member of the team.

4.3 The design team should:

.1 appoint a coordinator serving as the primary contact;

.2 communicate with the Administration for advice on the acceptability of the engineering analysis of the alternative design and arrangements throughout the entire process;

.3 determine the safety margin at the outset of the design process and review and adjust it as necessary during the analysis;

.4 conduct a preliminary analysis to develop the conceptual design in qualitative terms. This includes a clear definition of the scope of the alternative design and arrangements and the regulations which affect the design; a clear understanding of the intent requirements of the relevant regulations; the development of appropriate casualty scenarios, if necessary, and trial alternative designs. This portion of the process is documented in the form of a report that is reviewed and agreed by all interested parties and submitted to the Administration before the quantitative portion of the analysis is started;

.5 conduct a quantitative analysis to evaluate possible trial alternative designs using quantitative engineering analysis. This consists of the specification of design thresholds, development of performance criteria based upon the performance of an acceptable prescriptive design and evaluation of the trial alternative designs against the agreed performance criteria. From this step the final alternative design and arrangements are selected and the entire quantitative analysis is documented in a report; and

.6 prepare documentation, specifications and a life-cycle maintenance programme. The alternative design and arrangements should be clearly documented and approved by the Administration and a comprehensive report describing the alternative design and arrangements and required maintenance programme should be kept on board the ship. An operations and maintenance manual should be developed for this purpose. The manual should include an outline of the design conditions that should be maintained over the life of the ship to ensure compliance with the approved design.

5 Preliminary analysis in qualitative terms

5.1 *Definitions of scope*

5.1.1 The ship, ship system(s), component(s), space(s) and/or equipment subject to the analysis should be thoroughly defined. This includes the ship or system(s) representing both the alternative design and arrangements and the regulatory prescribed design. Depending on the extent of the desired deviation from prescriptive requirements, some of the information that may be required includes: detailed ship plans, drawings, equipment information and drawings, test data and analysis results, ship operating characteristics and conditions of operation, operating and maintenance procedures, material properties, etc.

5.1.2 The regulations affecting the proposed alternative design and arrangements, along with their functional requirements, should be clearly understood and documented in the preliminary analysis report (see paragraph 5.5). This should form the basis for the evaluation referred to in paragraph 6.4.

5.2 *Development of casualty or operational scenarios*

Casualty or operational scenarios should provide the basis for analysis and trial alternative design evaluation and, therefore, are the backbone of the alternative design process. Proper casualty or operational scenario development is essential and, depending on the extent of deviation from the prescribed design, may require a significant amount of time and resources. This phase should outline why an alternative design may be beneficial. For life-saving arrangements, this may focus on casualty scenarios where an alternative design or arrangement will provide an equivalent (or greater) level of safety. Mechanical or electrical arrangements may focus on an operational scenario that will provide an equivalent level of safety, but may increase efficiencies or reduce cost to the operator.

5.3 *Casualty scenario development*

5.3.1 *General*

Casualty scenario development can be broken down into four areas:

.1 identification of hazards;

.2 enumeration of hazards;

.3 selection of hazards; and

.4 specification of design casualty scenarios.

5.3.2 *Identification of hazards*

This step is crucial in the casualty scenario development process as well as in the entire alternative design methodology. If a particular hazard or incident is omitted, then it will not be considered in the analysis and the resulting final design may be inadequate. Hazards may be identified using historical and statistical data, expert opinion and experience and hazard evaluation procedures. There are many hazard evaluation procedures available to help identify the hazards including Hazard and Operability Study (HAZOP), Process Hazard Analysis (PHA), Failure Mode and Effects Analysis (FMEA), "what-if", etc. As a minimum, the following conditions and characteristics should be identified and considered:

.1 pre-casualty situation: ship, platform, compartment, available potential and kinetic energy, environmental conditions;

.2 potential initiating events, causes;

.3 detailed technical information and properties of potential hazards;

.4 secondary hazards that might be subject to effects of initial hazard;

.5 extension potential: beyond compartment, structure, area (if in open);

.6 target locations: note target items or areas associated with the performance parameters;

.7 critical factors relevant to the hazard: ventilation, environment, operational, time of day, etc.; and

.8 relevant statistical data: past casualty history, probability of failure, frequency and severity rates, etc.

5.3.3 *Enumeration of hazards*

All of the hazards identified above should be grouped into one of three incident classes: localized, major or catastrophic. A localized incident consists of a casualty with a localized effect zone, limited to a specific area. A major incident consists of a casualty with a medium effect zone, limited to the boundaries of the ship. A catastrophic incident consists of a casualty with a large affect zone, beyond the ship and affecting surrounding ships or communities. In the majority of cases, only localized and/or major incidents need to be considered. Examples where the catastrophic incident class may be considered would include transport and/or offshore production of petroleum products or other hazardous materials where the incident effect zone is very likely to be beyond the ship vicinity. The hazards should be tabulated for future selection of a certain number of each of the incident classes.

5.3.4 *Selection of hazards*

The number and type of hazards that should be selected for the quantitative analysis is dependent on the complexity of the trial alternative design and arrangements. All of the hazards identified should be reviewed for selection of a range of incidents. In determining the selection, frequency of occurrence does not need to be fully quantified, but it can be utilized in a qualitative sense. The selection process should identify a range of incidents which cover the largest and most probable range of enumerated hazards. Because the engineering evaluation relies on a comparison of the proposed alternative design and arrangements with prescriptive designs, demonstration of equivalent performance during the major incidents should adequately demonstrate the design's equivalence for all lesser incidents and provide the commensurate level of safety. In selecting the hazards it is possible to lose perspective and to begin selecting highly unlikely or inconsequential hazards. Care should be taken to select the most appropriate incidents for inclusion in the selected range of incidents.

5.3.5 *Specification of design casualty scenarios*

Based on the hazards selected, the casualty scenarios to be used in the quantitative analysis should be clearly documented. The specification should include a qualitative description of the design casualty (e.g. initiating and subsequent chain of events, location, etc.), description of the vessel, compartment or system of origin, safeguard systems installed, number of occupants, physical and mental status of occupants and available means of escape. The casualty scenarios should consider possible future changes to the hazards (increased or decreased) in the affected areas. The design casualty or casualties will be characterized in more detail during the quantitative analysis for each trial alternative design. Operational scenario development for a mechanical or electrical alternative design or arrangement should include the operating scenarios under which the alternative will be utilized.

