Guide for Nuclear Installation on Board of Marine Units

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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 Governments.

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 reinstatement. 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 the 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 part 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 certification 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 seaworthiness, 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 righ t 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 cl ass, 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 c lients 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 propert y 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, certificat es, 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 t o 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.

PREAMBLE

The purpose of this Guide is to provide some general requirements on nuclear installation on board of marine units and establish basic requirements independent of the particular technology of the reactor or the type of marine unit on which the nuclear installation will be foreseen.
For this reason, this Guide will be completed in the next future by other publications dealing with:

1. specific technologies such as Pressurized Water Reactors, Molten Salt Rector, Lead-Cooled Fast Reactor and so on, establishing goals and functional requirements to reach
2. specific types of ships, such as passenger ships and ro-ro passenger ships, in particular regarding their safe return to port capabilities.

The basic philosophy of this document is to provide a guidance for the arrangement and installation on board of nuclear installation with the aim of minimizing the risks to the unit, its crew and the environment in such a way that the safety, reliability and dependability of the nuclear installation is equivalent to that achieved with new and comparable conventional oil-fuelled main and auxiliary machinery.
This Guide addresses areas that need special consideration when nuclear installation is installed on board with specific reference to Hull, Stability, Fire Protection, Machinery, Electrical and automation systems.

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Section 1 - GENERAL

1. APPLICATION

1.1.
This Guide applies to marine units, such as Nuclear Ships and Floating Facilities (Units), having on board nuclear installation to produce power for their own needs or for delivery to third parties.

1.2.
This Guide highlights the safety issues connected to the nature of nuclear installation on board that could have harmful effect on crew, passengers, people on board in general, population and environment.

1.3.
This Guide recommends safety standards and criteria for Units having on board nuclear installation, their classification principles and procedure as well as design and testing requirements to be met to ensure safety.

1.4.
Safety standards and criteria, systems and arrangements alternative to those indicated in this Guide can be considered, provided that they meet an equivalent level of safety. The equivalence is to be demonstrated through documented comparative risk analysis to be submitted to the Society for review.

2. DEFINITIONS

2.1. General
For the purpose of this Guide, the following definitions have been adopted.

2.2. Heat transfer medium
Heat transfer medium is the medium used to transfer the heat generated by the nuclear energy and is depended on the technology adopted. The heat transfer medium, or coolant, removes heat from the nuclear reactor core, primary circuit, and transfers the heat to the secondary circuit.

2.3. Normal operation
Normal operation: radiation environment on board the Unit is within standard limits and the Unit and its heat transfer media supply systems are in normal operating conditions.

2.4. Minor faults
Faults not significantly impacting on Unit operation. Short-term stop of reactor may be required and minor deviations of radiation from standard limits may occur but without resulting in increasing the exposure of personnel on board beyond standard limits.

2.5. Major faults
Damages to Unit structures and or nuclear power equipment which affect safety of further Unit operations. Long-term shutdown of heat transfer media supply system and containment isolation may be required. Possible deviations of radiation on board the Unit from standard limits may occur but exposure of personnel on board is not beyond the specified limits.

2.6. Severe accidents
Severe damages which require activation of emergency cooling system and or containment operation, but which do not result in unacceptable radioactive emissions into environment. Radiation on board the ship/floating facility significantly deviates from permissible limits. Exposure of some persons on board is beyond the specified limits but does not exceed the double value of permissible dose as specified by applicable Radiation Safety Standards for the Personnel.

2.7. Passive components
Example of passive components are pipelines, vessels, heat exchangers, electric cables.

2.8. Equipment and systems single failure tolerant
Equipment and systems provided with appropriate (e.g. designed differently by operating principle) redundancy of components or subsystems, capable to operate independently and if required (depending on the extent of the single failure considered) located apart from each other.

2.9. Emergency electric system

Emergency electric system is a self-contained system, independent for its operation from the main electric system, consisting of emergency generators and emergency switchboards. It is intended to supply electric energy to emergency services and to those services essential for the safety of the nuclear installation, when the main sources of electrical power are not in operation.

2.10. Emergency electric energy sources

The emergency electric energy sources are electric generators intended to supply electric energy to emergency services and to those services essential for the safety of the nuclear installation when the main switchboard is not supplied.

2.11. Main electric system

The main electric system is a system consisting of main electric energy sources, stand-by energy sources and main switchboards intended to supply electric energy to all the Unit consumers, including services needed for the operation of nuclear installation.

2.12. Main electric energy sources

The main electric energy sources are sources of electric energy required to maintain normal operating condition of propulsion, safety and habitability conditions including operation of all auxiliary services of the nuclear installation, without recourse to the emergency source of electrical power.

2.13. Stand-by electric energy sources

The stand-by electric energy sources are electric generators independent of the nuclear installation to be used in cases of heat supply system failure or in other abnormal situations instead of main electric energy sources.

2.14. Uninterrupted power supply units

The uninterrupted power supply units are sources providing uninterrupted supply of electric energy to previously designated consumers when all the other electric energy sources are not in operation.

2.15. Biological shielding

Biological shielding includes special structures and structural components designed to protect biological organisms and environment against radioactive emissions, reducing them below the limits as specified in National or International Radiation Safety Standards. Biological shielding may be made of steel alloys, concrete, lead, polyethylene and others.

2.16. Unacceptable risk

Unacceptable risk is the design minimum probability of exposure of the crew, passengers, population and environment to ionizing radiation and radioactive contaminations exceeding the limits as specified in National or International Radiation Safety Standards.

2.17. Limited part of population

Limited part of population is population being in areas of possible radioactive emissions in case of severe accidents in the nuclear installation.

2.18. Physical Security – barrier

Physical barrier is a physical obstacle to prevent intrusion of unauthorized persons to controlled areas, nuclear materials, vulnerable points of nuclear plant.

2.19. Physical Security – facility

Physical security facility is a type of equipment to be used by designated personnel for detection of unauthorized actions, receipt of information on attempts and occurrence of such actions, notifications on attempts and occurrence of these actions, detection and suspension of unauthorized actions.

2.20. Physical Security – personnel

Physical Security personnel is personnel responsible for physical security on board as part of their duties.

2.21. Physical Security – control station

Physical security control station is designated space equipped with engineering facilities. This space is used for control, in full scope or in part, of physical security engineering facilities in normal and emergency situations by designated physical security personnel.

3. ENVIRONMENTAL CONDITIONS

3.1.
The states of the Units and their nuclear power installation are to be designed considering extreme environmental conditions in assumed operation area (hurricanes, tsunami, ice).

3.2.
Inertial forces affecting the Unit at a sea state are to be considered with regard to equipment safety class. When calculating inertial forces, six degrees of freedom are to be considered over the sea spectrum within the navigation/docking area. In general case, sea spectrum based on statistical data for the North Atlantic region may be used.

3.3.
Components and structures depending on their safety classes are to be capable of withstanding inertial expected forces depending on agreed sea spectrum acting for:

- 40 years in normal operative conditions
- 4 years in minor or major fault conditions
- 150 days in severe accident conditions

3.4.
For Units operating in restricted areas, the Society may accept design requirements other than those in [3.3].

4. DOCUMENTS TO BE SUBMITTED

4.1.
The documents listed in Tab 1 are to be submitted. They are to be regarded as additional in respect of those already required by the Tasneef Rules for Classification of Ships (hereinafter named “Tasneef Rules”). The list of documents requested is to be intended as guidance for the complete set of information to be submitted, rather than an actual list of titles. The Society reserves the right to request the submission of additional documents if it is deemed necessary for the evaluation of the system, equipment or components and of the particular nuclear technology adopted.

4.2.
In addition to the documentation listed in Tab 1, a Failure Mode and Effect Analysis (FMEA), carried out according to the Tasneef "Guide for Failure Mode and Effect Analysis" or other equivalent methods, and a Test Program, identifying the tests to be carried out in order to verify the assumptions and conclusions of the FMEA, may be requested, for information and review, for control and power systems necessary for the safe operation of the nuclear installation in normal and emergency conditions. The FMEA may be requested by the Society for other systems on a case-by-case basis, depending on their influence on the overall Unit safety.

4.3.
Where the Society carries out surveys relevant to fire protection statutory requirements on behalf of the flag Administration, the additional documents listed in Tab 2 are to be submitted.

4.4.
When an alteration or addition to an existing installation is proposed, updated plans are to be submitted for approval. As a minimum a technical specification, schematic diagrams and a proposed list of tests to be carried out onboard at the presence of the Tasneef Surveyor are to be included.

Table 1: Documents to be submitted

No.	I/A (1)	Documents to be submitted (2)	Notes
General			
1	I	Unit General Arrangement showing Nuclear Power Plant layout	Including controlled and supervised Areas
2	I	Plans of containment and shielding barrier	Including collision and grounding protection diagrams and biological shielding
3	I	Nuclear Power Plant Operating Manual	
4	I	General Information on Unit’s Nuclear Power Plant and its Safety	

5	I	List of equipment located in controlled areas	
6	A	Risk Assessment on main and auxiliary	
Structure			
6	A	Reactor compartment structural drawings	
7	A	Containment system structural drawings	Including calculation on biological shielding
8	I	Test procedure and list of instruments for containment system tightness test	
Machinery, electrical and automation system			
9	I	Documentation on heat transfer media supply system	
10	A	Diagrams of the heat transfer media supply systems and piping and relevant served systems	Including necessary calculations
11	I	Layout drawings for piping, piping joint, penetrations, containment and biological shielding	Showing bulkheads, decks and platforms
12	A	Diagram of the electrical supply for heat transfer media supply system consumers, automatic systems and radiation monitoring system	Including relevant circuit booklet
13	A	Automation system technical specification for heat transfer media supply system and turbine units	Including description of algorithms
14	I	List of remotely controlled equipment	Including the indication of Makers, type and approvals where applicable
15	A	Functional and schematic diagrams for automation pneumatic or hydraulic systems	
16	A	Technical specification and diagrams relevant to control management system for the emergency cooling operations	
17	A	Block and functional diagrams for heat transfer media supply alarm systems	
18	A	Block and functional diagrams for heat transfer media supply automation and remote control systems	
19	A	Block and functional diagrams for heat transfer media supply safety systems and for systems serving heat transfer media supply system	Including list of components, indication of Makers, type and approvals when applicable
20	I	Test procedure for dock testing and sea trials	
21	A/I	The drawings listed in Tasneef Rules Pt C, Ch 4, Sec 1, Tab 1	
22	A/I	The drawings listed in Table 1 of Tasneef Rules for Fire Protection, Detection and Extinction for either the Issue and Maintenance of SOLAS Certificate, or the Issue and Maintenance of Statutory Certificates other than SOLAS, as applicable.	

