

RESOLUTION A.325(IX) adopted on 12 November 1975
RECOMMENDATION CONCERNING REGULATIONS FOR
MACHINERY AND ELECTRICAL INSTALLATIONS IN
PASSENGER AND CARGO SHIPS



ASSEMBLY - 9th session
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IMCO

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THE ASSEMBLY,

NOTING Article 16(i) of the IMCO Convention concerning the functions of the Assembly,

HAVING CONSIDERED the Recommendations of the Maritime Safety Committee at its thirty-second and thirty-third sessions,

DESIRING TO ADOPT a single Recommendation concerning Regulations for Machinery and Electrical Installations in Passenger and Cargo Ships,

ADOPTS the Recommendation concerning Regulations for Machinery and Electrical Installations in Passenger and Cargo Ships, consisting of the following three Parts:

- Machinery Installations;
- Electrical Installations; and
- Periodically Unattended Machinery Spaces (which supersedes the Recommendation annexed to Resolution A.211(VII)),

RECOMMENDS governments to apply as soon as possible the Recommendation concerning Regulations for Machinery and Electrical Installations in Passenger and Cargo Ships set out at Annex to this Resolution in conjunction with the applicable requirements of the International Convention for the Safety of Life at Sea, 1974,

INVITES all governments concerned:

- (a) to make known the provisions of the regulations for machinery and electrical installations in passenger and cargo ships to shipowners and operators under their jurisdiction;
- (b) to make every effort to ensure that the regulations for machinery and electrical installations in passenger and cargo ships apply to all new ships;
- (c) to inform the Organization of measures taken in this respect,

REQUESTS the Maritime Safety Committee at the appropriate time to redraft the regulations for machinery and electrical installations in passenger and cargo ships for insertion into Chapter II-1 of the International Convention for the Safety of Life at Sea, 1974 and to consider their adoption as amendments to that Convention.

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**RECOMMENDATION CONCERNING REGULATIONS FOR
MACHINERY AND ELECTRICAL INSTALLATIONS IN
PASSENGER AND CARGO SHIPS**

Regulation 1

Definitions

Whenever the phrases defined below occur throughout these Regulations, they shall be interpreted in accordance with the following definitions:

(a) "Normal Operational and Habitable Conditions" means conditions under which the ship as a whole, all her machinery, services, means and aids ensuring propulsion, steerability, safe navigation, fire and flooding safety, internal and external communications and signals, means of escape and winches for emergency lifeboats, as well as the minimum comfortable conditions of habitability are in working order and functioning normally.

(b) "Emergency Conditions" means such conditions 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.

(c) "Main Source of Electrical Power" means a source intended to supply electrical power for all services necessary for maintaining the ship in normal operational and habitable conditions.

(d) "Dead Ship Condition" means the condition under which the main propulsion plant, boilers and auxiliaries are not in operation due to the absence of power.

(e) "Main Generating Station" means the space in which the main source of electrical power is situated.

(f) "Main Switchboard" means a switchboard directly supplied by the main source of electrical power and intended to distribute electrical energy to the ship's services.

(g) "Emergency Source of Electrical Power" means a source of electrical power intended to supply the necessary services in the event of failure of the main source of electrical power.

(h) "Main Steering Gear" means the machinery, the steering gear power units, if any, and ancillary equipment and the means of applying torque to the rudder stock (e.g. tiller or quadrant) necessary for effecting movement of the rudder for the purpose of steering the ship under normal service conditions.

(i) "Auxiliary Steering Gear" means that equipment which is provided for effecting movement of the rudder for the purpose of steering the ship in the event of failure of the main steering gear.

(j) "Steering Gear Power Unit" means:

- (i) in the case of electric steering gear, an electric motor and its associated electrical equipment;
- (ii) in the case of electrohydraulic steering gear, an electric motor and its associated electrical equipment and connected pump;
- (iii) in the case of other hydraulic steering gear, a driving engine and connected pump.

(k) "Maximum Ahead Service Speed" means the greatest speed which the ship is designed to maintain in service at sea at her deepest seagoing draught.

- (l) "Maximum Astern Speed" means the speed which it is estimated the ship can attain at the designed maximum astern power at her deepest seagoing draught.
- (m) "Machinery Spaces" are all machinery spaces of Category A and all other spaces containing propelling machinery, boilers, oil fuel units, steam and internal combustion engines, generators and major electrical machinery, oil filling stations, refrigerating, stabilizing, ventilation and air conditioning machinery and similar spaces; and trunks to such spaces.
- (n) "Machinery Spaces of Category A" are all spaces which contain internal combustion type machinery used either:
- (i) for main propulsion; or
 - (ii) for other purposes where such machinery has in the aggregate a total power of not less than 500 b.h.p., or which contain any oil-fired boiler or oil fuel unit; and trunks to such spaces.
- (o) "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 recording or fire control equipment is centralized.

MACHINERY INSTALLATIONS

Regulation 2

General

- (a) The machinery, boilers and other pressure vessels, associated piping systems and fittings shall be of a design and construction adequate for the service for which they are intended and shall be so installed and protected as to reduce to a minimum any danger to persons on board, due regard being paid to moving parts, hot surfaces and other hazards. The design shall have regard to materials used in construction, the purpose for which the equipment is intended, the working conditions to which it will be subjected and the environmental conditions on board.
- (b) Special consideration shall be given to the reliability of single essential propulsion components. The Administration may require separate propulsion capability sufficient to give the ship a navigable speed, especially in the case of unconventional arrangements.
- (c) Means shall be provided whereby normal operation of propulsion machinery can be sustained or restored even though one of the essential auxiliaries becomes inoperative. Special consideration shall be given to the malfunction of:
- (i) a generator set which serves as a main source of electrical power;
 - (ii) the sources of steam supply;
 - (iii) the arrangements for boiler feed water;
 - (iv) the arrangements which supply fuel oil for boiler(s) or engine(s);
 - (v) the sources of lubricating oil pressure;
 - (vi) the sources of water pressure;
 - (vii) a condensate pump and the arrangements to maintain vacuum in condensers;
 - (viii) the mechanical air supply for boilers;
 - (ix) an air compressor and receiver for starting or control purposes;

- (x) the hydraulic, pneumatic or electrical means for control in main propulsion machinery including controllable pitch propellers;

provided that the Administration, having regard to overall safety considerations, may accept a partial reduction in capability from full normal operation.

