

**PART II RULES FOR THE CONSTRUCTION
AND CLASSIFICATION OF VESSELS IDENTIFIED
BY THEIR MISSIONS**

TITLE 21 PASSENGER SHIPS

SECTION 7 ELECTRICITY

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CHAPTER A SCOPE

A1. APPLICATION

A2. DEFINITIONS

and auxiliaries are not in operation and in restoring the propulsion, no stored energy for starting the propulsion plant, the main source of electrical power and other essential auxiliaries should be assumed available. It is assumed that means are available to start the emergency generator at all times.

"Blackout" should be understood to mean a "deadship" condition initiating event.

End of guidance

A1. APPLICATION

100. Additional requirements for passenger vessels

101. The requirements of the present Title 21 are additional to those of Part II, Title 11, Section 7.

102. The following Chapters apply to all ships:

A APPROACH

B DOCUMENTS, REGULATIONS AND STANDARDS

102. The following Chapters apply to ships with $GT \geq 500$:

D PRINCIPLES OF INSTALLATION

E BASIC DESIGN PRINCIPLES

F DESIGN AND INSTALLATION OF THE ELECTRIC POWER SYSTEM

G DESIGN AND INSTALLATION OF THE ELECTRIC POWER DISTRIBUTION SYSTEM

103. The following Chapter applies to ships with $GT < 500$:

J REQUIREMENTS FOR PASSENGER SHIPS WITH $GT < 500$

103. **Loading area:** is the part of the vessel containing cargo tanks, waste tanks and cargo pumps space, including cofferdams square, ballast tanks and void spaces adjacent to cargo tanks, as well as the areas of the deck along the entire length and breadth of the part located above of these spaces mentioned.

104. **Earthing (grounding)** connecting device to the hull or other structure permanently attached, used as an arbitrary zero potential in such a manner as will ensure at all times an immediate discharge of electrical energy without danger, in order to protect the individual against hazardous contacts with accidentally energized metal parts, which can cause injuries during a phase-earth fault.

105. **Emergency condition** is a condition under which any services needed for normal operational and habitable conditions are not in working order due to failure of the main source of electrical power.

106. **Emergency consumers** are mandatory consumers which, after breakdown of the main energy supply, shall be fed by the emergency energy supply.

107. **Emergency switchboard** is a switchboard which in the event of failure of the main electrical power supply system is directly supplied by the emergency source of electrical power or the transitional source of emergency power and is intended to distribute electrical energy to the emergency services

108. **Hazardous areas** are areas in which an explosive atmosphere in dangerous quantity (a dangerous explosive atmosphere) is liable to occur owing to local and operating conditions. Hazardous areas are divided into zones depending on the probability that a dangerous explosive atmosphere may occur:

- a. Zone 0 comprises areas in which a dangerous explosive atmosphere is present either permanently or for long periods.
- b. Zone 1 comprises areas in which a dangerous explosive atmosphere is liable to occur occasionally.
- c. Zone 2 comprises areas in which a dangerous explosive atmosphere is liable to occur only rarely, and

A2. DEFINITIONS

100. Terms employed in this Section

101. **Control stations** are those spaces in which the ship's radio or main navigating equipment or the emergency source of power is located or where the fire-fighting recording or fire control equipment is centralized.

102. **Dead ship condition:** The condition under which the main propulsion plant, boilers and auxiliaries are not in operation due to the absence of power.

Guidance

"Deadship" condition should be understood to mean a condition under which the main propulsion plant, boilers

then only for a brief period (extended hazardous areas).

109. **Main generating station** is the space in which the main source of electrical power is situated.

110. **Main source of electrical power** is a source intended to supply electrical power to the main switchboard for distribution to all services necessary for maintaining the ship in normal operational and habitable conditions.

111. **Main switchboard** is a switchboard which is directly supplied by the main source of electrical power and is intended to distribute electrical energy to the ship's services.

112. **Normal operational and habitable condition** is a condition under which the ship as a whole, the machinery, services, means and aids ensuring propulsion, ability to steer, safe navigation, fire and flooding safety, internal and external communications and signals, means of escape, and emergency boat winches, as well as the designed comfortable conditions of habitability are in working order and functioning normally.

113. **Emergency source of electrical power** is a source of electrical power, intended to supply the emergency switchboard in the event of a failure of the supply from the main source of electrical power.

114. **Hull return:** a system in which insulated conductors are effectively connected to the mass of the ship for earthing.

115. **Special category spaces:** those enclosed spaces above or below the bulkhead deck intended for the carriage of motor vehicles with fuel in their tanks for their own propulsion, to which such vehicles can be taken and removed them by their own means and to which the passengers have access.

116. **SOLAS** – IMO International Convention for the Safety of Life at Sea.

117. **Transient source of emergency power:** accumulator batteries with sufficient capacity to supply automatically power for the emergency switchboard in the event of failure of main power source.

118. **Uninterruptible Power System (UPS)** - combination of converters, switches and energy storage means, for example batteries, constituting a power system for maintaining continuity of load power in case of input power failure [IEC 62040: series]

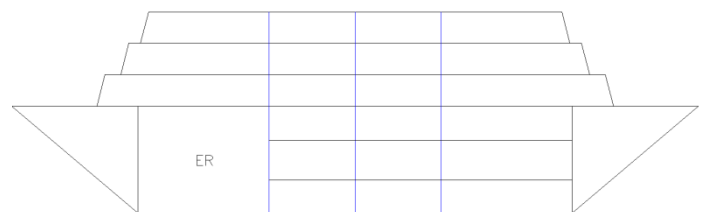
a. **Off-line UPS unit** - a UPS unit where under normal operation the output load is powered from the bypass line (raw mains) and only transferred to the inverter if the bypass supply fails or goes outside pre-set limits. This transition will invariably result in a brief (typically 2 to 10 ms) break in the load supply.

a.1. an off-line UPS unit where the bypass line switches to stored energy power when the input power goes outside the pre-set voltage and frequency limits.

b. **On-line UPS unit** - a UPS unit where under normal operation the output load is powered from the inverter, and will therefore continue to operate without break in the event of the supply input failing or going outside preset limits.

119. **Vertical zones:** in ships carrying more than 36 passengers, the hull, superstructure and deckhouses shall be subdivided into main vertical zones by "A-60" class divisions. Steps and recesses shall be kept to a minimum, but where they are necessary they shall also be "A-60" class divisions. See figure F.A2.119.1.

FIGURE F. A2.119.1 – VERTICAL ZONES IN A PASSENGER VESSEL



120. **Low-location lighting (LLL)** - Electrically powered lighting or photo-luminescent indicators placed at points of the escape route to readily identify all routes of escape.