(1) A: to be submitted for approval I: to be submitted for information
(2) Plans are to be schematic and functional and to contain all information necessary for their correct interpretation and verification such as:

- service pressures
- capacity and head of pumps and compressors, if any
- materials and dimensions of piping and associated fittings
- volumes of protected spaces
- surface areas of protected zones for pressure water-spraying systems
- type, number and location of nozzles of extinguishing media for gas and pressure water-spraying systems.

All or part of the information may be provided, instead of on the above plans, in suitable operation manuals or in specifications of the systems.

Table 2: Additional documents to be submitted when the Society carries out surveys relevant to statutory requirements on behalf of the flag Administration

No.	I/A (1)	Documents to be submitted	Notes
Fire protection			
1	A	Reactor compartment structural fire protection drawings)	may be included into general fire protection drawings for the Unit
Unit Safety in respect of Radiation Danger			
2	I	Chart for radiation	within the Unit and on external Unit surfaces
3	I	Calculations relevant to biological shielding	
4	A	Block and detailed diagrams of radiation monitoring system	
5	I	General arrangement for radiation monitoring system	Including equipment lay-out
6	I	Procedures for decontamination	Applicable to spaces and equipment subject to radioactive contamination
(1) A: to be submitted for approval I: to be submitted for information			

5. GENERAL SAFETY REQUIREMENTS

5.1.
The following requirements are to be considered to ensure safety of Units having on board nuclear installation to produce power for their own needs or for power delivery to third parties and to protect their personnel, people and environment against radioactive danger.

5.2.
Radioactivity sources are to be surrounded by several sequential shielding barriers to minimize diffusion into environment of ionizing radiation and radioactive materials.

5.3.
To ensure protection against ionizing radiation appropriate biological shielding are to be provided, on board radiation areas are to be carefully identified, maximum distance from radiation sources is to be kept by personnel unless it is necessary and exposure time is to be reduced at a minimum.

5.4.
In addition to the above, individual means of protection are to be available, as well as appropriate instructions in the Unit manual to be followed in case of incidents.

5.5.
Single failure concept is applicable to the supply of the control and protection, safety and other related automation systems, as specified in these Guide, of the heat transfer systems.

5.6.
Main systems in use during normal operation are to be supplemented by special-purpose safety systems capable to start automatically upon accident.

5.7.
A risk assessment approach is to be adopted to verify that the safety level identified by this Guide is achieved. This is to be done through a detailed analysis, in all operating and emergency conditions, of the Unit systems affecting its safety, taking also into consideration the systems needed for the Unit specific purpose, evaluating for each system possible failure, its frequency and effects. Based on this evaluation, safety design concepts are to be adopted to minimize the final risk, assuming that the more severe effects may be permitted at less frequency.

5.8.
Structures, systems and equipment are to comply with classification requirements based on their importance for the Unit safety.

5.9.
Under normal operative conditions, all shielding barriers against radioactive materials are to be operational. Heat transfer media supply systems are not to be operated at power if design safety limits of shielding barriers or their safety arrangements are beyond those specified in the detailed design of the Unit, according to safety operative conditions.

5.10.
To ensure that people's exposure to radiation and environmental contamination are as low as possible, the Unit is to be provided with for proper shielding from radiation sources and means to reduce at the minimum possible level the dissemination of radioactive materials.

5.11.
Fuel claddings of the reactor core, being the first shielding barrier between nuclear fuel and environment, and the primary heat transfer media circuit, being the second shielding barrier, are to be properly designed, constructed, tested and maintained.

5.12.
Containment, being the third barrier, is to be designed, constructed, tested and maintained in order to prevent accidental release and leakages of radioactive materials.

5.13.
The Unit is to be provided with means for effective removal of residual heat from the reactor core and with means for a safe and reliable control of the reactor, including safety systems to bring the reactor into a safe state (e.g. switching the reactor to subcritical state, maintaining it in this state for the required time).

5.14.
Residual heat is to be removed from the reactor core by the coolant that is to be supplied to the core in normal and emergency conditions. Power supply to the cooling systems is to be ensured in all normal and emergency conditions, whatever configuration of the electrical network is adopted during operations. When it is required to bring the reactor into a safe state, this is to be achieved without exceeding the specified design limits for the core. Radioactivity levels are to be properly and continuously monitored.

5.15.
To ensure proper operation of the safety functions described in [5.13], [5.14] and taking into consideration the analysed failure, accidents and their effects, dedicated safety systems are to be provided, independent from other control and normal operation support systems.

5.16.
Minor faults, major damage and severe accidents are to be considered during the design process. Safety systems are to be designed, constructed, tested and maintained to properly respond despite any system component single failure to any initial event that could lead to minor faults or major damage or severe accidents. Consequently, these safety systems are to be self-monitoring and single failure tolerant. This is to be considered when evaluating the fit for purpose characteristics of these safety systems.

5.17.
In the analysis of the related risks, the initial event (together with any other failures resulting directly from the initial event that could lead to minor faults, major damage and severe accidents) is combined with a failure in one component of safety system. Two or more simultaneously independent failures in the safety system are not required to be considered.

5.18.
A human error is to be considered as initial event or as single failure.

5.19.
In general, and unless required by the results of the risk analysis, failures in properly designed, manufactured, tested and installed passive components (such as pipelines, vessels, heat exchangers, electric cables) are not required to be considered.

Section 2 – HULL

1. GENERAL

1.1
The hull structures of nuclear Ships are to follow all applicable requirements in Tasneef Rules and, in addition, those in this chapter.

1.2
The hull structures of nuclear Floating units are to follow all applicable requirements in Tasneef Rules for offshore unites and, in addition, those in this chapter.

1.3
Structures designed to withstand collision, grounding and stranding events are to be approved and surveyed by the Society.

1.4
Structures designed to act as containment and shielding barriers are to be approved and surveyed by the Society.

2. MATERIALS

2.1
Structural Steel to be used for building hull components and containment barriers are to be at least of grade D or DH (for thicknesses below 12,5 mm) and grade E or EH (for thicknesses above 12,5 mm), see Tasneef Rules Pt D, Ch 2, Sec 1.

2.1
The use of materials other than Steel is in general not allowed and will be considered on a case-by-case basis.

3. GLOBAL STRENGTH IN INTACT CONDITION

3.1
The hull is to be designed in a way to avoid abrupt changes in the cross section torsional characteristics, throughout the structural protection area (see [5]).

3.2
The scantlings in the region between the structural protection area and the remaining portions of the hull are to be suitably and smoothly tapered. Longitudinal girders in way of the structurally protected compartments are to be continuous and extend sufficiently to ensure a robust overall performance of the global structure, to the satisfaction of the Society.

3.3
Whatever its rule length, the Unit should comply with the requirements of Tasneef Rules Pt B, Ch 6, Sec 3, Ultimate Strength Check.

4. RESIDUAL GLOBAL STRENGTH

4.1.
The residual longitudinal strength of the Unit is to remain above rules requirements even in case of design collision damage or design grounding or stranding occurrence.

4.2.
The residual longitudinal strength calculations is to consider also the hull girder torque generated by the design collision or design grounding or stranding.

4.3.
Residual longitudinal strength calculations is to be submitted to the Society for information.

5. LOCAL STRENGTH OF STRUCTURES CLOSE TO THE REACTOR COMPARTMENT

5.1.
A structural protection area is to be provided in way of the reactor compartment to prevent damage to the shielding barriers and to the containment.

5.2.
If the Unit has helidecks over or close to the reactor compartment and auxiliary facilities for storing cores and fuel assemblies, the structural protection area is to be extended to account for the event of a helicopter crash and not only of the design collision and design grounding or stranding.

5.3.
The design collision and design grounding or stranding is to be decided by the designer based on the outcome of a risk analysis carried out according to Tasneef GUI.015 - Guide for Risk Analyses and approved by the Society.

5.4.
The calculation procedure for evaluating the scantlings of the structure in the structural protection area should be also based on FEM direct calculations considering the material and geometric non-linear behaviour to simulate the most severe collision and grounding or stranding design scenarios.

5.5.
The Society may require experimental checks of the nonlinear FEM calculation results by physical modelling (mock up), where deemed necessary.

5.6.
The extension of the structural protection area forward and aft of traverse bulkheads of the reactor compartment and the used fuel storage compartment are to be evaluated by the Designer considering the FEM direct calculation results but in no case the extension is to be less than 20% of the distance between the transverse bulkheads forward and 20% aft.

5.7.
The double bottom and the foundations in the reactor compartment are to be reinforced to the satisfaction of the Society, to ensure protection of the reactor, its safety systems and core storage facilities against damages due to grounding or stranding.

5.8.
The bottom of the Unit is to be at least B/15 or 2 m (whichever is more) apart from the lowest point of the shielding barrier.

5.9.
The height of the double bottom in way of the engine compartment is to be sufficient to comply with the damage dimensions used for damaged stability calculations.

6. CONTAINMENT

6.1.
The containment is to be designed as to reduce release of radioactive materials into the environment both in normal operations and in the foreseen emergency conditions. For the permissible leakage values, see [6.10].

6.2.
The containment may be designed as:
a) a reinforced leak tight hull structure of the Unit or
b) an independent reinforced leak tight containment which is not integral with the hull.

6.3.
If the Unit is equipped with several steam supply systems, each of these is to be enclosed in a separate containment.

6.4.
In addition to the requirements in Pt B of Ship or Offshore Units' Rules, the containment is to be designed also considering the following loads/scenarios:

a) static heel of max. 30°, roll angles of max. 45° and trim of max. 10°
b) the inner pressure due to the emergency release of coolant caused by the breakup of the primary circuit
c) the constant and variable thermal loads.