- (d) Means shall be provided to ensure that the machinery can be brought into operation from the dead ship condition without external aid.
- (e) All boilers, all parts of machinery, all steam, hydraulic, pneumatic and other systems and their associated fittings which are under internal pressure shall be subjected to an appropriate pressure test before being put into service for the first time.
- (f) Main propulsion machinery and all auxiliary machinery essential to the propulsion and the safety of the ship shall, as fitted in the ship, be capable of operating when the ship is upright and when inclined at any angle of list up to and including 15 degrees either way under static conditions and 22½ degrees under dynamic conditions (rolling) either way and simultaneously inclined dynamically (pitching) 7½ degrees by bow or stern. The Administration may permit deviation from these angles, taking into consideration the type, size and service conditions of the ship.
- (g) Adequate provisions shall be made to facilitate cleaning, inspection and maintenance of main propulsion and auxiliary machinery including boilers and pressure vessels.
- (h) Special consideration shall be given to the design, construction and installation of propulsion machinery systems so that any mode of their vibrations shall not cause undue stresses in this machinery in the normal operating ranges.

Regulation 3

Machinery

- (a) Where risk from over-speeding of machinery exists, means shall be provided to ensure that the safe speed is not exceeded.
- (b) Where main or auxiliary machinery including pressure vessels or any parts of such machinery are subject to internal pressure and may be subject to dangerous overpressure, means shall, where applicable, be provided which will protect against such excessive pressure.
- (c) All gearing and every shaft and coupling used for transmission of power to machinery essential for the propulsion and safety of the ship or persons on board shall be so designed and constructed that it will withstand the maximum working stresses to which it may be subjected in all service conditions. Due consideration shall be given to the type of engines by which it is driven or of which it forms part.
- (d) Internal combustion engines of a cylinder diameter of 200 millimetres or a crankcase volume of 0.6 cubic metre and above shall be provided with crankcase explosive relief valves of an approved type with sufficient relief area. The relief valves shall be arranged or provided with means to ensure that discharge from them is directed so as to minimize the possibility of injury to personnel.
- (e) Main propulsion machinery and, where applicable, auxiliary machinery shall be provided with automatic shut-off arrangements in the case of failures, such as lubricating oil supply failure, which could lead rapidly to complete breakdown, damage or explosion. The Administration may permit provisions for overriding automatic shut-off devices.

Regulation 4***Means of Going Astern***

- (a) Ships shall have sufficient power for going astern to secure proper control of the ship in all normal circumstances.
- (b) The ability of the machinery to reverse the direction of thrust of the propeller in sufficient time, and so to bring the ship to rest within a reasonable distance from maximum ahead service speed shall be demonstrated.
- (c) The stopping times, ship headings and distances recorded on trials, together with the results of trials to determine the ability of ships having multiple propellers to navigate and manoeuvre with one or more propellers inoperative, shall be available on board for the use of the master or other designated personnel*.
- (d) Where the ship is provided with supplementary means for manoeuvring or stopping, these shall be demonstrated and recorded as referred to in paragraphs (b) and (c) of this Regulation.

Regulation 5***Steam Boilers and Boiler Feed Systems***

- (a) Every steam boiler and every unfired steam generator shall be provided with not less than two safety valves of adequate capacity. Provided that the Administration may, having regard to the output or any other features of any boiler or unfired steam generator, permit only one safety valve to be fitted if it is satisfied that adequate protection against overpressure is provided.
- (b) Each oil-fired boiler which is intended to operate without manual supervision shall have safety arrangements which shut off the fuel supply and give an alarm in the case of low water level, air supply failure or flame failure.
- (c) Water tube boilers serving turbine propulsion machinery shall be fitted with a high water level alarm.
- (d) Every steam generating system which provides services essential for the safety of the ship or which could be rendered dangerous by the failure of its feed water supply, shall be provided with not less than two separate feed water systems from and including the feed pumps, noting that a single penetration of the steam drum is acceptable. Means shall be provided which will prevent overpressure in any part of the systems.
- (e) Boilers shall be provided with means to supervise and control the quality of the feed water. As far as practicable means shall be provided to preclude the entry of oil or other contaminants which may adversely affect the boiler.
- (f) Every boiler essential for the safety of the ship and which is designed to have a water level shall be provided with at least two means for indicating its water level, at least one of which shall be a direct reading gauge glass.

* Reference is made to the Recommendation on Information to be included in the Manoeuvring Booklets adopted by the Organization by Resolution A.209(VII).

Regulation 6

Steam Pipe Systems

- (a) Every steam pipe and every fitting connected thereto through which steam may pass shall be so designed, constructed and installed as to withstand the maximum working stresses to which it may be subjected.
- (b) Efficient means shall be provided for draining every steam pipe where otherwise dangerous water hammer action might occur.
- (c) If a steam pipe or fitting may receive steam from any source at a higher pressure than that for which it is designed a suitable reducing valve, relief valve and pressure gauge shall be fitted.

Regulation 7

Machinery Controls

- (a) Main and auxiliary machinery essential for the propulsion and safety of the ship shall be provided with effective means for its operation and control. A pitch indicator shall be provided on the navigating bridge for controllable pitch propellers.
- (b) Where remote control of propulsion machinery from the bridge is provided and the machinery spaces are intended to be manned, the following shall apply:
 - (i) The speed, direction of thrust and, if applicable, the pitch of the propeller shall be fully controllable from the navigating bridge under all sailing conditions, including manoeuvring.
 - (ii) The remote control shall be performed, for each independent propeller, by a control device so designed and constructed that its operation does not require particular attention to the operational details of the machinery. Where more than one propeller is designed to operate simultaneously, these propellers may be controlled by one control device.
 - (iii) The main propulsion machinery shall be provided with an emergency stopping device on the navigating bridge and independent from the bridge control system.
 - (iv) Propulsion machinery orders from the navigating bridge shall be indicated in the engine control room or at the manoeuvring platform as appropriate.
 - (v) Remote control of the propulsion machinery shall be possible only from one station at a time; at one control station interconnected control units are permitted. There shall be at each station an indicator showing which station is in control of the propulsion machinery. The transfer of control between navigating bridge and machinery spaces shall be possible only in the machinery space or machinery control room.
 - (vi) It shall be possible to control the propulsion machinery locally, even in the case of failure in any part of the remote control system.
 - (vii) The design of the remote control system shall be such that in case of its failure an alarm will be given and the preset speed and direction of thrust is maintained until local control is in operation, unless the Administration considers it impracticable.