121. **Photo-luminescent (PL) system** - An LLL system which uses PL material. PL material contains a chemical (example: zinc sulphide) that has the quality of storing energy when illuminated by visible light. The PL material emits light which becomes visible when the ambient light source is less effective. Without the light source to re-energize it, the PL material gives off the stored energy for a period of time with diminishing luminance.

122. **Electrically powered (EP) system** - An LLL system which requires electrical power for its operation, such as systems using incandescent bulbs, light emitting diodes, electroluminescent strips or lamps, electro-fluorescent lamps, etc.

**CHAPTER B
TECHNICAL DOCUMENTATION**

CHAPTER CONTENTS

B1. DOCUMENTATION TO THE RBNA

B2. REGULATIONS AND STANDARDS

B1. DOCUMENTATION TO THE RBNA

100. Documentation in addition to Part II, Title 11, Section 7

101. In addition to the documentation listed in, Part II, Title 11, Section 7, Chapter B, Subchapter B1, the following plans will be required for passenger ships:

- a. general arrangement of the vessel showing the distribution of emergency electrical power for illumination of escape routes, photo-luminescent system and location of fire equipment in main vertical zones;
- b. diagram of systems of distribution, control, monitoring and segregation of indication circuits showing the supply from main and emergency sources, type and section of cables, visual and audible alarms of watertight doors;
- c. One line and functional diagram of the main control station showing the location and indication of each open or closed door;
- d. Diagram of the Uninterruptible Power Source (UPS).

B2. REGULATIONS AND STANDARDS

100. Regulations and Standards

101. The following Regulations and Standards, specific for passenger vessels, are additional to those in Part II, Title 11, Section 7, Chapter B:

- a. SOLAS II-1/D/42 – Emergency Source of Electrical Power in Passenger Ships
- b. SOLAS II-1/D/42-1 – Supplementary Emergency Lighting for Passenger Ships
- c. SOLAS II-1/D/ 39 - Location of Emergency Installations in Passenger Ships
- d. IACS UR E concerning Electrical Installations
- e. IACS UI SC Interpretations
- f. IEC 60092 series

IEC 60331-23: Procedures and Requirements – Electric Data Cables

g. IEC 60331-25: Procedures and Requirements – Optical Fibre Cables

h. IEEE 45-2002 – Recommended Practice for Electrical Installations on Shipboard

i. ISO 15370:2010 – Low Location Lighting (LLL) on Passenger Ships: Arrangement

**CHAPTER D
PRINCIPLES OF CONSTRUCTION**

CHAPTER CONTENTS

D1. INSTALLATIONS ON BOARD

D2. FACILITIES
See Part II, Title 11, Section 7, D2.

D1. INSTALLATIONS ON BOARD

100. Application

101. In a passenger ship, distribution systems shall be so arranged that fire in any main vertical zone as defined in A2.119 will not interfere with services essential for safety in any other such zone. This requirement will be met if main and emergency feeders passing through any such zone are separated both vertically and horizontally as widely as is practicable.

CHAPTER E BASIC PRINCIPLES FOR DIMENSIONING

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- E1. OPERATIONAL AND ENVIRONMENTAL CONDITIONS
See Part II, Title 11, Section 7, E1
- E2. DEGREES OF PROTECTION
See Part II, Title 11, Section 7, E2
- E3. CLASSES OF INSULATIONS
See Part II, Title 11, Section 7, E3
- E4. DISTRIBUTION SYSTEMS, VOLTAGES AND FREQUENCIES
See Part II, Title 11, Section 7, E4
- E5. ESSENTIAL SERVICES

E5. ESSENTIAL SERVICES

Guidance

IMO *MSC/Circ.1176* represents a revised version of IACS UI SC134 *Essential Services and Arrangements of Sources of Power, Supply, Control and Monitoring to the different Categories of Essential Services (SOLAS Regulations II-1/40 & 41)* which is shown in the present Part II, Title 21, Section 7, Chapter E, sub chapter E5.

End of guidance

100. Classification of electrical services

101. Essential Services are those services essential for propulsion and steering, and safety of the ship, which are made up of "Primary Essential Services" and "Secondary Essential Services". Definitions and examples of such services are given in E5.200 and E5.300 below.

102. Services to ensure minimum comfortable conditions of habitability are those services such as defined in E5.400 below.

200. Primary Essential Services

201. Primary Essential Services are those services which need to be in continuous operation to maintain propulsion and steering. Examples of equipment for primary essential services are as follows:

- a. Steering gears
- b. Pumps for controllable pitch propellers
- c. Scavenging air blower, fuel oil supply pumps, fuel valve cooling pumps, lubricating oil pumps and cool-

ing water pumps for main and auxiliary engines and turbines necessary for propulsion

- d. Forced draught fans, feed water pumps, water circulating pumps, vacuum pumps and condensate pumps for steam plants on steam turbine ships, and also for auxiliary boilers on ships where steam is used for equipment supplying primary essential services
- e. Oil burning installations for steam plants on steam turbine ships and for auxiliary boilers where steam is used for equipment supplying primary essential services
- f. Azimuth thrusters which are the sole means for propulsion/steering with lubricating oil pumps, cooling water pumps
- g. Electrical equipment for electric propulsion plant with lubricating oil pumps and cooling water pumps
- h. Electric generators and associated power sources supplying the above equipment
- i. Hydraulic pumps supplying the above equipment

300. Secondary Essential Services

301. Secondary Essential Services are those services which need not necessarily be in continuous operation to maintain propulsion and steering but which are necessary for maintaining the vessel's safety. Examples of equipment for secondary essential services are as follows:

- a. Windlass
- b. Fuel oil transfer pumps and fuel oil treatment equipment
- c. Lubrication oil transfer pumps and lubrication oil treatment equipment
- d. Pre-heaters for heavy fuel oil
- e. Starting air and control air compressors
- f. Bilge, ballast and heeling pumps
- g. Fire pumps and other fire extinguishing medium pumps
- h. Ventilating fans for engine and boiler rooms
- i. Services considered necessary to maintain dangerous spaces in a safe condition
- j. Navigation lights, aids and signals
- k. Internal safety communication equipment
- l. Fire detection and alarm system

- m. Lighting system
- n. Electrical Equipment for watertight closing appliances
- o. Electric generators and associated power sources supplying the above equipment
- p. Hydraulic pumps supplying the above equipment
- q. Control, monitoring and safety systems for cargo containment systems
- r. Control, monitoring and safety devices/systems for equipment to secondary essential services.