6.5.
The yield and tensile stresses of structural steel used for the design of the containment system is to be evaluated at the maximum temperature corresponding to the case of the release of coolant caused by the breakup of the primary circuit.

6.6.
In case of an approved system for reducing the inner pressure due to emergency release of coolant, the maximum pressure which may occur in the containment regarding such a system can be taken as the applicable design pressure, otherwise the unreduced inner pressure is to be taken as the applicable design pressure for the containment.

6.7.
The containment system is to continue to be operational also when loaded from outside due to the action of external pressure e.g. in case of flooding of the Unit.

6.8.
All means of closure, doors, stop valves/shut-off valves, cable passages sealing arrangements and other components included into the boundary of the containment are to be tested under surveillance of the Society and according to approved procedures.

6.9.
The tightness standards for tight circuit components are to be established considering the design pressure and the permissible leakage values (see [6.10]). These tightness standards are to be specified in the tight circuit components drawings.

6.10.
The permissible relative leakage rate value for the containment at design pressure is to be established by the designer to ensure environmental conditions as per applicable Radiation Safety Standards.

6.11.
The assembled containment along with its means of closure is to be subject to a structural hydraulic test at a test pressure of 110% of the design pressure, furtherly multiplied by the ratio of the containment material yield stress value at test temperature to the yield stress value at maximum temperature.

6.12.
If the structural hydraulic test is found to be practically unfeasible because the actual hydrostatic pressure may risk exceeding the calculated test pressure with the possibility to damage the structure, the equipment, or their foundations, then the structural hydraulic test may be replaced by a structural hydropneumatic test, according to Tasneef Rules Pt B, Ch 12, Sec 3, at the same test pressure as described in [6.11].

6.13.
The containment boundary structure is to be tested when the airtight circuit is completely installed.

6.14.
The containment airtightness (relative leakage rate) is to be measured with a leak test at pressure equal to the design pressure. In case of hydropneumatic structural test, the leak test may be combined with the structural test provided that, during the airtightness (relative leakage rate) measurements, the applied pressure is the design pressure and not the test pressure.

6.15.
The procedures for measuring and calculating the relative leakage rate as well as the Calibration Certificate for the measurement devices are to be approved by the Society.

6.16.
The proposed experimental procedures should be able to resolve differential relative leakage rates of 1%/day or less and have a confidence interval of at least 95%. The measurements should last a sufficiently long time

to obtain results that are stable and consistent at the required confidence level. The design measurement error on the relative leakage rate is in any case be less than 20% of the permissible relative leakage rate.

6.17.
The containment airtightness check is successfully complied with if the measured relative leakage rate based on directly measured pressure and temperature plus the design measurement error of relative leakage rate is found to be less than or equal to the permissible relative leakage rate.

6.18.
In the Unit operational life, during class renewal surveys and after reactor core reloading, is allowed only a maximum of 15% increase in the relative leakage rate compared to the values obtained and recorded in the tests carried out during the construction/commissioning.

7. STRUCTURES OF THE SHIELDING BARRIER

7.1.
The containment and significant radioactive sources related to steam supply system is to be surrounded by a shielding barrier made of longitudinal and transverse bulkheads, decks, and similar structures.

7.2.
The boundaries of the containment and of the shielding barrier are to be completely separate and independent. The containment and shielding barrier functionalities are not to be combined in a single boundary, not even partially.

7.3.
The boundary of the shielding barrier is to be built using steel and is to be designed for being watertight, see Tasneef Rules Pt B, Ch 2 and Ch 4.

7.4.
The longitudinal bulkheads designed to be the side walls of the shielding barrier are to be at least $B/5$ or 11,5 m (whichever is less) apart from outer shell side unless the outcome of the design collision calculations specify a greater distance for collision protection.

7.5.
The shielding barrier is to be tested for watertightness by “Leak testing” according to the test procedures, standards and requirements described in Tasneef Rules Pt B, Ch 12, Sec 3.

7.6.
In case the design pressure in the spaces enclosed by the shielding barrier is equal or above the atmospheric pressure, the Leak test is to be repeated at each Class renewal survey during the operational life of the Unit.

7.7.
The design of the shielding barrier structures should not impair the possibility to decontaminate them, should this be necessary.

8. DESIGN OF THE REACTOR FOUNDATIONS, FASTENERS OF CONTAINMENT AND BIOLOGICAL SHIELDING

8.1.
The foundations structures of the reactor and the fasteners and connectors of the containment to the rest of the hull is to be designed to withstand the static and dynamic loads appropriate for the design environmental conditions according to either the Tasneef Rules for ships or Rules for offshore units, respectively.

8.2.
The foundations structures are to be designed to support the reactor and primary systems as well as the containment also in case of transverse and longitudinal inclinations of the Unit up to and including capsizing.

8.3.
In addition to static and dynamic loads, the foundations structures are to be designed to maintain their purpose also in case of concurrent constant or time varying thermal loads.

8.4.
Provisions such as, for example, manholes, ladders, and passageways, are to be foreseen as far as possible to allow access for inspection to the foundation structures.

8.5.
The fasteners and connectors of the biological shielding are to be designed to withstand the static and dynamic loads and the hull deformations appropriate for the design environmental conditions according to either the Tasneef Rules for ships or Rules for offshore units, respectively.

8.6.
The fasteners and connectors of the biological shielding are to be designed to withstand the design pressure coming from the containment.

8.7.
The structures of the reactor foundations are to be designed in a way that, should it be necessary, nuclear decontamination would be possible.

9. MINIMUM WELD SCANTLINGS AND ADDITIONAL NON DESTRICTIVE TESTING

9.1.
When selecting design thickness of fillet welds of structures in structural protection area or structurally protected compartments as per Tasneef Rules Pt B, Ch 12, Sec 1, the welding factor w_F are be taken to be at least 0,45.

9.2.
The welds between the members of the structures that are part to of the structurally protected compartments and are jointed to the outer shell plating are to be of full penetration type.

9.3.
100% of the welded joints that are part of the containment structure are to be subject to non-destructive testing during construction according to Tasneef Rules Pt D.

9.4.
20% of welded joints of hull structures in way of the reactor compartment and structural protection area is to be subject to non-destructive testing during construction according to Tasneef Rules Pt D.

9.5.
In the controlled area, only double continuous welds are allowed, meaning that intermittent and/or staggered welds are to be avoided.

Section 3 – STABILITY AND COMPARTMENTATION

1. General

1.1. Purpose and application

The stability of the Unit is to comply with:

a) the applicable requirements of Tasneef Rules, Pt B, Ch 3, Sec 2, for the loading conditions defined in Pt B, Ch. 3, App. 2, and
b) where the Society carries out surveys to damage stability statutory requirements on behalf of the flag Administration, with the applicable requirements of SOLAS Chapter II-1.

Section 4 – REQUIREMENTS FOR FIRE PROTECTION, DETECTION AND EXTINCTION

1. General

1.1. Purpose and application

The fire protection of the Unit is to comply with:

a) the applicable requirements of Tasneef Rules Pt C, Ch 4, Sec 1, and
b) where the Society carries out surveys to fire protection statutory requirements on behalf of the flag Administration, with the applicable requirements of SOLAS Chapter VIII on Nuclear Ships, and
c) the requirements of this Section

2. Documentation to be submitted

The interested party is to submit to the Society the technical documents listed in Tab 1.

3. Definitions

3.1. General

In addition to those provided in Tasneef Rules Pt C, Ch 4, Sec 1, [3] the following definitions apply.

3.2. Reactor compartment

The space or compartment containing the nuclear reactor, the systems and equipment used for its operation, prevention and containment to reduce the effects in case of incidents.

3.3. Shielding barriers

The structural barrier, or sequential barriers, provided by the Unit's structure surrounding the radioactivity source to reduce the dissemination of ionizing radiation and radioactive materials into the environment.

3.4. Containment

A space or spaces used to contain a part of the system, designed to contain within permissible limits any emission of radiation from the system contained therein.

4. Structural Fire Protection

4.1.

To ensure protection in case of external fires or explosion, the compartment of the reactor is to be separated from the adjacent spaces by means of:

- cofferdams with a width of not less than 900 mm, or
- boundaries constructed and insulated in compliance with A-60 fire class to ensure protection against external fires.

Cofferdams may be avoided, or the fire resistance reduced to A-0, in case adjacent to the reactor compartment there are other cofferdams, spaces having little or no fire risk, open deck areas and void spaces.

4.2.

Within the reactor compartment and the spaces where is located the equipment for the safe operation of steam supply system, only non-combustible materials are allowed.

The use of combustible materials may be permitted as an exception when it is proved that non-combustible materials for the same purposes are unavailable. Such exception is to be specially considered by the Society on a "*case-by-case*" basis.

4.3.

Any space within the shielding barriers where combustible materials are used or spaces containing installations, where the use of combustible materials is required, are to be enclosed with class A-60 structures. The combustible materials mentioned above and in previous paragraph 4.2 do not include cables and paint materials for painting spaces.

Penetrations and devices used for the transit of pipelines and electric cables in the shielding barriers are to be capable to grant the properties of gas-tightness and the resistance to fire of the barrier on which they are fitted.

4.4.

The ducts and trunks used for the ventilation of the containment, the shielding barriers and spaces belonging to the controlled area, are to be constructed in compliance with A-60 fire class requirements:

a) for their whole length of the portion within the served spaces above, and
b) for a minimum length not less than that equivalent to the size of the duct or trunk cross section.

In case the ducts or trunks are provided with automatic fail-safe fire dampers, their construction may be reduced to A-0 fire class standard.

4.5.

Any tank located in the double bottom within the reactor compartment is not to be used to contain fuel and any combustible liquid.

Double bottom tanks containing fuel may be positioned forward or aft of the reactor compartment, provided that they are separated from the portion of the double bottom space of the reactor compartment by means of structural cofferdams in compliance with Tasneef Rules Pt B, Ch 2, Sec 2.

5. Suppression of fire – detection and alarm

5.1. Fixed fire detection and alarm

5.1.1.

A fixed automatic fire detection and alarm system is to be provided for all containments, shielding barriers, space or spaces related to the control of the nuclear power on board of the Unit and spaces within the controlled area.

5.1.2.