(viii) Indicators shall be fitted on the navigating bridge for:

- (1) Propeller speed and direction in case of fixed pitch propellers.
- (2) Propeller speed and pitch position in case of controllable pitch propellers.

(ix) An alarm shall be provided at the navigating bridge and in the machinery space to indicate low starting air pressure set at a level which still permits main engine starting operations. If the remote control system of the propulsion machinery is designed for automatic starting, the number of automatic consecutive attempts which fail to produce a start shall be limited to safeguard sufficient starting air pressure for starting locally.

(c) Where the main propulsion and associated machinery including sources of main electrical supply are provided with various degrees of automatic or remote control and are under continuous manned supervision from a control room this control room shall be designed, equipped and installed so that the machinery operation will be as safe and effective as if it were under direct supervision; for this purpose the Regulations 24 to 28 shall apply as appropriate. Particular consideration shall be given to protection against fire and flooding.

(d) Automatic starting, operational and control systems shall in general include provisions for manually overriding the automatic controls. Failure of any part of the automatic and remote control systems shall not prevent the use of the manual override.

Regulation 8

Air Pressure Systems

(a) In every ship means shall be provided to prevent excess pressure in any part of compressed air systems and where water jackets or casings of air compressors and coolers might be subjected to dangerous excess pressure due to leakage into them from air pressure parts. Suitable pressure relief arrangements shall be provided for all systems.

(b) The main starting air arrangements for main propulsion internal combustion engines shall be adequately protected against the effects of backfiring and internal explosion in the starting air pipes.

(c) All discharge pipes from starting air compressors shall lead directly to the starting air receivers, and all starting pipes from the air receivers to main or auxiliary engines shall be entirely separate from the compressor discharge pipe system.

(d) Provision shall be made to reduce to a minimum the entry of oil into the air pressure systems and to drain these systems.

Regulation 9

Arrangements for Oil Fuel, Lubricating Oil and Other Inflammable Oils

(a) Arrangements for the storage, distribution and utilization of oil fuel shall be such as to ensure the safety of the ship and persons on board.

(b) Arrangements for the storage, distribution and utilization of oil used in pressure lubrication systems shall be such as to ensure the safety of the ship and persons on board.

(c) Arrangements for the storage, distribution and utilization of other inflammable oils employed under pressure in power transmission systems, control and activating systems and heat transfer systems shall be such as to ensure the safety of the ship and persons on board.

- (d) In machinery spaces pipes, fittings and valves carrying inflammable oils shall be of a material approved by the Administration, having regard to the risk of fire.

Regulation 10

Bilge Pumping Arrangements for Cargo Ships*

- (a) Ships shall be provided with an efficient bilge pumping plant capable of pumping from and draining any watertight compartment under all practical conditions whether the vessel is upright or listed. Wing suction shall be provided if necessary for that purpose. If the Administration is satisfied that the safety of the ship is not impaired, the bilge pumping arrangements may be dispensed with in particular compartments.
- (b) Ships shall have at least two power pumps connected to the bilge main, one of which may be attached to the propelling unit.

Regulation 11

Ventilating Systems in Machinery Spaces

Category A machinery spaces shall be adequately ventilated so as to ensure that when machinery or boilers contained in them are operating at full power with the ship in the closed (secured) conditions necessary to resist heavy weather, there is still an adequate supply of air to the spaces for the safety and comfort of personnel. Any other machinery space shall be adequately ventilated appropriate for the purpose of that machinery space.

Regulation 12

Protection against Noise

Measures shall be taken to reduce machinery noise in machinery spaces to acceptable levels as determined by the Administration. If this noise cannot be sufficiently reduced the source of excessive noise should be suitably insulated, isolated or a refuge from noise shall be provided if the space requires manned supervision. Ear protectors shall be provided for personnel required to enter such spaces.

Regulation 13

Steering Gear

- (a) (i) Ships shall be provided with a main steering gear and an auxiliary steering gear to the satisfaction of the Administration. The main steering gear and the auxiliary steering gear shall be so arranged that a single failure in one of them so far as is reasonable and practicable will not render the other one inoperative.
- (ii) The main steering gear shall be of adequate strength and sufficient to steer the ship at maximum service speed and this shall be demonstrated. The main steering gear and rudder stock shall be so designed that they will not be damaged at maximum astern speed but this design requirement need not be proved by trials at maximum astern speed and maximum rudder angle.

* For passenger ships reference is made to Regulation 18 of Chapter II-1 of the International Convention for the Safety of Life at Sea, 1974.