400. Services for habitability

401. Services for habitability are those services which need to be in operation for maintaining the vessel's minimum comfort conditions for the crew and passengers. Examples of equipment for maintaining conditions of habitability are as follows:

- i. Cooking
- ii. Heating
- iii. Domestic refrigeration
- iv. Mechanical ventilation
- v. Sanitary and fresh water
- vi. Electric generators and associated power sources supplying the above equipment

500. SOLAS Regulations

501. Regulation II-1/40.1.1 and Regulation II-1/41.1.1 – For the purposes of these regulations, the services as included in items E5.200 to E5.400 are to be considered.

Guidance

SOLAS II-1/D/40.1.1 text:

All electrical auxiliary services necessary for maintaining the ship in normal operational and habitable conditions will be ensured without recourse to the emergency source of electrical power;

SOLAS II-1/D/41.1.1 text:

A main source of electrical power of sufficient capacity to supply all those services mentioned in regulation 40.1.1 shall be provided. This main source of electrical power shall consist of at least two generating sets

End of guidance.

502. Regulation II-1/40.1.2 - For the purposes of this regulation, the services as included in items E5.200 and

E5.300 and the services in the Subchapter E5 above (Emergency Source of Electrical Power in Passenger Ships) are to be considered.

Guidance - SOLAS II-1/D/40.1.2 text:

Electrical services essential for safety will be ensured under various emergency conditions

End of guidance

503. Regulation II-1/41.1.2 - For the purposes of this regulation, the services as included in 4 items E5.200 to E5.400, are to be considered.

Guidance

SOLAS II-1/D/41.1.2 text:

The capacity of these generating sets shall be such that in the event of any one generating set 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 shall also be ensured which include at least adequate services for cooking, heating, domestic refrigeration, mechanical ventilation, sanitary and fresh water.

End of guidance

504. Regulation II-1/41.1.5 - For the purposes of this regulation, the services as included in items E5.200, E5.300 and E5.400 are to be considered. See also IACS UI SC83.

Guidance - SOLAS II-1/D/41.1.5 text:

Where transformers constitute an essential part of the electrical supply system required by this paragraph, the system shall be so arranged as to ensure the same continuity of the supply as is stated in this paragraph.

End of guidance

505. Regulation II-1/41.5.1.2 - For the purposes of this regulation, the following interpretations are applicable.

- a. Services in item E5.200 are not to be included in any load shedding or other equivalent arrangements.
- b. Services in item E5.300 may be included in the automatic load shedding or other equivalent arrangement provided disconnection will not:
 - a.1. Cause immediate disruption of systems required for safety, e.g.:
 - i. Lighting systems,
 - ii. Navigation lights, aids and signals,

- iii. Internal safety communication equipment.
- a.2. Prevent services required for safety being immediately available when the power supply is restored to normal operating conditions, e.g.:
 - a. Fire pumps, and other extinguishing medium pumps,
 - b. Bilge pumps,
 - c. Ventilating fans for engine and boiler rooms.

- e. Fire and general alarms
- f. Fire detection systems
- g. Fire-extinguishing systems and fire-extinguishing media release alarms
- h. Low location lighting
- i. Public address systems
- j. Remote emergency stop/shutdown arrangements for systems which may support the propagation of fire and/or explosion

Guidance – SOLAS II-1/D/45.1.2 text:

Ships constructed on or after 1 July 1998:load shedding or other equivalent arrangements shall be provided to protect the generators required by this regulation against sustained overload;

End of guidance

506. Examples of equipment in the item E5.300, for which the automatic load shedding or other equivalent arrangement is normally allowed, includes:

- a. Fuel oil transfer pumps and fuel oil treatment equipment
- b. Lubrication oil transfer pumps and lubrication oil treatment equipment
- c. Pre-heaters for heavy fuel oil
- d. Starting air and control air compressors (except for control air compressors for propulsion control and its safety systems)

507. Services for habitability in the item E5.400 may be included in the automatic load shedding or other equivalent arrangement.

600. Electrical Services Required to be Operable Under Fire Conditions and Fire Resistant Cables [IACS UR E15]

601. Electrical services required to be operable under fire conditions are as follows:

- a. Control and power systems to power-operated fire doors and status indication for all fire doors
- b. Control and power systems to power-operated water-tight doors and their status indication
- c. Emergency fire pump
- d. Emergency lighting

602. Where cables for services specified in item E5.601 above including their power supplies pass through high fire risk areas, and in addition for passenger ships, main vertical fire zones, other than those which they serve, they are to be so arranged that a fire in any of these areas or zones does not affect the operation of the service in any other area or zone.

603. This may be achieved by either of the following measures:

- a. Cables being of a fire resistant type complying with IEC 60331-31 for cables of greater than 20 mm overall diameter, otherwise 60331-21, are installed and run continuous to keep the fire integrity within the high fire risk area, see Figure F.E5.603.1.
- b. At least two-loops/radial distributions run as widely apart as is practicable and so arranged that in the event of damage by fire at least one of the loops/radial distributions remains operational.

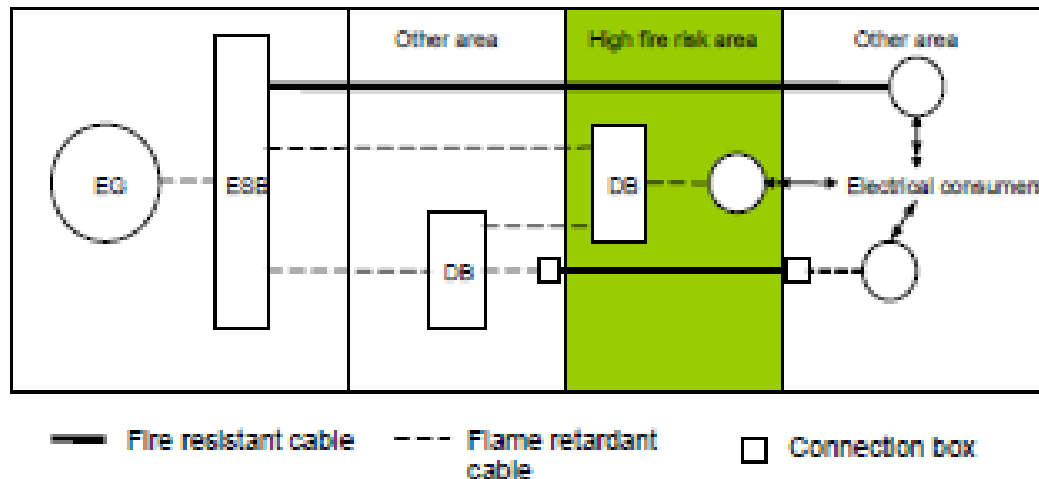
604. Systems that are self-monitoring, fail safe or duplicated with cable runs as widely separated as is practicable may be exempted.