The following spaces and areas are to be protected by a fixed fire detection and alarm system:

a) space or spaces for the storage of any radioactive waste;
b) space or spaces for equipment and systems for the collecting and discharge of radioactive waste;
c) spaces for piping, valves and equipment of the primary and tertiary circuits;
d) stations for decontamination, decontamination spaces and spaces used for work with contaminated equipment and radioactive materials;
e) exhaust ventilation system spaces;
f) control stations for the control of contamination;
g) spaces containing equipment for the automation system;
h) spaces where electrical cables related to the system control and regulation are present;
i) corridors and lobbies for the transit of personnel in the controlled area.

5.1.3.

The protection is not required within containments, shielding barriers and spaces within the controlled area having little or no fire risk, such as: void spaces, spaces for tanks for radioactive liquid waste, decontamination showers, etc.

5.1.4.

Inside highly radioactive spaces, the use of “ionizing radiation” detectors type is to be avoided.

5.1.5.

The fixed automatic fire detection and alarm system within containments and shielding barriers is to be arranged as follows:

a) smoke detectors are to be used in service spaces, control stations, corridors and lobbies, within the shielding barriers;
b) thermal detectors are to be used in spaces containing the reactor plant control instruments, exhaust ventilation system spaces and any space where steam may be present;
c) to avoid false alarms, the operation temperature of thermal detectors is to be at least 20 °C higher the maximum air temperature of the protected space.

5.1.6.

The protection by means of a combined detection system (fire + smoke) is recommended for all cases where the dominating fire factor is uncertain.

5.2. Manual call points

5.2.1.

Manual call points are to be provided for all containments, shielding barriers and space or spaces related to the control of the nuclear power on board of the Unit.

5.2.2.

Manual call points are to be fitted at suitable locations within the following spaces and areas:

a) decontamination spaces and spaces used for work with contaminated equipment and radioactive materials;
b) corridors and lobbies for the transit of personnel in the controlled area.

5.2.3.
Fire detection equipment and manual call points used in spaces within the controlled areas are to have at least IP 55 protection degree.

6. Suppression of fire – fire-fighting

6.1. Fixed fire-fighting systems

6.1.1.
Spaces used for the assembly of new fuel and spaces used for the storage of irradiated fuel assemblies, are to be protected by means of a fixed self-contained fire-extinguishing system.
In addition, provision is to be made to supply extinguishing medium by the Unit fixed fire-extinguishing system.

6.1.2.
In general, water is not to be used within the containment, in spaces used for the assembly of new and irradiated fuel assemblies and in spaces where radioactive waste is stored.
Any extinguishing medium is not to result in increase of the effective neutron multiplication factor (i.e. not capable of giving spontaneous nuclear chain reaction).

6.1.3.
Control stations related to the nuclear power plant, are to be fitted with an automatic fixed spray-water fire-extinguishing systems of a type acceptable by the Society.
Special considerations may be provided, where water may damage essential equipment for the Unit and nuclear power system safety.

6.2. Fire-fighting appliances

6.2.1.
The following areas are to be equipped with CO2 portable fire-extinguishers:
a) containment spaces;
b) spaces of the central control station;
c) shielding barriers.

6.2.2.
The Unit is to carry additional Emergency Escape Breathing Devices (EEBD’s) in the quantity sufficient for members of the damage control team.
In addition, one EEBD for training purposes is to be provided, marked appropriately and stored separately from the operative ones.

Section 5 – MACHINERY INSTALLATIONS

1. GENERAL

1.1.
Machinery installation are to comply with the requirements of Tasneef Rules Pt C, Ch 1, as applicable, and to the requirements of this Section.

1.2.
Units are to be capable of being started by power sources available on board.

1.3.
Marine Units, having on board Nuclear Installation, equipped with one reactor are to have a stand-by power source to provide movement and steerability, heat transfer media cooling in case of its failure as well as to provide normal habitable conditions, buoyancy, fire safety, Unit signals and communication, escape routes lighting and operation of boat winches.

1.4.
This stand-by power source:
.1 it is to be independent from the nuclear power installation and its cooling system;
.2 it to be placed outside the reactor compartment;
.3 it is to be ready to provide sufficient power for safe operation in harbour and maintain steerability at sea (up to wind force of Beaufort scale 6), under any normal loading conditions;
.4 it is to be ready when the Marine Units is in restricted waters or areas of intense navigation.

2. INCLINATION

2.1.
Main and auxiliary machinery are to remain operational under conditions specified in Tab 1.

Table 1: Inclination

No.	Conditions	Machinery and systems ensuring operation of heat transfer systems	Main and auxiliary machinery	Emergency machinery and equipment
1	Long-term heel (degrees)	30	15	22,5
2	Roll (degrees)	45	22,5	22,5
3	Long-term trim (degrees)	10	5	10
4	Pitch (degrees)	15	7	10
Note: For particular type of nuclear floating facility, different operability conditions may be agreed upon with the Society. The Society may agree on reduced requirements than those specified in column 3 if proper justifications are provided.				

3. HEAT TRANSFER SYSTEM COMPARTMENT

3.1.
Heat transfer system compartment is to be located so that the probability of damage to the heat transfer system is minimized including the case of collision, grounding and stranding.

3.2.
It is recommended that heat transfer system is located as far as possible close to the Unit centre line.

3.3.
Distance from shell plating to shielding barrier of heat transfer system is specified in Sec 2, [7.4] and height of double bottom in area of the reactor compartment is specified in Sec 2, [5.9].

3.4.
Heat transfer system and its components with radioactive substances are to be enclosed in containment.

3.5.
Passages of pipelines and electric cables through containment are to be minimized. These passages are to withstand conditions resulting in containment under normal operative conditions, minor fault conditions, major fault conditions and severe accident conditions.

3.6.
Layout and structure of these passages are to allow their inspections and tests.

3.7.
All pipelines connecting internal volume of the containment with shielding barrier compartments or with atmosphere are to be provided with shutoff valves.
These valves are to be
- located outside the containment and as close as possible to it.
- capable to automatically cut off the containment
- provided with remote control
- fail safe (e.g. containment cut-off means are to comply with single failure criterion).

3.8.
Containment is to be provided with facilities for automatic external and internal pressure balancing in case of flooding. Structure of these facilities are to be indicated in the structural drawing of the containment and approved by the Society.

3.9.
Special facilities are to be provided for periodic inspections and tests of containment in service to determine integral leakage.

3.10.
In addition to hatch for fuel loading, where necessary, special hatch is to be provided for personnel access to equipment in containment. This hatch is to be capable to maintain gas tightness of containment in normal operative conditions, minor fault conditions, major fault conditions and severe accident conditions. Containment is to be also provided in addition with escape manhole.

4. HEAT TRANSFER SYSTEM: ARRANGEMENT OF MACHINERY AND EQUIPMENT

4.1.
Machinery, equipment and components of the heat transfer system, which are relevant and essential for safety, are to be protected from internal and external emergencies.

4.2.
Components and systems operative normal in conditions, minor fault conditions, as well as systems and storage facilities containing radioactive elements and waste are to be located in such a way to be protected against grounding and collision.

4.3.
Shielding for machinery and equipment, which may be dangerous for steam supply system in case they are damaged and broken into fragments, are to be provided.

5. HEAT TRANSFER SYSTEM: CONTROL STATIONS

5.1.
Central control station for reactor is to be located in space protected against fires, explosions, flying fragments, radioactivity, etc., but as close to the reactor and machinery installation as possible.

5.2.
Central control stations are to be provided with at least two exits for people escape.

5.3.
Emergency cooling system control station is to be located in respect to the central control station at sufficient distance in order to avoid damages in case of fire or any other emergency in the central control station.

6. FUEL SYSTEMS OF STAND-BY AND EMERGENCY DIESEL GENERATORS

6.1.
Fuel systems are to be designed so that common failures will not cause the out of service of all generator sets.

6.2.
Service fuel tanks are to be located as close to diesel generators as possible.

6.3.
Stand-by and emergency diesel generators are to use the same fuel or compatible fuels. Fuel storage tanks and relevant piping systems are to be designed and arranged to permit fuels mutual transfer.

6.4.
Stand-by diesel generators are to have sufficient fuel to provide operations at full load considering the maximum expected Unit voyage.

6.5.
Fuel quantity for the emergency diesel generators is to provide operations for at least 30 days after any emergency state including severe accident conditions.

7. OTHER MACHINERY AND PIPING SYSTEMS

7.1.
Unless otherwise specified in the following paragraphs, machinery and piping systems, such as:
- controlled area bilge and draining systems
- compressed air and hydraulic service systems for heat transfer system
- containment pressure reducing systems
- ventilation

have to meet the requirements of Tasneef Rules Pt C, Ch 1 and Ch 4 and the mitigating measures resulting from a risk analysis to be conducted at the design stage.

7.2.
The pipelines outside the containment, which contain or might contain radioactive substances, are to be provided with double shut-off valves and leakage detectors.

7.3.
In the pipelines with diameter more than 15 mm, one of shut-off valves is to be provided with arrangements to be remotely operated and, when necessary, according to the risk analysis, actuated automatically.

7.4.
No connections are permitted between Unit's general systems and systems which contain or might contain radioactive substances.

7.5.
When these connections are necessary and unavoidable, they are to be fitted with double shut-off valves, and drainage is to be provided for the pipeline section between the valves.

7.6.
The systems which contain and carry radioactive media are to be fitted with glandless instruments and bellows sealed fittings.

8. BILGE SYSTEM FOR CONTROLLED AREA

8.1.
The controlled area bilge system is to be designed to correctly operate in normal conditions, minor fault conditions, major fault conditions and severe accident conditions, is to be provided with means capable to prevent emission of radioactive fluids and is to be independent of the Unit's bilge system.

8.2.
Compartments in controlled area are to be drained into special containers.

8.3.
The bilge system pipelines within the controlled area are to be made of seamless pipes of corrosion-resistant materials, with all connections welded.

8.4.
Pumps and pipelines are to be provided with biological protection, where necessary.

8.5.
The scuppers within the controlled area are to be provided of appropriate grating.

9. REACTOR SERVICE PNEUMATIC AND HYDRAULIC SYSTEMS

9.1.
Reactor services are understood to be services related to heat transfer system and equipment for reactor control and safety purposes.