- (iii) The main steering gear shall, with the ship at her deepest seagoing draught be capable of putting the rudder over from 35 degrees on one side to 35 degrees on the other side with the ship running ahead at maximum service speed. The rudder shall be capable of being put over from 35 degrees on either side to 30 degrees on the other side in not more than 28 seconds, under the same conditions.
- (iv) The main steering gear shall be operated by power where necessary to fulfil the requirements of sub-paragraph (iii) of this paragraph and in any case in which the Administration would require a rudder stock over 120 millimetres diameter in way of the tiller.
- (v) The main steering gear power unit(s) shall be arranged to start automatically when power is restored after a power failure.
- (vi) The auxiliary steering gear shall be of adequate strength and sufficient to steer the ship at navigable speed and capable of being brought speedily into action in an emergency.
- (vii) The auxiliary steering gear shall be capable of putting the rudder over from 15 degrees on one side to 15 degrees on the other side in not more than 60 seconds with the ship at her deepest seagoing draught while running at one half of her maximum speed ahead of 7 knots whichever is the greater.
- (viii) The auxiliary steering gear shall be operated by power where necessary to fulfil the requirements of sub-paragraph (vii) of this paragraph and in any case in which the Administration would require a rudder stock of over 230 millimetres diameter in way of the tiller.
- (ix) Where the main steering gear comprises two or more identical power units an auxiliary steering gear need not be fitted if:
 - (1) in case of passenger ships the main steering gear is capable of operating the rudder as required by sub-paragraph (iii) of this paragraph while any one of the units is out of operation;
 - (2) in case of cargo ships the main steering gear is capable of operating the rudder as required by sub-paragraph (iii) of this paragraph while operating with all power units.

As far as is reasonable and practicable the main steering gear shall be so arranged that a single failure in its piping or in one of the power units will not impair the integrity of the remaining part of the steering gear.

- (x)
 - (1) Control of the main steering gear shall be provided both on the navigating bridge and in the steering gear compartment. The steering gear control system which provides for control from the navigating bridge, if electric, shall be supplied from the steering gear power circuit from a point within the steering gear compartment.
 - (2) When the main steering gear is arranged according to sub-paragraph (ix) of this paragraph there shall be two independent control systems provided, each of which can be operated from the navigating bridge. Where the control system comprises a hydraulic telemotor, the Administration may waive the requirement for a second independent control system.
 - (3) Where the auxiliary steering gear is power operated, it shall be provided with a control system operated from the bridge and this shall be independent of the control system for the main steering gear.
 - (4) Means shall be provided in the steering gear compartment to disconnect the steering gear control system from the power circuit.

- (xi) A means of communication shall be provided between the navigating bridge and the steering gear compartment.
 - (xii) (1) The exact angular position of the rudder, if power operated, shall be indicated on the navigating bridge. The rudder angle indication shall be independent of the steering gear control system.
 - (2) The angular position of the rudder shall be recognizable in the steering gear compartment.
- (b) In every ship of 70,000 tons gross tonnage and upwards, in addition to the requirements of paragraph (a) of this Regulation the following shall apply:
- (i) The main steering gear shall comprise two or more identical power units and:
 - (1) in case of passenger ships it shall be capable of operating the rudder as required by sub-paragraph (a)(iii) of this Regulation while any one of the units is out of operation;
 - (2) in case of cargo ships it shall be capable of operating the rudder as required by sub-paragraph (a)(iii) of this Regulation while operating with all power units.
- As far as is reasonable and practicable the main steering gear shall be so arranged that a single failure in its piping or in one of the power units will not impair the integrity of the remaining part of the steering gear.
- (ii) In the event of failure of any of the steering gear power units an alarm shall be given on the navigating bridge. Every steering gear power unit shall be capable of being brought into operation either automatically or manually from a position on the navigating bridge. In the event of failure of the power supply to a steering gear control system in operation an alarm shall be given on the navigating bridge. The alternative steering gear control system shall be capable of being brought into operation from a position on the navigating bridge.
 - (iii) An alternative power supply, sufficient at least to supply a steering gear power unit which complies with the requirement of sub-paragraph (a)(vii) of this Regulation, 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 another independent source of power located in the steering gear compartment. This independent source of power shall be used only for this purpose and shall have a capacity sufficient for half an hour of continuous operation.
- (c) Every ship of less than 70,000 tons gross tonnage which is required by sub-paragraph (a)(viii) of this Regulation to be provided with power-operated auxiliary steering gear shall comply with sub-paragraph (b)(iii) of this Regulation except that the power supply need only be sufficient for 10 minutes of continuous operation.

Regulation 14

Electric and Electrohydraulic Steering Gear

- (a) Indicators for running indication of the motors of electric and electrohydraulic steering gear shall be installed on the navigating bridge and at a suitable machinery control position.
- (b) (i) Each electric or electrohydraulic steering gear comprising one or more power units shall be served by at least two circuits fed from the main switchboard. One of the circuits may pass through the emergency switchboard. An auxiliary electric or electrohydraulic steering gear associated with a main electric or electrohydraulic

steering gear may be connected to one of the circuits supplying this main steering gear. The circuits supplying an electric or electrohydraulic steering gear shall have adequate rating for supplying all motors which can be simultaneously connected to it and have to operate simultaneously.

- (ii) Short circuit protection and an overload alarm shall be provided for these circuits and motors. Protection against excess current, if provided, shall be for not less than twice the full load current of the motor or circuit so protected, and shall be arranged to permit the passage of the appropriate starting currents. Where a three-phase supply is used an alarm shall be provided that will indicate failure of any one of the supply phases. The alarms required in this sub-paragraph shall be both audible and visual and situated in a position on the navigating bridge where they can be readily observed.
- (iii) In ships of less than 1,600 tons gross tonnage, if the auxiliary steering gear corresponding to Regulation 13(a)(viii) is not electrically powered or is powered by an electric motor primarily intended for other services, the main steering gear may be fed with one circuit from the main switchboard. Where such an electric motor primarily intended for other services is arranged to power the auxiliary steering gear, sub-paragraph (b)(ii) of this Regulation may be waived by the Administration if satisfied with the protection arrangement.

Regulation 15

Communication between Navigating Bridge and Engine Room

Passenger and cargo ships shall be provided with at least two independent means for communicating orders from the navigating bridge to the position in the machinery space or control room from which the engines are normally controlled: one of these shall be an engine room telegraph providing visual indication of the orders and responses both in the engine room and on the navigating bridge. Consideration should be given to provide a means of communication to any other position(s) from which the engines may be controlled.

Regulation 16

Engineers' Alarm

An engineers' alarm shall be provided to be operated from the engine control room or at the manoeuvring platform as appropriate, and clearly audible in the engineers' accommodation.