605. Notes:

- a. For the purpose of this Subchapter E5 – Item 600 application, the definition for “high fire risk areas” is the following:
 - a.1. Machinery spaces as defined by Chap. II-2 / Reg. 3.30 of SOLAS.
 - a.2. Spaces containing fuel treatment equipment and other highly flammable substances
 - a.3. Galley and Pantries containing cooking appliances
 - a.4. Laundry containing drying equipment
 - a.5. Spaces as defined by paragraphs (8), (12), and (14) of Chap. II-2 / Reg. 9.2.2.3.2.2 of SOLAS for ships carrying more than 36 passengers

- b. Fire resistant type cables should be easily distinguishable. IEC60331-23: Procedures and requirements – Electric data cables
- c. For special cables, requirements in the following standards may be used: IEC60331-25: Procedures and requirements – Optical fibre cables

FIGURE F.E5.603.1 – CABLES OF FIRE RESISTANT TYPE INSTALLED AND RUN CONTINUOUS TO KEEP THE FIRE INTEGRITY WITHIN THE HIGH FIRE RISK AREA



**CHAPTER F
DESIGN AND CONSTRUCTION OF ELECTRIC
POWER GENERATION SYSTEM FOR SHIPS WITH
GT ≥ 500**

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- F1. ELECTRICAL LOAD ANALYSIS
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- F2. DIRECT CURRENT GENERATORS
See Part II, Title 11, Section 7, F2
- F3. ALTERNATE CURRENT GENERATORS
See Part II, Title 11, Section 7, F3
- F4. MAIN SOURCE OF ELECTRICAL POWER
AND LIGHTING SYSTEMS
- F5. EMERGENCY SOURCE OF ELECTRICAL
POWER IN PASSENGER SHIPS
- F6. SHORE POWER SOURCE
See Part II, Title 11, Section 7, F6
- F7. REQUIREMENTS FOR UNINTERRUPTIBLE
POWER SOURCE (UPS) UNITS AS ALTERNA-
TIVE AND/OR TRANSITIONAL POWER

**F4. MAIN SOURCE OF ELECTRIC POWER AND
LIGHTING SYSTEMS**

100. Additional requirements for passenger ships

101. The requirements of the present Subchapter F4 are additional to those of Part II, Title 11, Section 7, F4.
102. The source of electrical power must consist of at least two generating sets.
103. The capacity of each generating set must maintain normal electric services with one generating set stopped.
104. Normal electric services must be maintained regardless of the speed and direction of rotation of the main propulsion machinery or its shafting.
105. With one generator or its prime mover out of action, the remaining generating sets can supply the electric services necessary to start the main propulsion plant from a “dead ship” condition.
106. For generators arranged to operate in parallel and for individually operating generators, arrangements are to be made to disconnect automatically the excess load when the generators are overloaded in such a way as to prevent a sustained loss of speed. The operation of such device is to activate a visual and audible alarm.

F5. EMERGENCY SOURCE OF ELECTRICAL POWER

[SOLAS II-1/DC/42]

100. Application

101. A self-contained emergency source of electrical power shall be provided.

102. The emergency source of electrical power, associated transforming equipment, if any, transitional source of emergency power, emergency switchboard and emergency lighting switchboard shall be located above the uppermost continuous deck and shall be readily accessible from the open deck. They shall not be located forward of the collision bulkhead.

a. Emergency generator stored starting energy is not to be directly used for starting the propulsion plant, the main source of electrical power and/or other essential auxiliaries (emergency generator excluded)
[MSC/Circ.117]

103. The location of the emergency source of electrical power and associated transforming equipment, if any, the transitional source of emergency power, the emergency switchboard and the emergency electric lighting switchboards in relation to the main source of electrical power, associated transforming equipment, if any, and the main switchboard shall be such as to ensure to the satisfaction of RBNA that a fire or other casualty in spaces containing the main source of electrical power, associated transforming equipment, if any, and the main switchboard or in any machinery space of category A will not interfere with the supply, control and distribution of emergency electrical power, associated transforming equipment, if any, the transitional source of emergency electrical power and the emergency switchboard. The location of the emergency source of electrical power and associated transforming equipment, if any, the transitional source of emergency power and the emergency switchboard shall not be contiguous to the boundaries of machinery spaces of category A or those spaces containing the main source of electrical power, associated transforming equipment, if any, or the main switchboard.

104. Provided that suitable measures are taken for safeguarding independent emergency operation under all circumstances the emergency generator may be used exceptionally, and for short periods, to supply non-emergency circuits.

a. Unless instructed otherwise by the RBNA, the emergency generator may be used during lay time in port for the supply of the ship mains, provided the following requirements are to be complied with [IACS UI SC152]:

a.1. To prevent the generator or its prime mover from becoming overloaded when used in port, arrangements should be provided to shed sufficient non-emergency loads to ensure its continued safe operation.

a.2. The prime mover should be arranged with fuel oil filters and lubrication oil filters, monitoring equipment and protection devices as required for the prime mover for main power generation and for unattended operation.

a.3. The fuel oil supply tank to the prime mover should be provided with a low level alarm, arranged at a level ensuring sufficient fuel oil capacity for the emergency services for the period of time as required by SOLAS.

a.4. The prime mover should be designed and built for continuous operation and should be subjected to a planned maintenance scheme ensuring that it is always available and capable of fulfilling its role in the event of an emergency at sea.

a.5. Fire detectors should be installed in the location where the emergency generator set and emergency switchboard are installed.

a.6. Means should be provided to readily change over to emergency operation.

a.7. Control, monitoring and supply circuits, for the purpose of the use of emergency generator in port should be so arranged and protected that any electrical fault will not influence the operation of the main and emergency services.

a.8. When necessary for safe operation, the emergency switchboard should be fitted with switches to isolate the circuits.

a.9. Instructions should be provided on board to ensure that when the vessel is under way all control devices (e.g. valves, switches) are in a correct position for the independent emergency operation of the emergency generator set and emergency switchboard."

105. The electrical power available shall be sufficient to supply all those services that are essential for safety in an emergency, due regard being paid to such services as may have to be operated simultaneously.