9.2.
The pneumatic systems serving critical auxiliary equipment of the heat transfer system or to be used for reactor control purposes are to be supplied by air from two independent compressors, each of them capable of keeping the system full operational.

9.3.
Every compressed air system, operating as a part of the reactor safety system, is to include at least two separate air reservoirs, each of them having sufficient capacity for operating the safety systems as required.

9.4.
Compressed air is to be cleaned and dried and its temperature is to be maintained at values as specified by the pneumatic system designer.

9.5.
The above requirements are also applicable to pumps and hydro pneumatic accumulators and to hydraulic systems to be used for service of critical auxiliary equipment.

10. CONTAINMENT PRESSURE REDUCING SYSTEM

10.1.
In case the design foresees the actuation of the containment pressure reducing system in case of emergency release of coolant out of the primary circuit, it is to be capable of maintaining its normal operation also in case of failure of the main electric generators.

10.2.
The system is to remain permanently in stand by conditions, ready to start, and be capable of automatic actuation in addition to manual remote actuation, if the increase of pressure in containment is above the specified limit by the designer. If proper justification is provided, manual remote actuation only may be permitted.

10.3.
If sprinkler systems are used for reducing containment pressure, they are to be arranged to maintain pressure (e.g. by means of pumps and pressure tanks). Exception to the above may be given in case it is proven that the system can be actuated so quickly that the pressure in the containment does not reach critical values, taking into account the likelihood to have a single-failure in the system.

10.4.
When installation on board is completed, the pressure reducing system and its components are be tested.

10.5.
When in service, provision is to be made for periodical surveys and trials of the pressure reducing system.

10.6.
The pressure reducing system components (expansion tanks, bubbling chambers, etc.) may be located in spaces connected to the containment provided those spaces are similar to the containment structure as related to protection against emission of radioactive substances.

11. CONTROLLED AND SUPERVISED AREA VENTILATION SYSTEM

11.1.
The ventilation systems of controlled and supervised areas are to be independent, separated and isolated from each other and the rest of ventilation systems installed on board.

11.2.
Under pressure is to be maintained in the controlled areas where radioactive contaminations are present in normal operative conditions or minor fault conditions even when one entrance is open.

11.3.
Ventilation equipment for the controlled area are to be redundant, and the stand by fan is to be started automatically in case of failure of the one in operation.

11.4.
Directed air flow is to be established from spaces where probability of contamination is less into those spaces where probability of contamination is higher.

11.5.
The containment ventilation system structure is to be designed for both closed-circuit operation and open-circuit operation.

11.6.
The containment ventilation system is to be provided with automatic shutoff valves for quick closing air channels under minor fault conditions, major fault conditions and severe accident conditions.

11.7.
Ventilation output ducts from the containment are to be provided with radioactivity monitoring instruments and warning devices.

11.8.
In case of major faults and or severe accident conditions, the containment may be vented into the atmosphere but through filters capable to ensure the required rate of air cleaning.

11.9.
Air from the controlled area spaces are to be discharged through a dedicated mast.

11.10.
Layout for ventilation air intake for intern spaces is to be selected so as to prevent intake of discharged radioactive gases.

11.11.
Exhaust and intake ventilation units of the spaces where radioactive contaminations occur or might occur are to be located in gas tight enclosures.

Section 6 – ELECTRICAL INSTALLATIONS

1. GENERAL REQUIREMENTS

1.1.
Electrical installation on board of Units is to comply with the requirements of Tasneef Rules Pt C, Ch 2, as applicable, and to the requirements of this Section.

1.2.
Electric installation is to consist of the main, stand-by and emergency electric systems.

1.3.
The main electric system is to be provided with main and stand-by electric energy sources and main switchboards intended to supply electric energy to both nuclear installation auxiliaries, including the heat transfer systems, and all the other on board consumers.

1.4.
The capacity of the main energy sources is to be such that in the event of any one of them being stopped, it will still be possible to supply those services necessary to provide normal operational conditions of propulsion and safety, minimum comfortable conditions of habitability and all services needed for the operation of nuclear installation, without recourse to the emergency source of electrical power.

1.5.
The capacity of the stand-by energy sources is to be sufficient to supply electric energy to the consumers ensuring safety of nuclear installation and are to be capable to restore sufficient power for safety, minimum propulsion and comfortable conditions of habitability, without recourse to the emergency source of electrical power.

1.6.
Electric installation, with generators off, is to be capable of supplying electric energy to the systems required for disabling the reactor and keeping it in safe state for at least 30 days in normal operational conditions, minor fault conditions, major fault conditions including severe accident conditions, and considering a single failure of the electric installation in addition to the initial event which caused the abnormal operation.

1.7.
When starting up the reactor and shutting down the reactor, the safety control systems of the reactor are to be supplied with electric energy from at least two independent sources.

1.8.
The stand-by and emergency generators, in case one of them fails, are to be designed, installed and operated to supply electric energy to the consumers required for starting up the supply of the heat transfer systems from cooled (or hot stand-by) state and for maintaining minimal habitability conditions.

1.9.
The emergency generators may be used for starting up the heat transfer systems, if they produce enough power, and for supplying electric energy to the Unit emergency consumers.

1.10.
The main electric system is to be capable to supply the heat transfer system consumers and all Unit's essential consumers from two power stations in normal operational and transient modes.

1.11.
The provision is to be made for periodic tests of electric installation structure equipment which is critical for safety of the steam supply system and the whole Unit.

1.12.
Electric equipment of machinery and systems essential for safety of the heat transfer system are to be capable of operation under inclinations as per Sec 5, Tab 1.

1.13.
Power supply from uninterruptable power supply sources is to be provided for consumers needed to ensure safety actions on nuclear installation when main, stand-by and emergency power sources are not in operation (black out situation).

1.14.
Power supply from emergency diesel generators is to be provided for consumers which allow to be in power failure from the main and stand-by power sources for a period, determined by safety conditions and requiring power supply availability after immediate emergency protective actions have been taken on nuclear installation.

1.15.
Power supply from stand-by energy sources (stand-by generators) is to be provided for consumers which allow to be in power failure when switching off the main power sources and after emergency protective actions have been taken on nuclear installation, and for consumers providing safety services and minimum propulsion and minimum habitability conditions.

1.16.
Hull return distribution systems are not permitted.

2. MAIN ELECTRICAL SYSTEM

2.1.
Other design solutions, different or alternative to those described in the following paragraphs, will be considered acceptable on the basis of the result of a dedicated risk analysis aimed at demonstrating that they provide the same or higher degree of safety.

2.2.
Failure of a single component within any main generating set (including alternator and its drive engine, associated auxiliaries; etc), or within distribution devices of the main electric system is not to cause malfunctions or shutdown of the nuclear installation and or loss of the Unit minimum propulsion and maneuverability.

2.3.
Upon any single failure, provisions are to be foreseen for fast recovery of electric power needed for maintaining the Unit in normal operational condition and normal habitability conditions.

2.4.
In order to comply with the general principle already stated above, the main electric system is to be provided of at least two main generators, two stand-by generators and two main switchboards.

2.5.
At least two separate and functionally independent power stations are to be foreseen so that in normal operation and minor fault in one station, the other is not affected. Each station is to consist of main generator (generators), stand-by generator (generators) and main switchboard.

2.6.
Power supply to essential consumers for the safe operation of the nuclear installation and of the heat transfer system are to be provided from at least two power stations.

2.7.
Stand-by sources (hot stand-by) are be activated as fast as possible.

2.8.
The total capacity of the main generators of each power station is to be sufficient to supply all the essential services required for maintaining the Unit in normal operational conditions and normal habitability conditions.

2.9.
In case of black out on the main bars of any main switchboard, stand-by generators are to be automatically started and connected to the bars to take up load for a time necessary for safe operation of the heat transfer system.

2.10.
The design is to allow parallel operation of the stand-by generators with the main generators at least for a time necessary for load transfer.

2.11.
The total capacity of the stand-by and main generators, which remain operational, is to be sufficient to supply essential services required for maintaining the Unit in normal operational conditions and normal habitability conditions. Services which are not essential for the safety of the Unit may be disconnected.

2.12.
The total capacity of the stand-by generators, under abnormal conditions, is be sufficient to supply essential services providing safety, ensuring minimum habitability conditions, allowing return into a normal operational condition including start up and cooling of the heat transfer systems.

2.13.
Any single failure in controls and instrumentation systems located in the central control station consoles and panels is not to affect more than one power station.

2.14.
Power supplies for the heat transfer system consumers are to be provided from the main switchboards or from dedicated switchboards and from the emergency switchboard.

2.15.
The automation and monitoring systems supporting operation of the safety systems and radiation monitoring system are to be powered from the main and emergency switchboards. Power supply is to be normally from the main distribution system and automatically switched over to the emergency sources in case of loss of power from the main distribution system.

2.16.
In case the automation and monitoring systems supporting operation of the safety systems and radiation monitoring system or part of the systems needs to be continuously supplied, the systems or their relevant part are to be powered from the transitional source of emergency electrical power or equivalent source.

2.17.
The main switchboards are to be located in separate compartments (i.e. isolated from each other with watertight subdivisions and Class A-0 boundaries, or higher where required).

2.18.
The main generators of the power stations may be located in a common engine room compartment, provided that 2.14 requirement is complied with.

2.19.
Where the main generators are located in one common engine room compartment, the stand-by generators are to be located in a separate compartment.

3. EMERGENCY ELECTRICAL SYSTEM

3.1.
The emergency electrical system and the emergency generators are to be independent from the nuclear installation.

3.2.
The emergency electrical system is to include not less than two emergency generators and two emergency distribution system independent on each other. The design is not to allow synchronization of electric energy sources in emergency.

3.3.
Consumers for the heat transfer systems and essential auxiliaries of the nuclear installation are to be supplied by two separate emergency distribution systems with associated emergency generators. Emergency services required by Tasneef Rules Pt C, Ch 2, Sec 3, (or relevant parts for specific type of ships such as passenger and ro-ro passenger ships) are to be supplied by one emergency generator with an independent distribution system.