Regulation 17

Location of Emergency Installations in Passenger Ships

The emergency source(s) of electrical power, fire pumps, bilge pumps except those specifically serving the spaces forward of the collision bulkhead, any fixed fire-extinguishing installation required by the International Convention for the Safety of Life at Sea, 1974, and other emergency installations which are essential for the safety of the ship shall not be installed forward of the ship's collision bulkhead.

ELECTRICAL INSTALLATIONS

Regulation 18

General

- (a) Electrical installations in passenger and cargo ships shall be such that:
 - (i) all auxiliary services necessary for maintaining the ship in normal operational and habitable conditions will be assured without recourse to the emergency source of power;
 - (ii) services essential for safety will be assured under various emergency conditions; and
 - (iii) the safety of passengers, crew and ship from electrical hazards will be assured.
- (b) Administrations shall take appropriate steps to ensure uniformity in the implementation and application of the provisions of these Regulations in respect of electrical installations*.

Regulation 19

Main Source of Electrical Power

- (a)
 - (i) Every ship, the electrical power of which constitutes the only means of maintaining auxiliary services indispensable for the propulsion and safety of the ship, shall be provided with a main source of power which shall include at least two generating sets.
 - (ii) The power of these sets shall be such that it shall still be possible to ensure the functioning of the services referred to in Regulation 18(a)(i) in the event of any one of these generating sets being stopped.
 - (iii) The arrangements of the ship's main source of power shall be such that the services referred to in Regulation 18(a)(i) can be maintained regardless of the speed and direction of the main propelling engines or shafting.
 - (iv) In addition, the generating plant shall be such as to ensure that with any one generator or its primary source of power out of operation, the remaining generator(s) will be capable of providing the electrical services necessary to start the main propulsion plant from a dead ship condition. The emergency generator may be used for the purpose of starting from a dead ship condition if its capability either alone or combined with that of any other generator is sufficient to provide at the same time those services required to be supplied by subparagraphs (b)(i) to (b)(iv) of Regulations 20 or 21.
 - (v) Where transformers constitute an essential part of the supply system required by this paragraph, the system shall be so arranged as to ensure the same continuity of the supply, as stated in this paragraph.
- (b)
 - (i) A main electric lighting system which shall provide illumination throughout those parts of the ship normally accessible to and used by the passengers or by the crew shall be supplied from the main source of power.

* Reference is made to the Recommendations published by the International Electrotechnical Commission and, in particular, Publication 92 - Electrical Installations in Ships.

- (ii) The arrangement of the main lighting system shall be such that a fire or other casualty in the space(s) containing the main source of power, including transformers, if any, will not render the emergency lighting system required by subparagraphs (b)(i) and (ii) of Regulations 20 or 21 inoperative.
 - (iii) The arrangement of the emergency lighting system shall be such that a fire or other casualty in the space(s) containing the emergency source of power, including transformers, if any, will not render the main lighting system required by this Regulation inoperative.
- (c) The main switchboard shall be so placed relative to one main generating station that, as far as is practicable, the integrity of the normal supply may be affected only by a fire or other casualty in one space. An environmental enclosure for the main switchboard, such as may be provided by a machinery control room situated within the main boundaries of the space, is not to be considered as separating the switchboards from the generators.
- (d) In every ship where the total installed electrical power of the main generators is in excess of 3 megawatts, the main bus bars shall be subdivided into at least two parts which shall normally be connected by removable links or other approved means; so far as is practicable, the connexion of generators and any other duplicated equipment shall be equally divided between the parts. Equivalent alternative arrangements shall be permitted.

Regulation 20

Emergency Source of Electrical Power in Passenger Ships

- (a)
 - (i) Every passenger ship shall be provided with a self-contained emergency source of electrical power.
 - (ii) The emergency source of power, the transitional source of emergency power and the emergency switchboard shall be located above the uppermost continuous deck and shall be readily accessible from an open deck. They shall not be forward of the collision bulkhead*.
 - (iii) The location of the emergency source of power, the transitional source of emergency power and the emergency switchboard in relation to the main source(s) of electrical power shall be such as to ensure to the satisfaction of the Administration that a fire, or other casualty, in the space containing the main source(s) of electrical power or in any machinery space of Category A will not interfere with the supply or distribution of emergency power. As far as practicable, the space containing the emergency source of power, 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(s) of electrical power.
 - (iv) 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.
- (b) The 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. The emergency source of power shall be capable, having regard to starting currents and the transitory nature of certain loads, of supplying simultaneously at least

* Reference is made to the Recommendation on Position of Collision Bulkheads in Cargo Ships adopted by the Organization by Resolution A.324(IX).

the following services for the periods specified hereinafter, if they depend upon an electrical source for their operation:

- (i) For a period of 36 hours, emergency lighting at every embarkation station on deck and over sides as required by Regulations 19 and 30 of Chapter III of the International Convention for the Safety of Life at Sea, 1974.
- (ii) For a period of 36 hours, emergency lighting:
 - (1) in all service and accommodation alleyways, stairways and exits, personnel lift cars;
 - (2) in the machinery spaces and main generating stations including their control positions;
 - (3) in all control stations, and in all machinery control rooms;
 - (4) at the stowage position(s) for firemen's outfits;
 - (5) at the steering gear; and
 - (6) at the sprinkler pump referred to in sub-paragraph (vi) of this paragraph, at the fire pump referred to in sub-paragraph (v) of this paragraph, at the emergency bilge pump, and at the starting positions of their motors.
- (iii) For a period of 36 hours, the navigation lights and other lights required by the International Regulations for Preventing Collisions at Sea, in force.
- (iv) For a period of 36 hours:
 - (1) all internal communication equipment that is required in an emergency;
 - (2) navigational aids as required by Regulation 12 of Chapter V of the International Convention for the Safety of Life at Sea, 1974; where it is unreasonable or impracticable to make such provision the Administration may waive this requirement for ships of less than 5,000 tons gross tonnage;
 - (3) fire detection and its alarm system, and fire door holding and release system; and
 - (4) intermittent operation of the daylight signalling lamp, the ship's whistle, the manual fire alarms and all internal signals that are required in an emergency;unless they have an independent supply from an accumulator battery suitably located for use in an emergency and sufficient for the period of 36 hours.
- (v) For a period of 36 hours one of the fire pumps required by Regulation 47(b) of Chapter II-2 of the International Convention for the Safety of Life at Sea, 1974.
- (vi) For a period of 36 hours the automatic sprinkler pump, if any.
- (vii) For a period of 36 hours the emergency bilge pump and all equipment essential for the operation of electrically powered remote controlled bilge valves.
- (viii) For the period of time required, the steering gear where it is required to be so supplied by Regulation 13(b)(iii).
- (ix) For a period of half an hour the watertight doors which are required by Regulation 13 of Chapter II-1 of the International Convention for the Safety of Life at Sea, 1974 to be power operated together with their indicators and warning signals. Provided the requirements of Regulation 13(i)(ii) of Chapter II-1 of the International Convention for the Safety of Life at Sea, 1974 are complied with, sequential operation of the doors may be permitted providing all doors can be closed in 60 seconds.