106. The emergency source of electrical power shall be capable, having regard to starting currents and the transitory nature of certain loads, of supplying simultaneously at least the following services for the periods specified hereinafter, if they depend upon an electrical source for their operation:

a. For a period of 36 hours, emergency lighting:

a.1. at every muster and embarkation station and over the sides

a.2. in alleyways, stairways and exits giving access to the muster and embarkation stations;

- a.3. in all service and accommodation alleyways, stairways, and exits, personnel lift cars;
- a.4. in the machinery spaces and main generating stations including their control positions;
- a.5. in all control stations, machinery control rooms, and at each main and emergency switchboard;
- a.6. at all stowage positions for firemen's outfits;
- a.7. at the steering gear; and
- a.8. at the fire pump, the sprinkler pump and the emergency bilge pump and at the starting position of their motors.
- b. For a period of 36 hours:
- b.1. the navigation lights and other lights required by the International Regulations for Preventing Collisions at Sea in force; and
- b.2. on ships constructed on or after 1 February 1995, the VHF radio installation required by regulation SOLAS IV/7.1.1 and SOLAS IV/7.1.2; and, if applicable:
- b.3. the MF radio installation required by regulations SOLAS IV/9.1.1, SOLAS IV/9.1.2, SOLAS IV/10.1.2 and IV/10.1.3;
- b.4. the ship earth station required by regulation SOLAS IV/10.1.1; and
- b.5. the MF/HF radio installation required by regulations SOLAS IV/10.2.1, SOLAS IV/10.2.2 and SOLAS IV/11.1.
- c. For a period of 36 hours:
- c.1. all internal communication equipment required in an emergency;
- c.2. the shipborne navigational equipment as required by regulation SOLAS V/12 *; where such provision is unreasonable or impracticable the Administration may waive this requirement for ships of less than 5,000 gross tonnage;
- c.3. the fire detection and fire alarm system, and the fire door holding and release system; and
- c.4. for intermittent operation of the daylight signalling lamp, the ship's whistle, the manually operated call points and all internal signals that are required in an emergency;
- c.5. unless such services have an independent supply for the period of 36 hours from an accumulator battery suitably located for use in an emergency.
- d. For a period of 36 hours:
- d.1. one of the fire pumps required by Part II, Title 11, Section 3, E10.203.a (regulation SOLAS II-2/C/10.2.1);
- e. For the period of time required by SOLAS regulation 29.14 the steering gear if required to be so supplied by that Regulation.

Guidance

This relates to the chapter V in force before 1 July 2002. The equivalent in the amended chapter V is regulation 19.

End of guidance³

- d.2. the automatic sprinkler pump, if any; and
- d.3. the emergency bilge pump and all the equipment essential for the operation of electrically powered remote controlled bilge valves.

Guidance – Text of SOLAS Regulation II-1/C/29.14

Where the rudder stock is required to be over 230 mm diameter in way of the tiller, excluding strengthening for navigation in ice, an alternative power supply, sufficient at least to supply the steering gear power unit which complies with the requirements of paragraph 4.2 and also its associated control system and the rudder angle indicator, shall be provided automatically, within 45 seconds, either from the emergency source of electrical power or from an independent source of power located in the steering gear compartment. This independent source of power shall be used only for this purpose. In every ship of 10,000 gross tonnage and upwards, the alternative power supply shall have a capacity for at least 30 minutes of continuous operation and in any other ship for at least 10 minutes.

End of guidance

Guidance [IACS Interpretation UI SC5]

- *The means of communication which is provided between the officer of the watch and the person responsible for closing any watertight door which is not capable of being closed from a central control station*
- *The public address system or other effective means of communication which is provided throughout the accommodation, public and service spaces*
- *The means of communication which is provided between the navigating bridge and the main fire control station.*

End of guidance

- f. For a period of half an hour:
- f.1. any watertight doors required by SOLAS regulation II-1/15 to be power operated together with their indicators and warning signals.
 - f.2. the emergency arrangements to bring the lift cars to deck level for the escape of persons. The passenger lift cars may be brought to deck level sequentially in an emergency.
- g. In a ship engaged regularly on voyages of short duration, the Administration if satisfied that an adequate standard of safety would be attained may accept a lesser period than the 36 hour period specified in F5.105.a through F5.105.e but not less than 12 hours.
- h. In a ship engaged regularly in voyages of short duration], dispensation to the reduced period of availability of the emergency source of power can be given to [IACS UI SC72]:
- h.1. Vessels with a class notation "Coastal Service" (class notation O1)
 - h.2. Vessels engaged in voyages where the route is no greater than 20 nautical miles offshore.
107. The emergency source of electrical power may be either a generator or an accumulator battery, which shall comply with the following:
- a. Where the emergency source of electrical power is a generator, it shall be:
 - a.1. driven by a suitable prime-mover with an independent supply of fuel having a flashpoint (closed cup test) of not less than 43 degrees C;
 - a.2. started automatically upon failure of the electrical supply from the main source of electrical power and shall be automatically connected to the emergency switchboard; those services referred to in F5.112 above shall then be transferred automatically to the emergency generating set. The automatic starting system and the characteristic of the prime-mover shall be such as to permit the emergency generator to carry its full rated load as quickly as is safe and practicable, subject to a maximum of 45 seconds; unless a second independent means of starting the emergency generating set is provided, the single source of stored energy shall be protected to preclude its complete depletion by the automatic starting system; and
 - a.3. provided with a transitional source of emergency electrical power according to F5.112.
108. Where the emergency source of electrical power is an accumulator battery, it shall be capable of:
- a. carrying the emergency electrical load without re-charging while maintaining the voltage of the battery throughout the discharge period within 12 percent above or below its nominal voltage;
 - b. automatically connecting to the emergency switchboard in the event of failure of the main source of electrical power; and
 - c. immediately supplying at least those services specified in F5.112
109. Acceptable voltage variations when the emergency loads are supplied from a battery via an electronic converter/inverter [IACS UI SC186]:
- a. Where the emergency and/or transitional emergency loads are supplied from a battery via an electronic converter or inverter the maximum permitted d.c voltage variations are to be taken as those on the load side of the converter or inverter.
 - b. Where the dc. is converted into ac. the maximum variations are not exceed those given in Part II, Title 11, Section 7, E4.200 (IACS UR E5).
110. The following provision in F5.107.a.ii shall not apply to ships constructed on or after 1 October 1994: Unless a second independent means of starting the emergency generating set is provided, the single source of stored energy shall be protected to preclude its complete depletion by the automatic starting system.
111. For ships constructed on or after 1 July 1998, where electrical power is necessary to restore propulsion, the capacity shall be sufficient to restore propulsion to the ship in conjunction with other machinery, as appropriate, from a dead ship condition within 30 min after blackout.
- [IACS UI SC124]
- a. The emergency generator and other means needed to restore the propulsion are to have a capacity such that the necessary propulsion starting energy is available within 30 minutes of blackout/dead ship condition as defined above. Emergency generator stored starting energy is not to be directly used for starting the propulsion plant, the main source of electrical power and/or other essential auxiliaries (emergency generator excluded).
 - b. For steam ships, the 30 minute time limit given in SOLAS can be interpreted as time from blackout/dead ship condition defined above to light-off of the first boiler
112. The transitional source of emergency electrical power shall consist of an accumulator battery suitably located for use in an emergency which shall operate without re-charging while maintaining the voltage of the battery throughout the discharge period within 12 percent above or below its nominal voltage and be of sufficient capacity and so arranged as to supply automatically in the event of failure