5.4 *Development of trial alternative designs*

At this point in the analysis, one or more trial alternative designs should be developed so that they can be compared against the developed performance criteria. The trial alternative design should also take into consideration the importance of human factors, operations and management. It should be recognized that well defined operations and management procedures may play a big part in increasing the overall level of safety.

5.5 *Preliminary analysis report*

5.5.1 A report of the preliminary analysis should include clear documentation of all steps taken to this point, including identification of the design team, their qualifications, the scope of the alternative design analysis, the functional requirements to be met, the description of the casualty scenarios and trial alternative designs selected for the quantitative analysis.

5.5.2 The preliminary analysis report should be submitted to the Administration for formal review and agreement prior to beginning the quantitative analysis. The report may also be submitted to the port State for informational purposes, if the intended calling ports are known during the design stage. The key results of the preliminary analysis should include:

.1 a secured agreement from all parties to the design objectives and engineering evaluation;

.2 specified design casualty scenario(s) acceptable to all parties; and

.3 trial alternative design(s) acceptable to all parties.

6 Quantitative analysis

6.1 *General*

6.1.1 The quantitative analysis is the most labour intensive from an engineering standpoint. It consists of quantifying the design casualty scenarios, developing the performance criteria, verifying the acceptability of the selected safety margins and evaluating the performance of trial alternative designs against the prescriptive performance criteria.

6.1.2 The quantification of the design casualty scenarios may include calculating the effects of casualty detection systems, alarm and mitigation methods, generating timelines from initiation of the casualty until control of the casualty or evacuation, and estimating consequences in terms of damage to the vessel, and the risk of harm to passengers and crew. This information should then be utilized to evaluate the trial alternative designs selected during the preliminary analysis.

6.1.3 Risk assessment may play an important role in this process. It should be recognized that risk cannot ever be completely eliminated. Throughout the entire performance based design process, this fact should be kept in mind. The purpose of performance design is not to build a fail-safe design, but to specify a design with reasonable confidence that it will perform its intended function(s) when necessary and in a manner equivalent to or better than the prescriptive requirements of SOLAS chapters II-1 and III.

6.2 *Quantification of design casualty scenarios*

6.2.1 After choosing an appropriate range of incidents, quantification of the casualties should be carried out for each of the incidents. Quantification will require specification of all factors that may affect the type and extent of the hazard. The casualty scenarios should consider possible future changes to the affected systems and areas. This may include calculation of specific casualty parameters, ship damage, passenger exposure to harm, time-lines, etc. It should be noted that, when using any specific tools, the limitations and assumptions of these models should be well understood and documented. This becomes very important when deciding on and applying safety margins. Documentation of the alternative design should explicitly identify the models used in the analysis and their applicability. Reference to the literature alone should not be considered as adequate documentation. The general procedure for specifying design casualties includes casualty scenario development completed during the preliminary analysis, timeline analysis and consequence estimation which is detailed below.

6.2.2 For each of the identified hazards, a range of casualty scenarios should be developed. Because the alternative design approach is based on a comparison against the regulatory prescribed design, the quantification can often be simplified. In many cases, it may only be necessary to analyse one or two scenarios if this provides enough information to evaluate the level of safety of the alternative design and arrangements against the required prescriptive design.

6.2.3 A timeline should be developed for each of the casualty scenarios beginning with initiation. Timelines should include the entire chain of relevant events up to and including escape times (to assembly stations, evacuation stations and lifeboats, as appropriate). This timeline should include personnel response, activation of damage control systems or active damage control measures, untenable conditions, etc. The timeline should include a description of the extent of the casualty throughout the scenario, as determined by using the various correlations, models and data from the literature or actual tests.

6.2.4 Consequences of various casualty scenarios should be quantified in relevant engineering terms. This can be accomplished by using existing correlations and calculation procedures for determining the characteristics of a casualty. In certain cases, full scale testing and experimentation may be necessary to properly predict the casualty characteristics. Regardless of the calculation procedures utilized, a sensitivity analysis should be conducted to determine the effects of the uncertainties and limitations of the input parameters.

6.3 *Development performance criteria*

6.3.1 Performance criteria are quantitative expressions of the intent of the requirements of the relevant SOLAS regulations. The required performance of the trial alternative designs are specified numerically in the form of performance criteria. Performance criteria may include tenability limits or other criteria necessary to ensure successful alternative design and arrangements.

6.3.2 Compliance with the prescriptive regulations is one way to meet the stated functional requirements. The performance criteria for the alternative design and arrangements should be determined, taking into consideration the intent of the regulations.

6.3.3 If the performance criteria for the alternative design and arrangements cannot be determined directly from the prescriptive regulations because of novel or unique features, they may be developed from an evaluation of the intended performance of a commonly used acceptable prescriptive design, provided that an equivalent level of safety is maintained. In the case of life-saving appliances and arrangements according to SOLAS chapter III, the goals, functional requirements and expected performance criteria, as set out in appendix 5, should be taken into account. In the case of machinery installations, electrical installations and additional requirements for periodically unattended machinery spaces according to SOLAS chapter II-1 parts C, D and E, the goals, functional requirements and expected performance criteria, as set out in appendix 6, should be taken into account.

6.3.4 Before evaluating the prescriptive design, the design team should agree on what specific performance criteria and safety margins should be established. Depending on the prescriptive requirements to which the approval of alternative design or arrangements is sought, these performance criteria could fall within one or more of the following areas:

.1 Life safety criteria – These criteria address the survivability of passengers and crew and may represent the effects of flooding, fire, etc.

.2 Criteria for damage to ship structure and related systems – These criteria address the impact that casualty might have on the ship structure, mechanical systems, electrical systems, fire protection systems, evacuation systems, propulsion and manoeuvrability, etc. These criteria may represent physical effects of the casualty.

.3 Criteria for damage to the environment – These criteria address the impact of the casualty on the atmosphere and marine environment.

6.3.5 The design team should consider the impact that one particular performance criterion might have on other areas that might not be specifically part of the alternative design. For example, the failure of a particular safeguard may not only affect the life safety of passengers and crew in the adjacent space, but it may result in the failure of some system affecting the overall safety of the ship.

6.3.6 Once all of the performance criteria have been established, the design team can then proceed with the evaluation of the trial alternative designs (see section 6.4).