- (x) For a period of half an hour the emergency arrangements that will cause the lift cars to deck for the escape of passengers or crew. Sequential emergency decking of the passenger lift cars is permitted.

In the case of ships engaged regularly on voyages of short duration, the Administration may accept a lesser period than the 36 hour period specified in sub-paragraphs (i) to (vii) of this paragraph if satisfied that an adequate standard of safety would be attained. In any case, the reduced periods may not be less than 12 hours.

- (c) The emergency source of power may be either a generator or an accumulator battery.

- (i) Where the emergency source of power is a generator it shall be:

- (1) driven by a suitable prime-mover with an independent supply of fuel having a flashpoint of not less than 43°C;
- (2) started automatically upon failure of the electrical supply from the main power source(s) and shall be automatically connected to the emergency switchboard; those services referred to in paragraph (d) of this Regulation should then be transferred automatically to the emergency generator. 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, but in no more than 45 seconds; and unless a second independent means of starting the emergency generator is provided, the single source of stored energy shall be protected to preclude its complete depletion by the automatic starting system; and
- (3) provided with a transitional source of emergency power according to paragraph (d) of this Regulation.

- (ii) Where the emergency source of power is an accumulator battery it shall be capable of:

- (1) carrying the emergency load without recharging whilst maintaining the voltage of the battery throughout the discharge period within plus or minus 12 per cent of its nominal voltage;
- (2) automatically connecting to the emergency switchboard in the event of failure of the main power supply; and
- (3) immediately supplying at least those services specified in paragraph (d) of this Regulation.

(d) The transitional source of emergency power required by sub-paragraph (c)(i)(3) of this Regulation shall consist of an accumulator battery suitably located for use in an emergency which shall operate without recharging whilst maintaining the voltage of the battery throughout the discharge period within plus or minus 12 per cent of its nominal voltage and be of sufficient capacity and so arranged as to automatically supply in the event of failure of either the main or emergency source of power at least the following services, if they depend upon an electrical source for their operation:

- (i) for half an hour:

- (1) the lighting required by sub-paragraphs (b)(i), (b)(ii) and (b)(iii) of this Regulation;
- (2) all essential internal communication equipment, fire detecting systems and the fire door holding and release equipment required by sub-paragraphs (b)(iv)(1) and (3) of this Regulation; and
- (3) intermittent operation of the services required by sub-paragraph (b)(iv)(4) of this Regulation;

unless, in respect of (2) and (3) above, they have an independent supply for an accumulator battery suitably located for use in an emergency and sufficient for the period specified;

- (ii) power to close the watertight doors but not necessarily to close them all simultaneously;
 - (iii) the indicators which show whether power-operated watertight doors are open or closed;
 - (iv) the sound signals which give warning that the power-operated watertight doors have begun to close.
- (e)
- (i) The emergency switchboard shall be installed as near as is practicable to the emergency source of power.
 - (ii) Where the emergency source of 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.
 - (iii) 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 power or the transitional source of power referred to in sub-paragraph (c)(ii) or paragraph (d) of this Regulation are being discharged.
 - (iv) The emergency switchboard is to be supplied in 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. The arrangement at the emergency switchboard shall be such that the interconnector feeder is disconnected automatically at the emergency switchboard upon failure of the main power supply. 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.
 - (v) In order to ensure ready availability of emergency supplies, 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.
- (f) The emergency generator and its prime-mover and any emergency accumulator battery shall be so arranged as to ensure that it will function at full rated power when it is upright and when inclined at any angle of list up to and including 22½ degrees either way or up to and including 10 degrees inclination either way in the fore and aft direction, or is in any combination of angles within those limits.
- (g) Provision shall be made for the periodic testing of the complete emergency system and shall include the testing of automatic starting arrangements.

Regulation 21

Emergency Source of Electrical Power in Cargo Ships

- (a)
- (i) Every cargo ship shall be provided with a self-contained emergency source of electrical power.
 - (ii) The emergency source of power, the transitional source of emergency power and the emergency switchboard shall be located above the uppermost continuous deck and shall be readily accessible from an open deck. It shall not be forward of the collision bulkhead, if any, except where permitted by the Administration in exceptional circumstances.