of either the main or emergency source of electrical power at least the following services, if they depend upon an electrical source for their operation:

113. For half an hour:

- a.1. the lighting required by F5.106.a and F5.106.b.i;
- a.2. all services required by F5.106.c.i, F5.106.c.iii and F5.106.c.iv unless such services have an independent supply for the period specified from an accumulator battery suitably located for use in an emergency.

114. Power to operate the watertight doors, but not necessarily all of them simultaneously, unless an independent temporary source of stored energy is provided. Power to the control, indication and alarm circuits for half an hour.

115. The emergency switchboard shall be installed as near as is practicable to the emergency source of electrical power.

116. Where the emergency source of electrical power is a generator, the emergency switchboard shall be located in the same space unless the operation of the emergency switchboard would thereby be impaired.

117. No accumulator battery fitted in accordance with this Regulation shall be installed in the same space as the emergency switchboard. An indicator shall be mounted in a suitable place on the main switchboard or in the machinery control room to indicate when the batteries constituting either the emergency source of electrical power or the transitional source of emergency electrical power referred to in items F5.107.a.iii or F5.112 are being discharged.

118. The emergency switchboard shall be supplied during normal operation from the main switchboard by an interconnector feeder which is to be adequately protected at the main switchboard against overload and short circuit and which is to be disconnected automatically at the emergency switchboard upon failure of the main source of electrical power. Where the system is arranged for feedback operation, the interconnector feeder is also to be protected at the emergency switchboard at least against short circuit.

119. In order to ensure ready availability of the emergency source of electrical power, arrangements shall be made where necessary to disconnect automatically non-emergency circuits from the emergency switchboard to ensure that power shall be available to the emergency circuits.

120. The emergency generator and its prime-mover and any emergency accumulator battery shall be so designed and arranged as to ensure that they will function at full rated power when the ship is upright and when inclined at any angle of list up to 22.5 degrees or when inclined up to 10 degrees either in the fore or aft direction, or is in any combination of angles within those limits.

121. Provision shall be made for the periodic testing of the complete emergency system and shall include the testing of automatic starting arrangements.

[IACS UI SC3]

122. “**Exceptionally**” is understood to mean conditions such as:

- a. black-out situation;
- b. dead-ship situation;
- c. routine use for testing;
- d. short-term parallel operation with the main source of electrical power for the purpose of load transfer; and
- e. use of the emergency generator during lay time in port for the supply of the ship main switchboard, provided the requirements of F5.104.a (Suitable measures for the exceptional use of the emergency generator for power-supply of non-emergency circuits in port) are achieved and unless instructed otherwise by the Administration

F7. REQUIREMENTS FOR UNINTERRUPTIBLE POWER SOURCE (UPS) UNITS AS ALTERNATIVE AND/OR TRANSITIONAL POWER [WP/EL – IACS working group]

100. Requirements for a UPS source of power:

- a. The AC/DC UPS shall be consisting of at least a battery, a charge unit and a rectifier, if required.
- b. The AC/AC UPS shall be consisting of at least a battery, a battery charger, a converter and a bypass, if required.
- c. Batteries with capacity up to 2 kW may be below deck in a well-ventilated battery cupboard or container except where the calculation formula in IEC60092-305 (18/880/CD) indicates that the air volume of the compartment is too small for the battery ventilation. In this case the batteries may be installed in closed battery cupboard or container ventilated by air ducts which run to adequate ventilation areas. Another possibility is to install the batteries in a “battery room”. It should be noted that battery cupboards or battery rooms are hazardous areas.
- d. Small batteries with charging capacity of 0.2 kW or less may be installed in cases without separation of the other electrical components under the following conditions:
 - d.1. When the battery is a valve regulated type;

- d.2. The case is not totally closed (e.g. IP 2X protection degree)
- d.3. Charge power of the charger is limited on 0.2 kW
- e. Gas tight batteries need no ventilation
- f. Batteries with charging capacity of more than 2 kW installed below deck are to be enclosed in a cupboard / container or in a room with means of ventilation to the open deck.
- g. Batteries, except gas tight “device batteries” shall not be installed in accommodation areas or cargo holds.
- h. The float charge voltage or current has to be limited according to the manufacturer’s data sheet.
- i. NiCd batteries up to 2 kW charging capacity and Pb batteries up to 3 kW charging capacity may be ventilated natural. Above this value, batteries must be ventilated by forced ventilation with air outlet to the open deck.

200. Requirements for uninterruptible power source (UPS) units as alternative and/or transitional power [IACS UR E-21]

201. **Scope:** these requirements to UPS units, as defined in IEC 62040, apply when providing an alternative power supply or transitional power supply to services as defined in SOLAS Chapter II-1, Regulations 42 and 43.

202. A UPS unit complying with these requirements may provide an alternative power supply as an accumulator battery in terms of being an independent power supply for services defined in SOLAS Chapter II-1, Regulation 42, 2.3 or 43, 2.4.

203. Note: this application of UPS units as alternative and/or transitional power is typically applied to passenger ships.

300. Design and construction

301. UPS units are to be constructed in accordance with IEC 62040, or an acceptable and relevant national or international standard.

302. The operation of the UPS is not to depend upon external services.

303. The type of UPS unit employed, whether off-line, line interactive or on-line, is to be appropriate to the power supply requirements of the connected load equipment.

304. An external bypass is to be provided.

305. The UPS unit is to be monitored and audible and visual alarm is to be given in a normally attended location for:

- a. power supply failure (voltage and frequency) to the connected load,
- b. earth fault,
- c. operation of battery protective device,
- d. when the battery is being discharged, and
- e. when the bypass is in operation for on-line UPS units.