6.4 *Evaluation of trial alternative designs*

6.4.1 All of the data and information generated during the preliminary analysis and specification of design casualty should serve as input to the evaluation process. The evaluation process may differ depending on the level of evaluation necessary (based on the scope defined during the preliminary analysis), but should generally follow the process illustrated in figure 6.4.1.

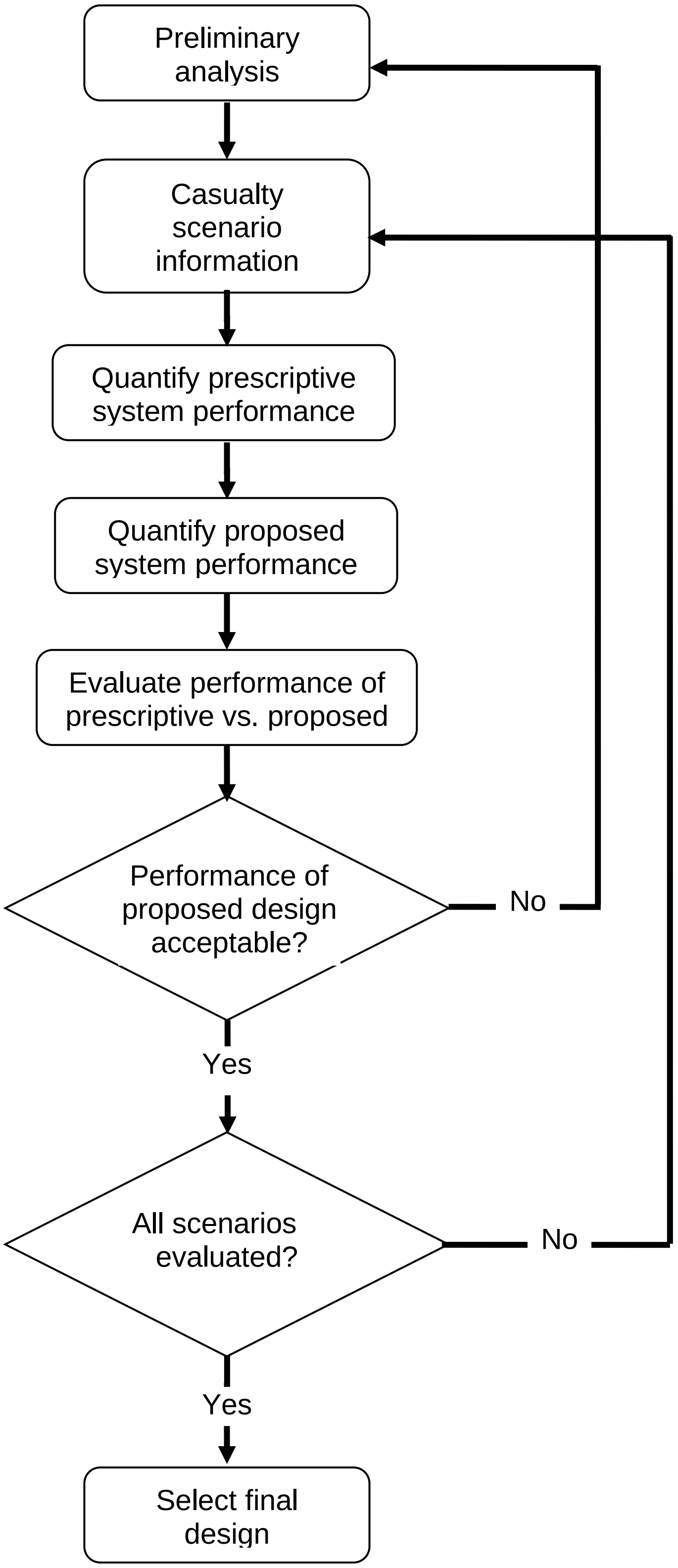

Figure 6.4.1 Alternative design and arrangements process flowchart

6.4.2 Each selected trial alternative design should be analysed against the selected design casualty scenarios to demonstrate that it meets the performance criteria with the agreed safety margin, which in turn demonstrates equivalence to the prescriptive design.

6.4.3 The level of engineering rigour required in any particular analysis will depend on the level of analysis required to demonstrate equivalency of the proposed alternative design and arrangements to the prescriptive requirements. Obviously, the more components, systems, operations and parts of the ship that are affected by a particular alternative design, the larger the scope of the analysis.

6.4.4 The final alternative design and arrangements should be selected from the trial alternative designs that meet the selected performance criteria and safety margins.

7 Documentation

7.1 Because the alternative design process may involve substantial deviation from the regulatory prescribed requirements, the process should be thoroughly documented. This provides a record that will be required if future design changes to the ship are proposed or the ship transfers to the flag of another State and will also provide details and information that may be adapted for use in future designs. The following information should be provided for approval of the alternative design or arrangements:

.1 scope of the analysis or design;

.2 description of the alternative design(s) or arrangements(s), including drawings and specifications;

.3 results of the preliminary analysis, to include:

.3.1 members of the design team (including qualifications);

.3.2 description of the trial alternative design and arrangements being evaluated;

.3.3 discussion of affected SOLAS regulations and their requirements;

.3.4 hazard identification;

.3.5 enumeration of hazards;

.3.6 selection of hazards; and

.3.7 description of design casualty scenarios;

.4 results of quantitative analysis:

.4.1 design casualty scenarios:

.4.1.1 critical assumptions;

.4.1.2 initial conditions;

.4.1.3 engineering judgements;

.4.1.4 calculation procedures;

.4.1.5 test data;

.4.1.6 sensitivity analysis; and

.4.1.7 timelines;

.4.2 performance criteria;

.4.3 evaluation of trial alternative designs against performance criteria;

.4.4 description of final alternative design and arrangements;

.4.5 test, inspection and maintenance requirements; and

.4.6 references.

7.2 Documentation of approval by the Administration and the following information should be maintained onboard the ship at all times:

.1 scope of the analysis or design, including the critical design assumptions and critical design features;

.2 description of the alternative design and arrangements, including drawings and specifications;

.3 listing of affected SOLAS regulations;

.4 summary of the results of the engineering analysis and basis for approval; and

.5 test, inspection and maintenance requirements.

7.3 *Reporting and approval forms*

7.3.1 When the Administration approves alternative design and arrangements under these guidelines, pertinent technical information about the approval should be summarized on the reporting form given in appendixes 1 or 2, as appropriate, and should be submitted to the Organization for circulation to the Member Governments.