3.4.
Each emergency generator is to be connected to its associated emergency switchboard.

3.5.
The emergency switchboards are to be powered in normal conditions from every main switchboard.

3.6.
Each emergency generator is to be started automatically in case of
- black out of the relevant emergency switchboard
- activation of the reactor emergency protection system
- loss of voltage at the supply system of heat transfer system consumers.

3.7.
The emergency electrical system is to be capable of being loaded in a time as short as required by the maintenance of the reactor safety conditions.

3.8.
The capacity of the emergency source of electrical power is to be sufficient to supply, in addition to the requirements specified in Tasneef Rules Pt C, Ch 2, Sec 3 (or relevant parts for specific type of ships such as passenger and ro-ro passenger ships), system and components necessary to ensure the shut-down of the reactor and all the consumers performing the reactor safety functions.

3.9.
Measuring instruments for every emergency generator are to be installed both in the emergency switchboard and in the central control station.

4. UNINTERRUPTABLE POWER SUPPLY SOURCES

4.1.
At least two independent uninterruptable power supply sources are to be foreseen.

4.2.
In case of power failure from the main and emergency sources to the console of the heat transfer system or radiation monitoring systems and other instruments and indicators essential for safety of the Unit, it is to be supplied from an UPS as transient electric energy source. Switch over from main supply to emergency and further to transient source of electric energy is to be performed automatically.

4.3.
Monitoring systems and instrumentation measuring parameters of the heat transfer system, radiation monitoring systems and other instruments and indicators essential for safety of the Unit are to be supplied from both UPS for 30 minutes.

4.4.
UPSs as transient power supply sources may not be required if evidence is provided that the consumers specified in [4.2] have built-in uninterrupted power supply for 30 minutes complying with single failure principle under normal conditions, minor or major fault conditions and severe accidents.

4.5.
The UPSs are to be located and installed so that not more than one UPS fails in case normal operation, minor or major fault conditions and severe accidents.

4.6.
Batteries used as transient sources of electrical power for the supply of the heat transfer system are to be located below the bulkhead deck.

4.7.
Batteries are to be provided with their own battery charger, whose power is to be sufficient to fully charge completely discharged batteries in not more than 8 hours.

4.8.
A low battery energy indicator (non-critical) is to be fitted in the central control station.

5. LIGHTING SYSTEM

5.1. Main lighting system

5.1.1.

Spaces in controlled area which are important for safety of the heat transfer system are be provided with at least two main light distribution systems powered from dedicated switchboards connected to different main switchboards via separate feeders.

5.1.2.

The main lighting distributions of the spaces in controlled area are to be provided with remote enable/disable systems with appropriate indication in the central control station.

5.1.3.

Switches of the main lights of separate spaces or groups of spaces within the controlled area are to be installed outside these spaces.

5.1.4.

The degree of protection of lighting fittings within spaces in controlled areas are to be at least IP 55.

5.2. Emergency lighting system

The following spaces are to be fitted with emergency lighting:

1. central control station;
2. radiation monitoring station (if located separately);
3. reactor emergency cooling station;
4. dedicated switchboards of the heat transfer system (if available);
5. spaces to be attended by personnel within the controlled area and compartments important for safety of the heat transfer system;
6. storages places of new and wasted fuel assemblies.

6. INTERNAL COMMUNICATION

6.1.

Reliable communication between the central control station and spaces as mentioned below is to be provided also in case of black out of the main and emergency power sources:

- navigating bridge;
- central control station;
- radiation monitoring station (if located separately);
- reactor emergency cooling control station;
- main engine, main generator and stand-by generator local control positions;
- emergency generator rooms;
- spaces to be attended by personnel within the controlled area and compartments important for safety of the heat transfer system;
- storages places of new and wasted fuel assemblies.

7. SHORE SUPPLY

7.1.

A shore connection (or a connection for an external power supply) complying with the requirements of Tasneef Rules Pt C, Ch 2, Sec 3 is to be provided and capable to be connected to every main swithchboard.

8. SPECIAL REQUIREMENTS FOR CABLES IN CONTROLLED AREAS

8.1.

Number of cables passing through the containment and shielding barrier is to be minimized.

8.2.

Electric cables with outer metal screen are not permitted

8.3.

Cable routes are to be designed so as to

- be as short as possible

- so as to facilitate, in case of need, decontamination procedures (i.e. at appropriate distance from deck and bulkheads)

8.4.
Cable penetrations are not to impair the tightness and fire resistance properties of the relevant decks or bulkheads. Cable glands are to be fitted from outside the spaces in the controlled areas and are to be easily inspected and tested.

8.5.
Cables running through the containment system are to be provided with special gaskets or a special bulkhead connector.

8.6.
Depending on the arrangement of their terminations, cables may be required to have longitudinal tightness. Methods and standards for cable testing for longitudinal tightness will be agreed between the cable manufacturer and the Society.

8.7.
Cables transit through the containment may be permitted only in exceptional cases (e.g. when this space cannot be bypassed) and provided they are laid in steel tight pipes.

8.8.
Cables of safety systems are not to run together with the main power cables.

8.9.
Cables for duplicated safety system components and or supplying redundant systems are to be installed as far as possible at the opposite Unit sides, and where it is not possible in several different spaces separated by fire structures both within and outside the spaces in controlled areas.

8.10.
In addition to the properties required for a marine installation, those cables and electric equipment that are to be kept in operation after accidents have to withstand environmental factors (pressure, temperature, humidity, etc.) associated with those accidents.

8.11.
All the cables running from the transient power supply sources (if available) to the designated switchboards and going from the switchboards to consumers are to be separate and distant from each other and from cable routes of the main and emergency distribution systems, as far as possible.

8.12.
In case cables and wiring are connected to equipment to be dismantled in reloading the core they are to be clearly marked.

8.13.
Starters for the electric motors located within spaces of the controlled area are to be installed outside them. Only start buttons are allowed in that case.

9. ELECTRIC EQUIPMENT INSPECTIONS AND TESTS

9.1.
Electric installation design has to include facilities for testing the stand-by and emergency generators. The tests have to include checking of:
- automatic, remote and local start-up
- the start-up time and
- 100 % load take-up.

Speed regulators of the primary movers are to be tested in action as well.

9.2.
A procedure for periodical testing the transient power supply sources is to be agreed with the Society, available and implemented on board.

Section 7 – AUTOMATION SYSTEMS

1. GENERAL

1.1. Application

Automation systems on board of Unit are to comply with the requirements of Tasneef Rules Pt C, Ch 3, as applicable, and to the requirements of this Section.

1.2. Scope of technical supervision.

In addition to automation systems specified in Tasneef Rules Pt C, Ch 3, the following requirements are applicable to monitoring, control and safety systems relevant to heat transfer systems and other nuclear installation auxiliary and safety systems.

2. REQUIREMENTS

2.1.

Common sensors may be used in redundant automation systems for safety (i.e. protection), control, monitoring, alarm and indication functions if systems are of self-monitoring type in respect of their internal failures and, in case of any single failure, this will not affect proper operation of safety system (i.e. protection).

2.2.

The automation system is to be continuously powered so that short power losses will not not affect proper operation of safety functions (i.e. protection) and control functions (e.g. short power losses have not to cause false actuation).

2.3.

The automation system design documentation is to include the list of heat transfer system equipment, including monitored parameters, subject to safety system actions, and subject to control and monitoring from central control station.

2.4.

Each automation system loop is to be electrically separated and galvanically independent. A visual and acoustic alarm is to be activated in case of failure (e.g. loss of power to the complete system, loss of loop continuity, loop short circuit, loop earth failure).

2.5.

In addition to the automatic intervention, automation systems of heat transfer systems are to be provided with means for remote actuation of safety systems.

2.6.

Safety systems automatic intervention is to have priority over remote control on protection actuation.

2.7.

In case of integrated automation system, redundant systems a risk analysis (e.g. FMEA) may be required. Depending on the location of the system(s) on board, a risk assessment, studying consequences of loss of one single space and relevant mitigating actions, may be required.

3. INDICATION, ALARM, CONTROL AND SAFETY SYSTEMS

3.1.

The list of alarm, indication, control functions and safety intervention based on safety parameters of the heat transfer system is to be defined depending on the specific technology adopted.

3.2.

The list is to include pre-emergency and emergency values of the parameters relevant to the heat transfer system.

3.3.

Emergency parameters recording system and all other information from the Unit automation system, as deemed useful, are to be connected to the VDR or, in case the Unit is not required to have a VDR, to a system complying with the same VDR requirements.

Section 8 – RADIATION SAFETY

1. BIOLOGICAL SHILDING BARRIERS FOR RADIOLOGICAL PROTECTION

1.1.
All spaces in controlled areas where radioactive contamination may occur under normal operation are to be located inside the shielding barrier.

1.2.
Heat transfer system, storage facilities for radioactive waste and core fuel assemblies and other radioactive sources are to be provided with biological shielding to ensure radiation safety for all states, normal operation, minor and major faults, severe accident.

1.3.
Biological shielding is to be provided, directed towards the bottom of the Unit, to prevent adverse effects on sea water when reactor plants is operating at a rated power.

1.4.
Radiation levels below the bottom of the Unit, with the reactor stopped, are to be within the limits required for docking operations.

1.5.
The biological shielding is to be designed considering repair works, reactor core handling, replacing heat transfer system equipment, survey to the heat transfer system equipment with shielding dismantled to the minimum level.

1.6.
According to actual and potential radiation hazards as identified, the controlled and supervised areas are to be enclosed on board the Unit and contamination transfer into unrestricted area is to be prevented.

2. OTHER RADIOLOGIC PROTECTIONS

2.1.
In addition to the biological shielding, in order to reduce radiation exposure and minimize the relevant risks, it is required to provide and use individual protection means, maintain distance to radiation source and limit time of exposure.

2.2.
The radiation protection facilities are to be designed and used to prevent exposure of people on board or near the Unit to radiation/radioactive contamination in amounts above the appropriate radiation dose limits as specified by the applicable National or International Radiation Safety Standards under normal operation, minor and major faults and in case of reactor shutdown.

2.3.
The basic design radiation dose limit for people on board the Unit and limited part of population in case of severe accident is to be less than double maximum permissible dose as specified by applicable National or International Radiation Safety Standards for the Personnel.