400. Location

401. The UPS unit is to be suitably located for use in an emergency.

402. UPS units utilising valve regulated sealed batteries may be located in compartments with normal electrical equipment, provided the ventilation arrangements are in accordance with the requirements of IEC 62040 or an acceptable and relevant national or international standard.

500. Performance

501. The output power is to be maintained for the duration required for the connected equipment as stated in SOLAS Chapter II-1, Regulation 42 or 43.

502. No additional circuits are to be connected to the UPS unit without verification that the UPS unit has adequate capacity. The UPS battery capacity is, at all times, to be capable of supplying the designated loads for the time specified in the regulations.

503. On restoration of the input power, the rating of the charge unit shall be sufficient to recharge the batteries while maintaining the output supply to the load equipment.

600. Testing and survey

601. UPS units of 50 kVA and over are to be surveyed by the RBNA during manufacturing and testing.

602. Appropriate testing is to be carried out to demonstrate that the UPS unit is suitable for its intended environment. This is expected to include as a minimum the following tests:

- a. Functionality, including operation of alarms;
- b. Temperature rise;
- c. Ventilation rate;
- d. Battery capacity.

603. Where the supply is to be maintained without a break following a power input failure, this is to be verified after installation by practical test.

**CHAPTER G
DESIGN AND CONSTRUCTION OF ELECTRIC
POWER DISTRIBUTION SYSTEM**

CHAPTER CONTENTS

- G1. LIGHTING CIRCUITS AND SOCKET
OUTLETS
See Part II, Title 11, Section 7
- G2. NAVIGATION LIGHT CIRCUITS
See Part II, Title 11, Section 7
- G3. MOTOR FEEDER CIRCUITS
See Part II, Title 11, Section 7
- G4. EQUIPMENT AND CIRCUITS
PROTECTION SYSTEM
See Part II, Title 11, Section 7
- G5. EARTHING SYSTEM
See Part II, Title 11, Section 7
- G6. DETERMINATION OF NOMINAL SECTION
OF CONDUCTORS
See Part II, Title 11, Section 7
- G7. PRECAUTIONS AGAINST SHOCK, FIRE AND
OTHER HAZARDS OF ELECTRICAL ORIGIN
See Part II, Title 11, Section 7
- G8. LOW LOCATION LIGHTING IN PASSENGER
SHIPS WITH $GT \geq 500$

G8. LOW-LOCATION LIGHTING ON PASSENGER SHIPS WITH $GT \geq 500$

100. Scope

101. The present Subchapter G8 covers the approval, installation and maintenance of low-location lighting (LLL) required by Part II, Title 11, Section 3, E12.306.e, on all passenger ships carrying more than 36 passengers, to readily identify the passengers' route of escape when the normal emergency lighting is less effective due to smoke.

Guidance – Text of Part II, Title 11, Section 3, E12.306.e:

Marking of escape routes: *In addition, the means of escape, including stairways and exits, shall be marked by lighting or photoluminescent strip indicators placed not more than 300 mm above the deck at all points of the escape route, including angles and intersections. The marking must enable passengers to identify the routes of escape and readily identify the escape exits. If electric illumination is used, it shall be supplied by the emergency source of power and it shall be so arranged that the failure of any single light or cut in a lighting strip will not result in the marking being ineffective. Additionally, escape route signs and fire equipment location markings shall be of photoluminescent material or marked*

by lighting. The RBNA shall ensure that such lighting or photoluminescent equipment has been evaluated, tested and applied in accordance with the Fire Safety Systems Code.

End of guidance

200. System requirements

201. The means of escape including stairways and exits should be marked by LLL at all points of the escape route including angles and intersections. In addition, all escape route signs and fire equipment location markings should be of photo-luminescent material, or marked by lighting, or a combination of both.

202. The supplementary emergency lighting for ro-ro passenger ships required by Part II, Title 26, Section 7 may be accepted to form partly or wholly the LLL system provided that such a system complies with the requirements of these guidelines.

203. The LLL system should function at all times for at least 60 min after its activation. Entire systems, including those that are automatically activated or continuously operating, are to be capable of being manually activated by a single action from the continuously manned central control station.

204. In all passageways, the LLL should be continuous except as interrupted by corridors and cabin doors in order to provide a visible delineation along the escape route. Systems tested to an international standard to demonstrate a visible delineation without being continuous should also be acceptable. The LLL should be installed at least on one side of the corridor, either on the bulkhead within 300 mm of the deck, or on the deck within 150 mm of the bulkhead. In corridors more than two metres wide, LLL should be installed on both sides.

205. In dead-end corridors, LLL should have arrows placed at intervals of no more than 1 m, or equivalent direction indicators, pointing away from the dead-end.

206. In all stairways, LLL should be installed on at least one side at a height less than 300 mm above the steps which will make the location of each step readily identifiable to any person standing above and below that step. LLL should be installed on both sides if the width of the stairway is two metres or more. The top and bottom of each set of stairs should be identified to show that there are no further steps.

207. IMO symbols should be incorporated into the LLL which directs the passengers to the muster stations.

207. In all passenger cabins a placard explaining the LLL system should be installed on the inside of the cabin door. It should also have a diagram showing the location of, and the way to, the two closest exits with respect to the cabin.

208. Materials used in the manufacture of LLL products should not contain radioactive or toxic materials.

300. Doors

301. LLL should lead to the exit door handle. To prevent confusion, no other doors should be similarly marked.

302. Sliding fire doors and watertight doors should be marked with an LLL sign showing how the door opens.

400. Signs and markings

401. All escape route signs and fire equipment location marking should be of photoluminescent material or marked by lighting and fitted in the lower 300 mm of the bulkhead. The dimensions of such signs and markings are to be commensurate with the rest of the LLL system.

402. LLL exit signs should be provided at all exits. The signs should be located within the lower 300 mm on the side of exit doors where the handle is located.

403. All signs should contrast in colour to the background (bulkhead or deck) on which they are installed.

500. Photoluminescent (PL) systems

501. Except where noted, PL strips should be no less than 75 mm wide. PL having a width less than that stated herein should be used only if their luminance is increased proportionally to compensate for their width.

502. PL materials should provide at least 15 mcd/m² measured 10 min after the removal of all external illuminating sources. The system should continue to provide luminance values greater than 2 mcd/m² for 60 min.