7.3.2 When the Administration approves alternative design and arrangements under these guidelines, documentation should be provided as indicated in appendixes 3 or 4, as appropriate. The documentation should be in the language or languages required by the Administration. If the language is neither English, French nor Spanish, a translation into one of those languages should be included.

APPENDIX 1

REPORT ON THE APPROVAL OF ALTERNATIVE DESIGN AND ARRANGEMENTS FOR MACHINERY AND ELECTRICAL INSTALLATIONS

The Government of ………………………. has approved on ………………… an alternative design and arrangement in accordance with provisions of regulation II-1/55 of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, as described below:

Name of ship ....

Port of registry ....

Ship type ....

IMO Number ....

1. Scope of the analysis or design, including the critical design assumptions and critical design features:

2. Description of the alternative design and arrangements:

3. Conditions of approval, if any:

4. Listing of affected SOLAS chapter II-1 regulations in parts C, D and E:

5. Summary of the result of the engineering analysis and basis for approval, including performance criteria and design casualty scenarios:

6. Test, inspection and maintenance requirements:

APPENDIX 2

REPORT ON THE APPROVAL OF ALTERNATIVE DESIGN AND ARRANGEMENTS FOR LIFE-SAVING APPLIANCES AND ARRANGEMENTS

The Government of ………………………. has approved on ………………… an alternative design and arrangement in accordance with provisions of regulation III/38 of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, as described below:

Name of ship ....

Port of registry ....

Ship type ....

IMO Number ....

1. Scope of the analysis or design, including the critical design assumptions and critical design features:

2. Description of the alternative design and arrangements:

3. Conditions of approval, if any:

4. Listing of affected SOLAS chapter III regulations:

5. Summary of the result of the engineering analysis and basis for approval, including performance criteria and design casualty scenarios:

6. Test, inspection and maintenance requirements:

APPENDIX 3

DOCUMENT OF APPROVAL OF ALTERNATIVE DESIGN AND ARRANGEMENTS FOR MACHINERY AND ELECTRICAL INSTALLATIONS

Issued in accordance with provisions of regulation II-1/55.4 of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, under the authority of the Government of ....…………………………….. by ………..………………………….……….

(Name of State) (Person or organization authorized)

Name of ship ....

Port of registry ....

Ship type ....

IMO Number ....

THIS IS TO CERTIFY that the following alternative design and arrangements applied to the above ship have been approved under the provisions of SOLAS regulation II-1/55:

1. Scope of the analysis or design, including the critical design assumptions and critical design features:

2. Description of the alternative design and arrangements:

3. Conditions of approval, if any:

4. Listing of affected SOLAS chapter II-1 regulations:

5. Summary of the result of the engineering analysis and basis for approval, including performance criteria and design casualty scenarios:

6. Test, inspection and maintenance requirements:

7. Drawings and specifications of the alternative design and arrangement:

Issued at .... on ....

....
(Signature of authorized official issuing the certificate)

(Seal or stamp of issuing authority, as appropriate)

APPENDIX 4

DOCUMENT OF APPROVAL OF ALTERNATIVE DESIGN AND ARRANGEMENTS FOR LIFE-SAVING APPLIANCES AND ARRANGEMENTS

Issued in accordance with provisions of regulation III/38.4 of the International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended, under the authority of the Government of ....……………………………. by ……...……………………………………...

(Name of State) (Person or organization authorized)

Name of ship ....

Port of registry ....

Ship type ....

IMO Number ....

THIS IS TO CERTIFY that the following alternative design and arrangements applied to the above ship have been approved under the provisions of SOLAS regulation III/38.

1. Scope of the analysis or design, including the critical design assumptions and critical design features:

2. Description of the alternative design and arrangements:

3. Conditions of approval, if any:

4. Listing of affected SOLAS chapter III regulations:

5. Summary of the result of the engineering analysis and basis for approval, including performance criteria and design casualty scenarios:

6. Test, inspection and maintenance requirements:

7. Drawings and specifications of the alternative design and arrangement:

Issued at .... on ....

....
(Signature of authorized official issuing the certificate)

(Seal or stamp of issuing authority, as appropriate)

APPENDIX 5

GOALS, FUNCTIONAL REQUIREMENTS AND EXPECTED PERFORMANCE CRITERIA FOR SOLAS CHAPTER III

Goal: To save and maintain human life during and after an emergency situation

FR 1: All life-saving appliances should be in a state of readiness for immediate use. This will be accomplished by ensuring:

EP 1: All life-saving appliances should be easily accessible (e.g. not obstructed and not locked).

EP 2: All life-saving appliances should be stowed securely in a sheltered position and protected from damage by fire and explosion.

EP 3: All life-saving appliances should be maintainable to ensure reliability for the specified service cycle.

EP 4: All life-saving appliances should be designed considering uncertainty in material properties, loads, deterioration and consequences of failure in operating environment.

EP 5: Descriptions and instructions for operation, inspection, maintenance and functional testing should be provided for all life-saving appliances.

EP 6: All life-saving appliances should be able to withstand environmental exposure of the ship including sunlight, ozone, seawater (wash, heavy seas), icing, wind, humidity, oil, air temperature (-30°C to +65°C), water temperature (at least -1°C to +30°C if it is likely to be immersed in seawater), fungus and marine atmosphere.

EP 7: All life-saving appliances should be usable and operational under adverse vessel conditions, i.e. list and trim.

EP 8: Deployment of life-saving appliances should be possible without depending upon any means other than gravity or stored power which is independent of the ship's power supplies to launch the survival craft.

EP 9: The number of crew members on board should be sufficient for operating the life-saving appliance and launching arrangements required for abandonment by the total number of persons on board. This should include substitutes for key persons and crew members on board operating survival craft and launching arrangements are assigned and trained appropriately.

FR 2: Training and drills should be sufficient to ensure that all passengers and crew are familiar with their responsibilities in an emergency. This will be accomplished by ensuring:

EP 1: All life-saving appliances and arrangements should be designed and installed to facilitate training and drills.

EP 2: Training and drills should be routinely conducted to ensure crew are in a state of readiness and are competent with the operation of life-saving appliances and their assigned emergency duties.

EP 3: Every crew member should participate in drills. These should be conducted, as far as practicable, as if there were an actual emergency.

EP 4: Drills should be planned and conducted in a safe manner.