2.4.
Spaces in controlled area are to have emergency escape route to the open deck.

3. DECONTAMINATION

3.1.
Decontamination facilities are to be provided for removing radioactive contaminations.

3.2.
Decontamination stations are to be positioned between the controlled area and adjacent compartments.

3.3.
Decontamination station are to be provided with clothes changing facilities, dose control facilities for people and overalls and washing equipment.

3.4.
In case of radioactive contamination, access to supervised area spaces is to be allowed through special purpose sanitary space. Warning sign are to be placed near the entrance to the controlled area and supervised area.

3.5.
Systems are to be provided to supply fresh air to pressure suits and helmets. Air is to be supplied by two independent ventilation units, one of which in the stand-by.

3.6.
The stand-by ventilation unit in para [3.4] is to be automatically started and maintained in operation in case of failure in the main ventilation unit.

3.7.
Material of structures, paint coatings of spaces in controlled areas and equipment where radioactive contaminations occur under normal operation and minor fault conditions are to be such to permit multiple decontamination procedures.

3.8.
Spaces in controlled areas where decontamination solutions and washing water may stagnate are to be, as far as possible, of simple configuration without recesses and projecting parts. Bulkhead stiffeners are be fitted from the side of less likely contaminated spaces. As far as possible, comers of hull structures are to be rounded.

3.9.
Foundations, machinery and equipment fixing points in spaces within the controlled areas where radioactive contaminations occur under normal and minor fault conditions are to be designed to ensure access to all surfaces of foundations and relevant attachments for decontamination. Foundation spaces inaccessible for decontamination are to be sealed.

3.10.
Machinery and equipment not suitable for decontamination are to be easily replaceable and arrangements for covering these machinery and equipment during operation or general decontamination of spaces are to be foreseen.

3.11.
The structure of ladders, flooring and catwalks are to be such as to enable decontamination.

4. SPACES IN CONTROLLED AREAS

4.1.
Spaces in controlled areas, where radioactive contaminations may occur, are to be arranged to be protected in case of collision and, as far as practicable, in a single block. They are to be provided with the shortest possible route for equipment, materials and radioactive waste transportation. This will facilitate maintenance of machinery and equipment.

4.2.
Spaces in controlled areas on decks are to have an exit to cargo lift trunk.

4.3.
Spaces in controlled areas, where more fittings are located and lift/trunk is likely to be used, are to have direct exit/entrance from lift/trunk, as far as possible.

4.4.
Spaces in controlled areas are to be free equipment, machinery and devices which require frequent or continuous supervision and maintenance.

4.5.
The scuppers in spaces within controlled areas are to be provided with shut-off valves and have to permit the water to be completely drained from spaces. Decks in these spaces are to be inclined towards the scuppers.

4.6.
Compartments intended for handling radioactive substances, fluids, contaminated machinery and materials are to be fitted with exhaust ventilation in the vicinity of workplaces.

4.7.
Pipelines and cable routes not related to equipment located in spaces within controlled areas and passing through are to be installed in special-purpose sealed ducts, trunk within these areas, and penetrations of these routes and pipelines through bulkheads enclosing the controlled areas are to be sealed.

4.8.
Layout of equipment, fittings and valves, relevant to pipelines and cable routes in [4.7] are to be arranged within the controlled area having special regard to their accessibility for maintenance, repair, inspection, decontamination and survey as well as application of protective coatings and covering.

5. RADIATION MONITORING

5.1.
Radiation situation is to be monitored on board under all states.

5.2.
Dedicated radiation monitoring systems are to be provided and have to comply with Tasneef Rules Pt C, Ch 2 and Pt C, Ch 3, and with the following requirement.

5.3.
The radiation monitoring systems are to be capable of recording levels of air and surface radiation, contamination and radioactivity of liquids.

5.4.
The radiation monitoring systems are to be designed for radiation process and radiation dose monitoring on board for all states: during normal operation, in case of minor or major fault and of severe accident.

5.5.
The radiation monitoring systems have to ensure the monitoring of various physical quantities depending on the reactor technology. The following list is given for reference:

- monitoring leak (loss of tightness) of fuel element claddings;
- monitoring radioactivity of primary coolant;
- monitoring radioactivity of the secondary and third fluids;
- monitoring radioactivity of fluids in radioactive waste storage facilities
- monitoring leakages flowing from primary to secondary and third circuits and to spaces;
- measuring intensity of alpha, beta and neutron radiation, volumetric activity of gases and aerosols in corresponding spaces of controlled areas;
- radiometric analysis of radioactive samples;
- indication on high ionizing radiation, contamination and fluid radioactivity;
- indication of open access doors to spaces in controlled areas and open emergency escape doors;
- output of signal for isolating the faulty steam generator.

5.6.
The ionizing radiation detecting units are to be redundant in spaces within the controlled areas and their degree of protection is to be at least IP67 for the radiation detecting sensors and IP23 for the rest of the equipment.

5.7.
The recording system is to be able to record and store various physical quantities depending on the reactor technology. The following list is given for reference:

- radiation doses for people involved in operations within the controlled area and supervised area;
- ionizing radiation levels on board;
- radioactive contamination levels within attended areas on board;

- amounts and activity of radioactive waste stored on board;
- activity of waste being discharged to shore facilities or special-purpose ships;
- volumetric radioactivity of primary coolant;
- data on pre-emergency situation change in radiation situation in case of accident.

5.8.
The radiation monitoring systems is to be provided with a dedicated console.

5.9.
The console is to be equipped with indicators for monitoring any increase in radiation level, e.g. data on radiation levels within controlled and supervised areas, air radioactivity within the containment, concentrations of radioactive gas and aerosols being released into environment and so on.

5.10.
Sufficient portable means of radiation dose monitoring for operation under normal and emergency conditions are to be available on board. This equipment is to include dosimeters for alpha, beta and neutron radiation, air sample activity and contamination meters.

5.11.
Sufficient number of individual dosimeters for all people on board are to be available on board to cover the needs in normal operative conditions, minor fault conditions, major fault conditions and sever accident conditions.

5.12.
In addition to the devices specified in [5.10] and [5.11], the Unit may be equipped with laboratory instruments for analysing radioactive samples.

6. HANDLING RADIOACTIVE WASTE – GENERAL

6.1.
The design of the nuclear installation and the arrangement of the Unit have to ensure safety of crew and passengers and environmentally friendly collection, storage and treatment of radioactive waste before this radioactive waste is further discharged from the Unit.

6.2.
The design of the nuclear installation ad of its heat transfer system have to ensure the minimum formation of radioactive waste to the extent practicable, including arrangements for monitoring and handling of solid, liquid and gaseous radioactive waste being formed during normal operation to minimize its harmful effects on crew members, passengers, environment and Unit.

6.3.
Design of and operation with radioactive waste treatment and storage arrangements have to take into account at least:

- permissible radioactive levels
- requirement for radioactive leakage detection
- biological shielding
- usage of cooling system
- possible corrosive effects of some radioactive gases and liquids on materials of containers, pipelines, equipment and fittings
- possible formation of radioactive gases
- measures to be taken to prevent combustible gas explosions
- measures to be taken to reduce effects of possible combustible gas explosions
- capacity of radioactive waste storage facilities
- preventive measures for radioactive waste discharge from storage facilities into environment and spaces of the Unit.

6.4.
Waste treatment and storage equipment are to be designed, manufactured, operated and tested according to documented criteria and information on safety. These criteria have to ensure subdivision of waste according to their composition and volumetric radioactivity.

6.5.
Radioactive materials with major impact on individual radiation doses is to be arranged within the shielding barrier.

6.6.
The amount of radioactive gas being released into the atmosphere under normal operation, minor and major faults conditions is not to result in radiation dose for passengers, crew or limited part of population above the limits as specified in the National or International Radiation Safety Standards.

6.7.
Radiation and Sanitary Requirements, as established by National or International Radiation Safety Standards, are to be complied with when discharging ashore solid and liquid radioactive waste.

6.8.
Materials and alloys of containers and pipelines with fittings are to be corrosion-resistant and intended for multiple decontamination. These material and alloy characteristics are to be documented.

6.9.
Pipelines intended for radioactive fluid transfer systems are to be made of seamless electro polished pipes. Welded joints are required except that, flanges are permitted only where pipelines are connected to the equipment (filters, pumps, separators, tanks).

6.10.
Where necessary, depending on their location, pumps, pipelines and fittings are to be provided with biological shielding.

6.11.
The distance between piping and systems are to be as such to ensure their proper maintenance and survey.

6.12.
The designer has to establish requirements relevant to the quality of external surfaces of structures and equipment located in spaces within controlled and supervised areas. However the interior surface of radiation safety system containers exposed to radioactive fluid and not to be painted is to have roughness not more than Ra = 6,3 µm.

6.13.
The foundations and fasteners of radiation safety system equipment are to prevent its displacement in case of variation in Unit inclination up to and including capsizing.

6.14.
Strength of equipment and radiation safety system is to be evaluated according to Sec 1, [3.3] in minor or major fault conditions.

7. HANDLING SOLID RADIOACTIVE WASTE

7.1.
Solid radioactive waste is depending on the reactor technology but includes also dirty tools, laboratory kits, etc.

7.2.
Solid radioactive waste is to be stored and transported in special-purpose containers.

7.3.
Special considerations are to be given to the possibility that the storage of solid radioactive waste could result in possible concentration and formation of gases and liquids.

8. HANDLING LIQUID RADIOACTIVE WASTE

8.1.
Waste are classified according to their activity and with regard to physical and chemical properties, if required. Liquid radioactive waste are classified into low, medium and high radioactivity waste as specified in the National or International Radiation Safety Standards.

8.2.
Liquid radioactive waste which could be generated during normal operation or in case of minor fault is to be collected on board into enclosed containers or tanks located in spaces within the controlled areas.

8.3.
Two separate pipelines are to be provided for the transfer on shore or on a special purpose ship of the liquid radioactive waste from treatment and storage facilities. One pipeline is to be dedicated to the transfer of medium-radioactivity liquid radioactive waste; the other one to the transfer of low-radioactivity liquid radioactive waste.

8.4.
Medium- and low-radioactivity liquid radioactive waste are to be stored in separate spaces.

8.5.
Liquid radioactive waste discharge pipelines are to be fitted with means to be remotely isolated from central control station and from discharge station.