503. Any PL system materials should be provided with not less than the minimum level of ambient light necessary to charge the PL material to meet the above luminance requirements

600. Electrically powered (EP) systems

601. EP systems should be connected to the emergency switchboard required by regulation II-1/42 of the 1974 SOLAS Convention, as amended, so as to be powered by the main source of electrical power under normal circumstances and also by the emergency source of electrical power when the latter is in operation. Alternatively, for existing ships only, EP systems may be connected to the main lighting system, provided independent batteries provide a backup of at least 60 min and are charged from the main lighting system. Performance of the system while powered by batteries should meet all the requirements stated herein.

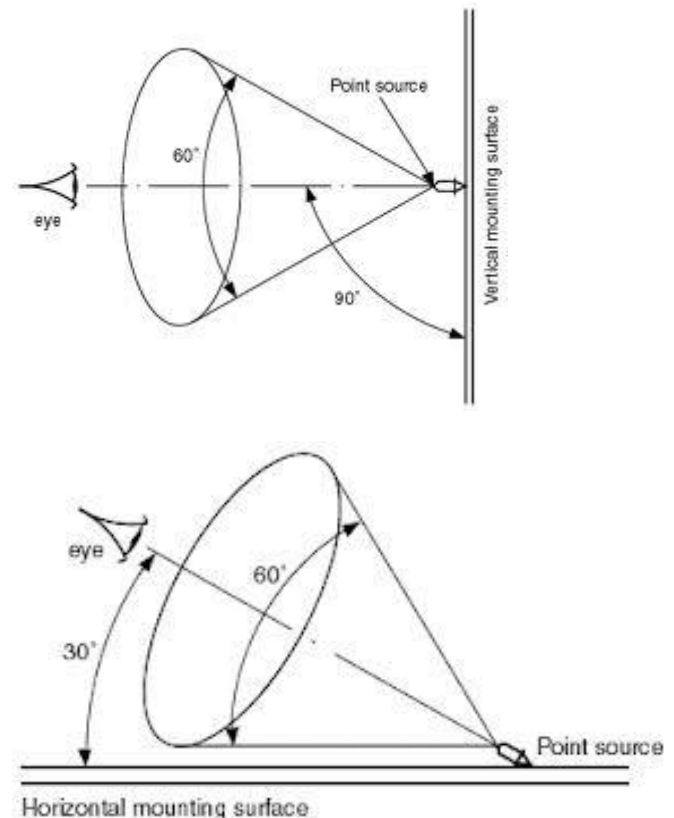
602. Where electrically powered systems are installed the following standards of luminance are to be applied:

- the active parts of electrically powered system should have a minimum luminance of 10 cd/m²;
- the point sources of miniature incandescent lamps should provide not less than 150 mcd mean spherical

intensity with a spacing of not more than 100 mm between lamps;

- the point sources of light emitting diode systems should have a minimum peak intensity of 35 mcd. The angle of half intensity cone should be appropriate to the likely track directions of approach and viewing. Spacing between lamps should be no more than 300 mm (see figure F.G8.602.1 below; and

FIGURE F.G8.602.1 – VERTICAL AND HORIZONTAL MOUNTING SURFACE



- for electroluminescent systems these should function for 60 min from the instant when the main power supply to which it was required to be connected by item G8.601 is removed.

603. All EP systems should be arranged so that the failure of any single light, lighting strip, or battery will not result in the marking being ineffective.

604. EP systems should meet the relevant requirements for emergency luminaries in the current edition of publication 598-22-2 published by the International Electro Technical Commission (IEC) when tested at a reference ambient temperature of 40°C.

605. EP systems should meet the requirements for vibration and electromagnetic interference in the current edition of publication 945 published by the IEC.

606. EP systems should provide a minimum degree of ingress protection of at least IP 55 in accordance with publication 529 published by the IEC.

700. Maintenance

701. All LLL systems should be visually examined and checked at least once a week and a record kept. All missing, damaged or inoperable LLL should be replaced.

702. All LLL systems should have their luminance tested at least once every five years. Readings should be taken on site. If the luminance for a particular reading does not meet the requirement of these guidelines, readings should be taken in at least ten locations equally spaced apart in the space. If more than 30% of the readings do not meet the requirements of these guidelines, the LLL should be replaced. If between 20% and 30% of the readings do not meet the requirements of these guidelines, the LLL should be checked again in one year or may be replaced.

CHAPTER J ELECTRICAL SYSTEM REQUIREMENTS FOR PASSENGER SHIPS WITH GT < 500

CHAPTER CONTENTS

- J1. APPLICATION
- J2. REGULATIONS AND STANDARDS
- J3. EMERGENCY POWER SOURCE FOR PASSENGER SHIPS WITH GT < 500

J1. APPLICATION

100. Application

101. The present Chapter J applies for the electrical systems of passenger vessels having GT < 500, and are additional to the requirements of Part II, Title 11, Section 7.

J2. REGULATIONS AND STANDARDS

100. Regulations

101. Vessels with GT < 500 under the Brazilian Flag shall comply with the regulations of NORMAM 01.

102. Vessels with GT < 500 under foreign Flags are to comply with National Regulations or, in the absence of those, with the IMO requirements as far as possible.

200. Standards

201. RBNA may refer to other regulations and standards when deemed necessary. These include the IEC publications, notably the IEC 60092 series and IEEE 45.

J3. EMERGENCY POWER SOURCE FOR PASSENGER SHIPS WITH GT < 500

100. Emergency source of electrical power in vessels less than 500 GT

201. All passenger ships with GT < 500 are to be fitted with an emergency power source independent from the main power source.

202. The emergency source of electrical power is to be able to supply at the same time, at least, the services indicated below.

- a. Emergency lighting for a period of 6 hours:
 - a.1. at muster and embarkation stations for survival crafts and over the sides;
 - a.2. at survival crafts, their launching equipment and the water area where they are launched.
 - a.3. in all service and accommodation alleyways, stairways and exits, personnel lifts and shafts;
 - a.4. in the machinery spaces and main generating stations including their control positions;
 - a.5. in all control stations, navigation bridge, machinery control rooms, and at each main and emergency switchboards;
 - a.6. at all stowage positions for firemen's outfits;
 - a.7. at the steering gear;
- b. The required services for a period of 6 hours:
 - b.1. the navigation lights and other lights required by the International Regulations for Preventing Collisions at Sea (COLREGs), in force;
 - b.2. radio installations for calling distress signals and rescue;
 - b.3. navigational equipment;
 - b.4. internal communication system, as required in an emergency;
 - b.5. fire detection and fire alarm system, if existent;

202. Attention is drawn to the specific requirements from national authorities for the services to be supplied by the emergency source of electrical power.

203. The emergency power source may be a battery system or an emergency generator set independent from the main engine.

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