EP 5: Drills should be planned in such a way that due consideration is given to regular practice in the various emergencies that may occur depending on the type of ship and cargo.

FR 3: Before proceeding to sea, all crew and passengers should be provided with information and instructions of the actions to be taken in an emergency. This will be accomplished by ensuring:

EP 1: Safety information and instructions should be presented in a manner that is easily understood by passengers, in language, illustration and/or demonstration.

EP 2: Information should be distributed and displayed in appropriate conspicuous places accessible under all conditions, e.g. emergency lighting.

EP 3: All ships should clearly indicate and highlight the stowage location of all life-saving appliances, display directions to places designated for assembling all persons in the event of an emergency, display assignment to life-saving appliances and display how to operate life-saving appliances.

EP 4: The number and type of life-saving appliances should be marked at each stowage location.

FR 4: All ships should have an effective emergency management system. A copy of the emergency management system should be readily available to crew. This will be accomplished by ensuring:

EP 1: The emergency management system should clearly identify roles and responsibilities during an emergency.

EP 2: Assembly locations, muster stations and escape routes should be identified on all ships.

EP 3: All passenger ships should establish a decision support system.

EP 4: The emergency management system should include the consideration of physical characteristics and capabilities of embarked persons.

EP 5: All ships should have the means to account for all persons on board.

EP 6: The emergency management system should have a uniform structure, be easy to use and be provided on board in an appropriate conspicuous location.

FR 5: All ships should be provided with means of external communications with shore, ships and aircraft. This will be accomplished by ensuring:

EP 1: All ships should have the means to indicate their position visually in an emergency, which makes it possible to detect and locate the ship from an altitude of at least 3,000 m at a range of at least 10 miles under clear daytime and night-time conditions for a period of at least 40 s.

EP 2: All ships should be provided with means for two-way on-scene communication between survival craft, between survival craft and ship, and between survival craft and rescue craft.

EP 3: All ships should carry search and rescue locating devices that are designed to automatically activate and operate continuously and can be rapidly placed into any survival craft from their place of storage on the ship.

FR 6: All ships should be able to internally communicate emergency messages and instructions to all crew and passengers. This will be accomplished by ensuring:

EP 1: Emergency alerts, messages and instructions to all crew and passengers should be received regardless of an individual's location on the ship.

EP 2: Emergency alerts, messages and instructions should be communicated in appropriate languages expected to be understood by all those on board.

EP 3: Two-way communications should be possible between emergency control stations, places designated for assembling and/or embarkation to survival craft and strategic positions on board.

FR 7: All ships should provide means for a safe abandonment for all persons. This will be accomplished by ensuring:

EP 1: Means should be available to embark survival craft from both the embarkation deck and the waterline in the lightest seagoing condition and under adverse conditions of list and trim.

EP 2: Means of evacuation should be distributed on the ship considering access of persons and areas where persons may become isolated.

EP 3: Each davit-launched, self-propelled survival craft boarded from the embarkation deck should be capable of being launched from two positions by one crew member: from a position in the survival craft and from a position on deck.

EP 4: All survival and rescue craft should be stowed as near the water surface as is safe and practicable.

EP 5: All ships should provide for safe unobstructed launching of each survival craft, for example, by avoiding interference with fixed structures, fixtures, fittings, equipment and other life-saving appliances.

EP 6: Embarkation platforms should provide for protection from the seaway and the effects of hazardous cargo, if carried.

EP 7: Relative movement and gaps between the survival craft and ship during embarkation should be minimized.

EP 8: All life-saving appliances should enable safe abandonment of all persons on board regardless of their physical condition, age and mobility, including those needing evacuation by stretcher or other means.

EP 9: All ships should provide for safe launching of survival craft both in a seaway and when the ship is adrift.

EP 10: Passenger ships should provide float free survival craft capacity for at least 25% of the total number of persons on board and cargo ships should provide 100% float free survival craft capacity for the total number of persons on board.

EP 11: All ships should provide adequate space to muster and provide instructions for all persons on board.

EP 12: Abandonment of all persons on board should take no more than 30 minutes after mustering on passenger ships, and 10 minutes on cargo ships.

EP 13: Each survival craft should be prepared for boarding and launching by no more than two crew members in less than 5 minutes.

EP 14 Life-saving appliances and the craft they launch should operate as a system.

FR 8: All ships should provide means for the safety and survivability of all persons after abandonment for the time until expected rescue. This will be accomplished by ensuring:

EP 1: Survival craft should provide a habitable environment for all persons on board.

EP 2: Survival craft should provide adequate ventilation and protection for its complement against wind, rain and spray at all ambient temperatures between -15 and 30 degrees C.

EP 3: Each survival craft shall have sufficient buoyancy when loaded with its full complement of persons and when punctured in any one location.

EP 4: All passenger ships must have sufficient self-propelled craft capable of marshalling all non-self-propelled survival craft sufficient for the total number of persons on board.

EP 5: Self-propelled survival and rescue craft should be capable of proceeding ahead in calm water at least at 2 knots when towing the largest passive survival craft carried on the ship loaded with its full complement of persons and equipment.

EP 6: Survival craft should be able to reach a safe distance from the ship in a timely manner, either by its own propulsion or by assistance from other survival craft or rescue craft.

EP 7: Each survival craft should have sufficient first aid supplies, anti-seasickness medication, and supply of food and water for the number of persons on board.

EP 8: Survival craft should be approved for the maximum number of persons it is permitted to accommodate, as decided by practical seating tests afloat and based upon the number of adult persons wearing individual buoyancy equipment who can be seated without, in any way, interfering with the normal operation of its equipment or means of propulsion.

EP 9: All life-saving appliances and arrangements should be designed to reflect the expected capabilities and characteristics of persons on board.

EP 10: All survival craft should provide means for persons in the water to cling to the survival craft, and permit persons to board the survival craft from the water when wearing individual buoyancy equipment.

FR 9: Each person should be provided with means to facilitate survival in the water until rescued into a survival craft or rescue unit. This will be accomplished by ensuring:

EP 1: Each person on a cargo ship and each crew member assigned to operate the life-saving appliances on any ship should be provided with individual garments for protection against hypothermia.

EP 2: Each person on board should have ready access to a physically suitable personal life-saving appliance, regardless of their location on the vessel.

EP 3: All ships must ensure individual wearable buoyancy equipment are available for persons on watch and at remote locations on the ship so that they are readily accessible in an emergency.