8.6.
Damages to pipelines are not to result in spontaneous emptying of relevant containers and tanks due to liquid ejection by siphon effect or by gravity.

8.7.
Liquid radioactive waste collection and storage containers are to be free-standing, externally framed, inclined towards the drain hole, provided with means for remote measurements of liquid radioactive waste levels, provided with appropriate biological shielding and designed considering para [6.12].

8.8.
Materials and alloy of containers for storing medium-radioactivity liquid radioactive waste have to comply with [6.8].

8.9.
At least two containers are to be available on board.

8.10.
Containers for storing low-radioactivity liquid radioactive waste may be made of ordinary structural materials with anti-corrosion coatings applied. Unit's structures and spaces may be used as a biological shielding.

8.11.
Overflow of high-radioactivity liquid waste is not to be conveyed to containers for low-radioactivity liquid waste.

8.12.
Containers intended for liquid radioactive waste collection and storage are to be designed and constructed to allow for regular removal of contamination.

8.13.
Liquid radioactive waste overboard discharge is not permitted, unless it can be demonstrated that contamination of the Unit and environment is excluded.

8.14.
Prior to starting operations, removable pipelines are to be subject to leak tests. Trays with water draining into liquid radioactive waste collection system are to be provided at connection points of removable pipelines.

8.15.
In case of unpredicted disconnection of removable pipelines, arrangements for automatic discharge stop are to be provided for immediate piping shut-off and these arrangements are to be capable of automatic actuation upon the low pressure signal.

8.16.
Removable pipelines are to be capable of being decontaminated, washed and completely drained without being disconnected from the liquid radioactive waste discharge pipeline.

8.17.
Air pipes made of corrosion resistant materials are to be provided for containers storing liquid radioactive waste and are to be connected each other and to containers/tanks by welding.

8.18.
Air pipes of liquid radioactive waste storage containers or tanks working under hydrostatic pressure are to be led from the top of container or tank to spaces where they are located.

8.19.
Air pipes from low radioactivity liquid radioactive waste storage containers or tanks may be led to the ventilation mast through dedicated ventilation system.

8.20.
Water injection from liquid radioactive waste containers to vent ducts is not permitted.

8.21.
An overflow system for collection and discharge of liquid radioactive waste, in addition to air pipes, is to be provided for liquid radioactive waste storage containers under hydrostatic pressure.

8.22.
Containers continuously or regularly operating under internal pressure are to be designed, constructed and tested according to Tasneef Rules Pt C, Ch 1, Sec 3.

8.23.
Fittings of liquid radioactive waste storage and discharge systems are to be of bellows type with branches to be welded and fitted with local position indicators and indication of extreme positions.

8.24.
Liquid radioactive waste discharge system is to be provided with:
- at least two pumps for liquid radioactive waste transfer, corrosion resistant and leak tight,
- arrangements for preventing pressure increase above design values.

8.25.
Where local control is fitted, liquid radioactive waste pipelines and fittings are to be provided with biological shielding.

8.26.
Bilge wells and bilge alarms are to be provided in all space which are likely to be contaminated with liquid radioactive substances.

9. HANDLING GASEOUS RADIOACTIVE WASTE

9.1.
All escape routes for gaseous radioactive waste are to be provided with radioactivity monitoring equipment.

9.2.
Gaseous radioactive waste are to be compressed and stored in pressure vessels (cylinders) and appropriate pipelines meeting the requirements stated in this guide.

9.3.
A risk analysis is to be conducted in relation to the radioactivity risks consequent to the depressurization of the cylinder(s) containing gaseous radioactive waste.

9.4.
Radioactive gases and aerosols may be discharged into environment only through pipelines and vent ducts meeting tightness requirements and fitted with radioactivity filtering and monitoring equipment. Discharge lines are to be fitted with automatic, remote and local shutdown means to prevent uncontrolled discharge.

9.5.
The total volumes and radioactivity levels of aerosols and gases going to be discharged into the atmosphere are to be continuously and progressively monitored. These parameters are not to exceed the limits as specified in the National or International Radiation Safety Standards.

10. STORAGE FACILITIES FOR CORE FUEL ASSEMBLIES

10.1.
Depending on the reactor technology, it may be required to arrange on board storage facilities for new fuel assemblies and spent core fuel assemblies.

10.2.
Immediate and safe entrance and or escape of personnel from any space in the event of accidents (fire, flooding, etc) are not be prevented or conditioned by any measures taken to ensure physical security.

Section 9 – SECURITY

1. GENERAL

1.1.
Units are not to be operated without ensuring physical security of nuclear materials, nuclear plants, storage facilities for nuclear materials and radioactive waste.

1.2.
Immediate and safe entrance and or escape of personnel from any space in the event of accidents (fire, flooding, etc) are to be prevented or conditioned by any measures taken to ensure physical security, being them physical barriers (decks, bulkheads, doors, hatch covers) or engineering facilities of secured areas (obstructions, grating, reinforced doors).

1.3.
Technical facilities of physical security usually include the following main functional systems:
- intrusion protection and security alert systems;
- access monitoring and control systems;
- optoelectronic surveillance and situation assessment systems;
- communication and address systems (including wired and radio means);
- data protection system;
- power supply and lighting system.
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1.4.
Physical security system control stations are to be foreseen for the control engineering and technical facilities of physical security. The access to control stations is to be possible only by means of test and access control facilities.

1.5.
Signals and data are to be displayed at the operator consoles in visual and audible modes.

1.6.
Documents are to be provided at the design stage to classify secured and limited access areas, subdividing them into appropriate categories:
- secured areas are protected, internal or critical areas;
- protected areas include open areas of decks with restricted and controlled access;
- internal areas are areas at interior locations surrounded by physical barriers with restricted and controlled access;
- critical areas are areas at interior locations surrounded by physical barriers with continuously restricted and controlled access.

The critical areas are to be located within the interior areas and the interior areas are to be located within the protected area.

1.7.
Detection facilities, access monitoring and control means, surveillance and situation assessment arrangements are to be foreseen at all accesses to spaces of appropriate categories.

2. PHYSICAL BARRIERS AND ENGINEERING EQUIPMENT

2.1.
Physical barriers are to be in compliance with the Society's classification rules (regarding structure and fire protection) and in addition to the requirements of [2].

2.2.
Physical barriers are to be designed and installed with the aim of stalling or slowing down of unauthorized people. Provisions for opening doors from inside the secured space and for having emergency unlocking of doors or other locking devices from control station in case of accidents are to be provided.

2.3.
Secured areas are to be provided engineering equipment to prevent attempts of unauthorized access and carrying of prohibited objects.

2.4.
Arrangements for protection (e.g. against small arms and weapons) of personnel responsible for control and check operations is to be foreseen at check points and or stations.

3. INTRUSION PROTECTION SYSTEM

3.1.
Intrusion protection system is to be designed to detect attempts of unauthorized actions and, in case unauthorized actions actually occurred, to provide personnel with data and to transmit appropriate signals to other physical security systems.

3.2.
To prevent uncontrolled actions on intrusion protection system, remote control of system components state from physical security system control stations and backing up all events occurred in the physical security system are to be ensured.

4. SECURITY ALERT SYSTEM

4.1.
The security alert system is to be designed with the scope of alerting and notifing the physical security personnel, at the physical security system control station, regarding unauthorized actions and where on board they are taking place. Its activation will transmit alert signals upon pressing alert buttons.

4.2.
The security alert system is to be designed and installed so that its unauthorized shutdown is excluded.

4.3.
Data being transmitted to operator from security alert system equipment is to be of the highest priority as compared to other signals.

5. ACCESS MONITORING AND CONTROL SYSTEM

5.1.
The access monitoring and control system is to be designed and installed to provide
- automatic and remote control of actuator of lock and unlock devices as per established algorithms
- monitoring the state of lock and unlock devices

5.2.
The system is to be capable of:
- actuating only upon reading of identification attribute which permits access to the secured area at a given time
- monitoring authorized access of crew members or other people to secured areas and preventing attempts for unauthorized access within specified time;
- automatically recording of events to the event log
- submitting data to the operator of physical security system on attempts for unauthorized access and forced actions on structural components;
- automatic saving of data (with recording of data and time) on current events, emergency situations, attempts for unauthorized access, states of access monitoring and control devices;
- failing open in case of loss of power (actuators will act to unlock devices)
- being self-protected against unauthorized attempts to change system operation mode
- being self-protected against data tampering or deletion

5.3.
An alarm is to be given in case of breaking, or attempting to break, components which when broken may result in unauthorized passage or malfunction of system.

5.4.
Monitoring and surveillance, possibility for quick escape in case of accident are to be ensured to people attending lobbies of critical areas.

6. SURVEILLANCE SYSTEM

6.1.
Surveillance and situation assessment system is to be protected against unauthorized access, to be tested for faults to be notified to control station operator and to be designed to ensure:
- surveillance in secured areas
- transmission of visual data to physical security system control point(s)
- recording of received data.

7. COMMUNICATION SYSTEM FOR SECURITY PURPOSES

7.1.
Communication system for security purposes is to be designed for voice and data exchange between physical security system personnel by means of wired and radio communication.

7.2.
Communication system for security purposes is to be capable of:
- operating independently from other Unit's communication systems and designed only for physical security purposes
- recording voice conversations both manually and automatically
- recording conversations time and duration
- isolating the unauthorized connection.

8. POWER SUPPLY SYSTEM FOR PHYSICAL SECURITY FACILITIES

8.1.
Power supply units and cable networks are to be protected against unauthorized actions intended to cause their breakdown.

8.2.
Space where physical security system switchboard is located are to be equipped with access monitoring and control means and intrusion protection system arrangements.

8.3.
Physical security facilities are to be switched over from their main to stand-by or emergency power supply and vice versa without generating alarm signals.

9. SECURITY LIGHTING SYSTEM

9.1.
All switchgears of security lighting system are to be protected against unauthorized actions.

9.2.
Security lighting are to be capable of automatic switching on upon actuation of intrusion protection system.

9.3.
Security lighting system are to be switched over from their main to stand-by or emergency power supply and vice versa without decrease in lighting intensity in the supervised area.