- (iii) The location of the emergency source of power, the transitional source of emergency power and emergency switchboard in relation to the main source(s) of electrical power shall be such as to ensure to the satisfaction of the Administration that a fire or other casualty, in the space containing the main source(s) of electrical power or in any machinery space of Category A will not interfere with the supply or distribution of emergency power. As far as practicable, the space containing the emergency sources of power, 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(s) of electrical power.
 - (iv) 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.
- (b) The 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. The emergency source of 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:
- (i) For a period of 3 hours, emergency lighting at every embarkation station on deck and over sides as required by Regulations 19 and 38 of Chapter III of the International Convention for the Safety of Life at Sea, 1974.
 - (ii) For a period of 18 hours, emergency lighting:
 - (1) in all service and accommodation alleyways, stairways and exits, personnel lift cars and personnel lift trunks;
 - (2) in the machinery spaces and main generating stations including their control positions;
 - (3) in all control stations and in all machinery control rooms;
 - (4) at the stowage position(s) for firemen's outfits;
 - (5) at the steering gear; and
 - (6) at the sprinkler pump if any, at the fire pump referred to in sub-paragraph (v) of this paragraph, at the emergency bilge pump if any, and at their starting positions.
 - (iii) For a period of 18 hours, the navigation lights and other lights required by the International Regulations for Preventing Collisions at Sea, in force.
 - (iv) For a period of 18 hours:
 - (1) all internal communication equipment that is required in an emergency;
 - (2) navigational aids as required by Regulation 12 of Chapter V of the International Convention for the Safety of Life at Sea, 1974; where it is unreasonable or impracticable to make such provision the Administration may waive this requirement for ships of less than 5,000 tons gross tonnage;
 - (3) fire detection and its alarm systems; and
 - (4) intermittent operation of the daylight signalling lamp, the ship's whistle, the manual fire alarms, and all internal signals that are required in an emergency;unless they have an independent supply from an accumulator battery suitably located for use in an emergency and sufficient for the period of 18 hours.

- (v) For a period of 18 hours one of the fire pumps required by Regulation 52(b) of Chapter II-2 of the International Convention for the Safety of Life at Sea, 1974 if dependent upon the emergency generator for its source of power.
- (vi) For the period of time required, the steering gear where it is required to be so supplied by Regulation 13(b)(iii).

In the case of ships engaged regularly in voyages of short duration, the Administration may accept a lesser period than the 18 hour period specified in sub-paragraphs (i) to (iv) of this paragraph if satisfied that an adequate standard of safety would be attained. In any case the reduced periods may not be less than 12 hours.

- (c) The emergency source of power may be either a generator or an accumulator battery.
 - (i) Where the emergency source of power is a generator it shall be:
 - (1) driven by a suitable prime-mover with an independent supply of fuel, having a flashpoint of not less than 43°C;
 - (2) started automatically upon failure of the normal electrical supply unless a transitional source of emergency power in accordance with (3) hereafter is provided; where the emergency generator is automatically started, it shall be automatically connected to the emergency switchboard; those services referred to in paragraph (d) of this Regulation should then be connected automatically to the emergency generator; and unless a second independent means of starting the emergency generator is provided the single source of stored energy shall be protected to preclude its complete depletion by the automatic starting system; and
 - (3) provided with a transitional source of emergency power as specified in paragraph (d) of this Regulation unless there is provided an emergency generator capable of supplying the services mentioned in paragraph (d) of this Regulation and which is capable of being automatically started and supplying the required load as quickly as is safe and practicable but in not more than 45 seconds.
 - (ii) Where the emergency source of power is an accumulator battery it shall be capable of:
 - (1) carrying the emergency load without recharging whilst maintaining the voltage of the battery throughout the discharge period within plus or minus 12 per cent of its nominal voltage;
 - (2) automatically connecting to the emergency switchboard in the event of failure of the main power supply; and
 - (3) immediately supplying at least those services specified in paragraph (d) of this Regulation.

(d) The transitional source of emergency power where required by sub-paragraph (c)(i)(3) of this Regulation shall consist of an accumulator battery suitably located for use in an emergency which shall operate without recharging whilst maintaining the voltage of the battery throughout the discharge period within plus or minus 12 per cent of its nominal voltage and be of sufficient capacity and so arranged as to automatically supply in the event of failure of either the main or emergency source of power for half an hour at least the following services if they depend upon an electrical source for their operation:

- (i) the lighting required by sub-paragraphs (b)(i), (b)(ii) and (b)(iii) of this Regulation. For this transitional phase, the required emergency lighting, in respect of the machinery space and accommodation and service areas, may be provided by permanently fixed, individual, automatically charged, relay operated accumulator lamps;

- (ii) all essential internal communication equipment required by sub-paragraph (b)(iv)(1) of this Regulation; and
- (iii) intermittent operation of the services referred to in sub-paragraph (b)(iv)(4) of this Regulation;

unless, in respect of (ii) and (iii) above, they have an independent supply from an accumulator battery suitably located for use in an emergency and sufficient for the period specified.

- (e) (i) The emergency switchboard shall be installed as near as is practicable to the emergency source of power.
 - (ii) Where the emergency source of 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.
 - (iii) 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 power or the transitional source of power referred to in sub-paragraph (c)(ii) or paragraph (d) of this Regulation are being discharged.
 - (iv) The emergency switchboard is to be supplied in 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. The arrangement at the emergency switchboard shall be such that the interconnector feeder is disconnected automatically at the emergency switchboard upon failure of the main power supply. 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.
 - (v) In order to ensure ready availability of emergency supplies, arrangements shall be made where necessary to disconnect automatically non-emergency circuits from the emergency switchboard to ensure that power shall be available automatically to the emergency circuits.
- (f) The emergency generator and its prime-mover and any emergency accumulator battery shall be so arranged as to ensure that it will function at full rated power when it is upright and when inclined at any angle of list up to and including 22½ degrees either way or up to and including 10 degrees inclination either way in the fore and aft direction, or is in any combination of angles within those limits.
- (g) Provision shall be made for the periodic testing of the complete emergency system and shall include the testing of automatic starting arrangements.

Regulation 22

Starting Arrangements for Emergency Generators

- (a) Emergency generators shall be capable of being readily started in their cold condition down to a temperature of 0°C. If this is impracticable, or if lower temperatures are likely to be encountered, consideration is to be given to the provision and maintenance of heating arrangements, acceptable to the Administration, so that ready starting will be assured.
- (b) Each emergency generator which is arranged to be automatically started shall be equipped with approved starting devices with a storage energy capability of at least three consecutive starts. A second source of energy shall be provided for an additional three starts within 30 minutes unless hand (manual) starting can be demonstrated to be effective.