EP 4: All ships shall ensure that each adult on board has a suitable individual wearable buoyancy equipment considering their weight and girth.

EP 5: Passenger ships shall ensure that each infant and child on board has a suitable individual wearable buoyancy equipment, as appropriate, for the duration of the voyage and the type of service.

EP 6: Throwable personal flotation devices are distributed so that they are readily available on both sides of the ship and as far as practicable on all open decks extending to the ship's side or to the stern.

EP 7: Throwable personal flotation devices are stowed so as to be capable of being rapidly cast loose and not permanently secured in any way.

EP 8: Personal life-saving appliances should be provided with adequate spare capacity.

FR 10: Each survival craft should provide active and passive means of detection by other survival and rescue craft. This will be accomplished by ensuring:

EP 1: Survival craft should have active and passive means of detection which makes it possible to visually locate or detect the survival craft in a seaway from a ship or an aircraft.

EP 2: Visual means of detection for survival craft should make it possible for an aircraft at an altitude of up to 3,000 meters to detect the survival craft at a range of at least 10 miles; and for a ship to detect the survival craft in a seaway in clear conditions at a range of at least 2 miles.

FR 11: All ships should provide active and passive means for detection of persons in the water by survival units and by rescue craft.

EP 1: Visual means of detection for persons in the water should make it possible for a ship to detect the person in a seaway in clear daytime conditions at a range of at least 0.2 miles; and in clear night-time conditions at a range of at least 0.5 miles for a duration of at least 8 hours.

EP 2: Individual wearable buoyancy equipment should have a manually controlled active means of detection which makes it possible to detect a person in a seaway audibly at a range of at least 0.2 miles in calm weather.

EP 3: Buoyancy equipment intended to support and enable the detection of persons in the water should be provided on board. The buoyancy equipment should have passive means of detection, which makes it possible to detect the buoyancy equipment in a seaway visually and, have active means of detection attached which is automatically activated when the buoyancy equipment is deployed.

FR 12: All ships should provide for the search, rescue and retrieval of persons in the water. This will be accomplished by ensuring:

EP 1: Rescue craft should be stowed in such a way that they are kept in a state of continuous readiness and can be launched within 5 minutes and neither the rescue craft nor its stowage arrangements interfere with the operation of any survival craft at any other launching station.

EP 2: Launching arrangements for rescue craft should provide safe launching from the ship in a seaway with the ship making way at speeds of up to 5 knots.

EP 3: Rescue craft should be capable of maintaining a speed of at least 6 knots for at least 4 hours in a seaway.

EP 4: Rescue craft should be capable of being towed at speeds of up to 5 knots and be capable of towing other survival craft.

EP 5: Rescue craft should have sufficient mobility and manoeuvrability in a seaway to enable retrieval of persons from the water. Ro-ro passenger ships should be equipped with effective means for rapidly recovering survivors from the water and transferring survivors from rescue or survival craft to the ship.

EP 6: The full complement of occupants for which the rescue craft is approved to carry must be recovered to a position where they can disembark to the deck of the ship.

EP 7: Rescue craft should be capable of carrying at least five persons seated and at least one person lying down.

APPENDIX 6

GOALS, FUNCTIONAL REQUIREMENTS AND EXPECTED PERFORMANCE CRITERIA FOR SOLAS CHAPTER II-1, PARTS C, D AND E

GOALS, FUNCTIONAL REQUIREMENTS AND EXPECTED PERFORMANCE CRITERIA FOR SOLAS CHAPTER II-1 (PART C) (MACHINERY INSTALLATIONS)

Goal: To ensure adequate design, construction and availability of machinery installations for safe operation of the ship and safeguard of the persons on board from associated hazards in expected operating conditions

FR 1: Sufficient availability and capacity of propulsion to avoid navigational hazards should be ensured. Sufficient design and construction to reduce, to a minimum, any danger to persons on board should be ensured. This will be accomplished by ensuring:

EP 1-1: Special consideration should be given to the reliability of single essential propulsion components, and a separate source of propulsion power may be required to give the ship a navigable speed.

EP 1-2: Means should be provided whereby normal operation of propulsion machinery can be sustained or restored even though one of the essential auxiliaries becomes inoperative.

EP 1-3: Means should be provided to ensure that the machinery can be brought into operation from the dead ship condition without external aid.

EP 1-4: All machineries should be subjected to appropriate tests before being put into service for the first time. Machineries subject to internal pressure should be pressure tested prior to being put into service.

EP 1-5: Machinery essential to the propulsion and manoeuvring and safety of the ship should be designed to operate when the ship is upright and when inclined at certain angles in both static and dynamic conditions.

EP 1-6: Provision should be made to facilitate cleaning, inspection and maintenance of essential machinery including boilers, internal combustion engines, and pressure vessels.

EP 1-7: Any mode of the vibrations raised by machineries should not cause undue stresses in the machineries in the normal operating conditions.

EP 1-8: The design and installation of vent pipes for fuel oil settling and service tanks and lubricating oil tanks should not lead to the risk of ingress of seawater or rainwater.

EP 1-9: Means should be provided to protect against hazards originating from the machinery, such as moving parts and hot surfaces.

FR 2: It should be ensured that machinery (main and auxiliary; both reciprocating engines and turbine engines, gears and shafts) should be capable of maintaining optimal operational conditions for safe voyages. This will be accomplished by ensuring:

EP 2-1: Means should be provided to keep the machinery in safe and stable operating speed.

EP 2-2: Machinery subject to internal pressure should be protected against excessive pressure.

EP 2-3: Machinery and the parts for transmission of power should be designed and constructed to withstand the maximum working stress.

EP 2-4: Machinery should be provided with automatic shut-off arrangements in the case of failures which could lead to breakdown or serious damage.

FR 3: Adequate means of reversing the direction of thrust should be provided. This will be accomplished by ensuring:

EP 3-1: The thrust can be reversed and be sufficient to stop the ship within a reasonable distance.

EP 3-2: The test results and information on means of going astern should be available on board.

FR 4: Sufficient steering availability and capacity in normal and under failure conditions should be provided to ensure sufficient manoeuvring capabilities and to avoid navigational hazards. This functional requirement is also applicable to electrical and electrohydraulic steering gear. This will be accomplished by ensuring:

EP 4-1: The steering performance should not be lost owing to a single failure in the steering gear or the control system.

EP 4-2: The steering gears and their components should have sufficient strength and overload of the steering gears should be avoided.

EP 4-3: The steering system should have capability to redirect the steering force in sufficient time.

EP 4-4: The steering gear should be controlled from the location where lookout and conning function take place. The steering gear should also be capable of being controlled from the steering gear compartment with sufficient communication capability to the navigation bridge.

EP 4-5: Electrical and electrohydraulic steering power systems and steering control systems should be provided with sufficient redundancy and safeguards.

FR 5: Machinery essential for the propulsion and safe control of the ship should be provided with effective means for its operation and control. This will be accomplished by ensuring:

EP 5-1: Where remote control of propulsion machinery from the navigation bridge is provided and the machinery control rooms are intended to be continuously attended:

5-1.1: the speed, direction of thrust and, if applicable, the pitch of the propeller should be fully controllable from the navigation bridge;

5-1.2: the means of remote control should be provided, for each independent propeller;

5-1.3: the propulsion machinery should be provided with an emergency stopping device on the navigation bridge;

5-1.4: propulsion machinery orders from the navigation bridge should be indicated in the machinery control room;

5-1.5: control of the propulsion machinery should be possible only from one location at a time;

5-1.6: it should be possible to control the propulsion machinery in the case of failure of remote control;

5-1.7: indicators should be fitted on the navigation bridge for propeller speed and direction of rotation, and pitch position if applicable; and

5-1.8: an audible and visible alarm should be provided on the navigation bridge and in the machinery control room to indicate a malfunction or failure of the control system.

EP 5-2: Where machinery is provided with automatic or remote control from an attended control room, the control should be designed and installed such that the machinery operation is as safe and effective as if it were under direct supervision.

EP 5-3: Automatic starting, operational and control systems should include provisions for manual override.

EP 5-4: Failure of any part of automatic or remote-control systems should not prevent the use of the manual override.

FR 6: Means for safe operation of steam boilers, boiler feed system and steam piping system should be provided. This will be accomplished by ensuring:

EP 6-1: Means should be provided to prevent the steam pressure from exceeding the design pressure.

EP 6-2: All pressure components for steam and feed water systems should be designed and installed with an adequate safety margin.

EP 6-3: Steam piping system should have sufficient strength and safety means to avoid over-pressure and water hammer actions.

FR7: Sufficient air supply to machinery spaces should be provided for operation of machinery and crew comfort. This will be accomplished by ensuring:

EP 7-1: Ventilation systems in machinery space should be designed with sufficient capacity for all the machinery operations and crew in the space.

FR 8: An efficient bilge pumping system capable of pumping from and draining any watertight compartment under all conditions should be provided. This will be accomplished by ensuring:

EP 8-1: Sufficient capacity of system (pump, piping), redundancy of system (pump) should be provided.

EP 8-2: Unnecessary discharging/intaking/ingress of bilge from one compartment to another compartment should be avoided.

EP 8-3: For passenger ships, the bilge system should be operable when any one compartment is flooded or damaged.

FR 9: Sufficient and non-interrupted means of communication should be provided between machinery control room and the location where lookout and conning function take place. Sufficient means for calling engineers should be provided. This will be accomplished by ensuring:

EP 9-1: Two independent means of communication between machinery control room and the location where lookout and conning function take place should be provided.

EP 9-2: An engineer's alarm should be provided from the machinery control position.

FR 10: Emergency power installation in passenger ships should be located in a safe position. This will be accomplished by ensuring:

EP 10-1: Machineries for use in emergency in passenger ships should be located in a safe position.

GOALS, FUNCTIONAL REQUIREMENTS AND EXPECTED PERFORMANCE CRITERIA FOR SOLAS CHAPTER II-1 (Part D) (ELECTRICAL INSTALLATIONS)

Goal: To ensure adequate availability of electrically-powered services for the safe operation of the ship and to protect the persons on board from hazards of electrical origin in normal and emergency conditions.

FR 1: Sufficient power supply to electrical loads in normal and emergency conditions should be provided and maintained. This will be accomplished by ensuring:

EP 1-1: Sufficient power supply to essential services and to maintain habitable conditions should be provided and maintained.

EP 1-2: Adequate power supply to emergency services should be ensured.

EP 1-3: Power supply for essential services should be maintained regardless of speed and direction of rotation of propulsion machinery or shafting.

EP 1-4: Means for monitoring availability of emergency source of electrical power and its distribution system should be provided.

EP 1-5: Power supply to emergency services should be ensured for at least the time duration as required by SOLAS chapter II-1 part D.

EP 1-6: For passenger ships, steady and uninterrupted power supply to emergency services should be ensured.

EP 1-7: Power supply for normal operation of propulsion, steering gear, illumination and other essential systems for overall safety and minimum habitability should be provided even in case of malfunction of one power source.

EP 1-8: Adequate power supply should be provided to recover from dead ship condition within a time duration not more than 30 minutes after blackout.

EP 1-9: Power supply to emergency services should be provided in at least the following conditions:

A) inclined at any angle of list up to 22.5°;

B) inclined up to 10° either in the force or aft direction; and

C) any combination of above angles within those limits.

EP 1-10: Power supply to emergency services should not be impaired by malfunction in non-essential services.

EP 1-11: A single failure in the distribution system should not result in an unacceptable loss of electrical power in essential systems.

FR 2: Electrical power supply should be restored after malfunction. This will be accomplished by ensuring:

EP 2-1: Power should be made available automatically within 45 seconds to emergency services.

EP 2-2: Emergency services should be automatically connected to available electrical power supply.

EP 2-3: For emergency services for which an interruption to electrical power supply is unacceptable, means of transitional electrical power supply should be provided with sufficient capacity and duration (a minimum time of 30 minutes).

EP 2-4: Reliable and quick starting arrangement for electrical power supply for emergency services should be provided.

EP 2-5: Emergency services should be available in case of any single failure of the main electrical supply.

FR 3: Impact of incidents that are not originated from electrical systems should be limited. This will be accomplished by ensuring:

EP 3-1: Availability of emergency power supply in case of flooding of any one compartment should be maintained.

EP 3-2: Impact of heat, fire and mechanical or accidental damage should be minimized.

EP 3-3: Main and emergency cabling should be separated.

EP 3-4: Means to prevent spread of fire through cables and cable entries should be provided.

EP 3-5: Power supply to emergency services should be maintained in case of fire in any one compartment which contains a main source of electrical power.

EP 3-6: Risk of malfunction due to the impact of Electromagnetic Interference (EMI) should be minimized.

EP 3-7: Appropriate degree of ingress protection (IP Class) should be provided.

FR 4: Shock, fire and other hazards of electrical origin should be prevented. This will be accomplished by ensuring:

EP 4-1: Protection against sustained electrical overloads should be provided.

EP 4-2: Protection against short circuit should be provided.

EP 4-3: Means to prevent short circuit should be provided.

EP 4-4: Means to detect abnormal condition of emergency source of electrical power and distribution system should be provided.

EP 4-5: Means to protect against and isolate faulty circuit should be provided.

EP 4-6: Suitable arrangements for the safe installation, application and maintenance of energy storage devices should be provided.

EP 4-7: Means to prevent electrical leakage and earth fault should be provided.

EP 4-8: Means to detect earth fault should be provided.

EP 4-9: Means to prevent ignition of flammable or combustible materials should be provided.

EP 4-10: Means to prevent explosion should be provided.

EP 4-11: Means to prevent persons from contacting live electrical circuits should be provided.

EP 4-12: Appropriate signs for dangerous voltage warning purposes should be provided.

EP 4-13: Battery energy storage system for essential systems should be designed to recognized standards and, where appropriate, a battery management system should be provided.

FR 5: Adequate illumination for normal and emergency conditions should be provided and maintained. This will be accomplished by ensuring:

(Illumination for normal condition)

EP 5-1: Illumination with sufficient intensity (LUX) should be provided in all areas normally accessible by passengers and crew.

EP 5-2: Sufficient illumination intensity (LUX) with redundancy should be provided in all essential areas normally accessible by passengers and crew.

(Illumination for emergency condition)
EP 5-3: Sufficient illumination intensity (LUX) with redundancy should be provided in all essential locations on the ship for safe emergency operations.

EP 5-4: For passenger ships, illumination in cabins should be provided to indicate the exit for at least 30 minutes when power to normal cabin lighting is lost.

EP 5-5: Means to check the conditions of all lighting systems for emergency use should be provided.

EP 5-6: For ro-ro passenger ships, illumination for escape of passengers should be provided with independent power supply for at least three hours.

GOALS, FUNCTIONAL REQUIREMENTS AND EXPECTED PERFORMANCE CRITERIA FOR SOLAS CHAPTER II-1 (Part E) (ADDITIONAL REQUIREMENTS FOR PERIODICALLY UNATTENDED MACHINERY SPACES)

Goal: Ensure adequate design, construction and availability of machinery installations in periodically unattended machinery spaces so that the safety of the ship in expected operating conditions, including manoeuvring, is equivalent to that of a ship having continuously attended machinery spaces.

FR 1: Measures should be taken to ensure that the equipment is functioning in a reliable manner and that satisfactory arrangements are made for regular inspections and routine tests to ensure continuous reliable operation. This will be accomplished by ensuring:

EP 1-1: The systems and equipment for remote or automatic control of systems in periodically unattended machinery spaces should be adequately designed and installed.

EP 1-2: The systems and equipment for remote or automatic control of systems installed in periodically unattended machinery spaces should be tested and inspected regularly.

FR 2: The ship should be provided with documentary evidence of its fitness to operate with periodically unattended machinery spaces. This will be accomplished by ensuring:

EP 2-1: Documentary evidence of fitness of the system and equipment for periodically unattended machinery spaces should be provided.

FR 3: A fail-safe alarm system should be provided indicating any fault requiring attention. This will be accomplished by ensuring:

EP 3-1: Alarm systems should be adequately designed, constructed and installed.

EP 3-2: Machinery system faults should be detected and adequately informed to person in charge on board. Alarms should activate audible and visible signals in machinery control room, the location where lookout and conning function take place and places where engineers are on watch.

EP 3-3: Means to detect and alarm conditions that may result in crankcase fire or explosion should be provided.

FR 4: The propulsion machinery including manoeuvring capability should be adequately monitored and controlled from the navigation bridge, and the control should be indicated in the machinery control room. This will be accomplished by ensuring:

EP 4-1: Adequate monitoring and control of the propulsion system from the navigation bridge should be ensured.

EP 4-2: The monitoring and control system for periodically unattended machinery control room should be single failure tolerant.

EP 4-3: Local manual control of propulsion machinery should be provided in the event of failure of the remote-control system. The remote control of the propulsion machinery should be possible only from one location at a time, and at each location there should be an indicator showing which location is in control of the propulsion machinery.

EP 4-4: Means independent of navigating bridge control system should be provided for emergency stopping of propulsion machinery.

FR 5: The communication between navigation bridge and machinery control room should be ensured at all times. This will be accomplished by ensuring:

EP 5-1: Adequate communication means between the machinery control room, the navigation bridge, engineer's public rooms and engineer's cabins are provided.

FR 6: A safety system should be provided to ensure that serious malfunction in machinery or boiler operations initiates an alarm and automatic shutdown of that part of the plant. This will be accomplished by ensuring:

EP 6-1: The complete shutdown of the propulsion system should not be automatically activated except in cases which could lead to serious damage, complete breakdown, or explosion.

EP 6-2: Shutdown of the propulsion system should be controlled effectively, and results in continuity of safe operation of the ship.

EP 6-3: Automatic controls of valves should be designed to fail-safe in the event of a loss of power supply.

FR 7: Electric power should be provided to all essential components in order to ensure the integrity of power supply to those services required for propulsion and steering as well as the safety of the ship. This will be accomplished by ensuring:

EP 7-1: Special consideration should be given for system overloads and load shedding.

EP 7-2: Electric power system should be adequately designed, constructed and installed.

EP 7-3: Electric power system should provide adequate power to machineries including propulsion, essential auxiliaries and steering systems.

FR 8: Periodically unattended machinery spaces should be provided with adequate means for protection against flooding. This will be accomplished by the following:

EP 8-1: Bilge wells in periodically unattended machinery spaces should be provided with means to detect accumulation of liquids at normal angles of trim and heel with a visual and audible alarm on the navigation bridge and machinery control room.

EP 8-2: For a bilge pumping system having arrangement to start automatically, means should be provided to indicate that the influx of water is exceeding the pumping capacity.

EP 8-3: The control of any valves serving a sea inlet and discharge below waterline should be designed and arranged to remain accessible in case of excessive influx of water into unattended machinery space.

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