- (c) Provisions shall be made to continuously maintain the stored energy at all times:
- (i) Electrical and hydraulic starting systems shall be maintained from the emergency switchboard.
 - (ii) Compressed air starting systems may be maintained by the main or auxiliary compressed air receivers, through a suitable non-return valve, or by an emergency air compressor energized by the emergency switchboard.
 - (iii) All of these starting, charging and energy storing devices shall be located in the emergency generator room; these devices are not to be used for any other purpose than the operation of the emergency generator set. This does not preclude the supply to the air receiver of the emergency generator set from the main or auxiliary compressed air system through the non-return valve fitted in the emergency generator room.
- (d) (i) When automatic starting is not required by these Regulations and where it can be demonstrated as being effective, hand (manual) starting is permissible, such as manual cranking, inertial starters, manual hydraulic accumulators, powder charge cartridges.
- (ii) When hand (manual) starting is not practicable, the provisions under (b) and (c) of this Regulation shall be complied with except that starting may be manually initiated.

Regulation 23

Precautions against Shock, Fire and Other Hazards of Electrical Origin

- (a) (i) Exposed metal parts of electrical machines or equipment which are not intended to be "live", but which are liable under fault conditions to become "live" shall be earthed (grounded) unless:
- (1) they are supplied at a voltage not exceeding 55 volts direct current or 55 volts, root mean square between conductors; autotransformers shall not be used for the purpose of achieving this alternative current voltage; or
 - (2) they are supplied at a voltage not exceeding 250 volts by safety isolating transformers supplying one consuming device only; or
 - (3) they are constructed in accordance with the principle of double insulation.
- (ii) The Administration may require additional precautions for portable electric lamps, tools or similar apparatus for use in confined or exceptionally damp spaces where particular risks due to conductivity may exist.
- (iii) All electrical apparatus shall be so constructed and so installed that it shall not cause injury when handled or touched in the normal manner.
- (b) Main and emergency switchboards shall be so arranged as to give easy access needed to apparatus and equipment, without danger to attendants. The sides and backs and, where necessary, the fronts of switchboards, shall be suitably guarded. Exposed live parts having voltages to earth (ground) exceeding a voltage to be specified by the Administration shall not be installed on the front of such switchboards. There shall be non-conducting mats or gratings at the front and rear, where necessary.
- (c) (i) The hull return system of distribution shall not be used for any purpose in tankers, nor for power, heating, or lighting in any other ship of 1,600 tons gross tonnage and upwards.

- (ii) The requirement of sub-paragraph (i) of this paragraph does not preclude under conditions approved by the Administration the use of:
 - (1) impressed current cathodic protective systems,
 - (2) limited and locally earthed systems, or
 - (3) insulation level monitoring devices provided the circulation current does not exceed 30 milliamperes under the most unfavourable conditions.
- (iii) Where the hull return system is used, all final subcircuits shall be two-wire and special precautions shall be taken to the satisfaction of the Administration.
- (d)
 - (i) Earthed distribution systems shall not be used in tankers. The Administration may exceptionally permit in such ships the earthing of the neutral for alternating current power networks of 3,000 volts (line to line) and over, provided that any possible resulting current does not flow directly through any of the dangerous spaces.
 - (ii) When a distribution system, whether primary or secondary, for power, heating or lighting, with no connexion to earth is used, a device capable of continuously monitoring the insulation level to earth and of giving an audible or visual indication of abnormally low insulation values shall be provided.
- (e)
 - (i) Except as permitted by the Administration in exceptional circumstances, all metal sheaths and armour of cables shall be electrically continuous and shall be earthed (grounded).
 - (ii) All electric cables shall be at least of a flame retardant type and shall be installed so as not to impair their original flame retarding properties. Administrations may permit the use of special types of cables when necessary for particular applications, such as radio frequency cables, which do not comply with the foregoing.
 - (iii) Cables and wiring serving essential or emergency power, lighting, internal communications or signals shall so far as practicable be routed clear of galleys, laundries, machinery spaces of Category A and their casings and other high fire risk areas. Cables connecting fire pumps to the emergency switchboard shall be of a fire resistant type where they pass through high fire risk areas. Where possible all such cables should be run in such a manner as to preclude their being rendered unserviceable by heating of the bulkheads that may be caused by a fire in an adjacent space.
 - (iv) Where cables which are installed in hazardous areas introduce the risk of fire or explosion in the event of an electrical fault in that space, special precautions against such risks shall be taken to the satisfaction of the Administration.
 - (v) Wiring shall be supported in such a manner as to avoid chafing or other injury.
 - (vi) Terminations and joints in all conductors shall be made such that they retain the original electrical, mechanical, flame retarding and, where necessary, fire resisting properties of the cable.
- (f)
 - (i) Each separate circuit shall be protected against short circuit. Each separate circuit shall also be protected against overload, except in accordance with Regulation 14 or where the Administration may exceptionally otherwise permit.
 - (ii) The rating or appropriate setting of the overload protective device for each circuit shall be permanently indicated at the location of the protection device.
- (g) Lighting fittings shall be arranged to prevent temperature rises that would be injurious to the wiring, and to prevent surrounding material from becoming excessively hot.

- (h) All lighting or power circuits terminating in a bunker or cargo space shall be provided with a multiple pole isolating switch outside the space.
- (i) (i) Accumulator batteries shall be suitably housed, and compartments used primarily for their accommodation shall be properly constructed and efficiently ventilated.
- (ii) Electrical or other equipment which may constitute a source of ignition of inflammable vapours shall not be permitted in these compartments except as permitted in paragraph (j) of this Regulation.
- (iii) Accumulator batteries shall not be located in sleeping quarters. Administrations may permit relaxations from this requirement where hermetically sealed batteries are installed.
- (j) In all spaces where inflammable mixtures are liable to collect, including those on board tankers, and in any compartment assigned principally to accumulator batteries, no electrical equipment shall be installed unless the Administration is satisfied that it is:
- (i) essential for operational purposes;
 - (ii) of a type which will not ignite the mixture concerned;
 - (iii) appropriate to the space concerned; and
 - (iv) appropriately certified for safe usage in the dusts, vapours or gases likely to be encountered.
- (k) In passenger ships, distribution systems shall be so arranged that fire in any main vertical zone as is defined in Regulation 3(b) of Chapter II-2 of the International Convention for the Safety of Life at Sea, 1974 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.

PERIODICALLY UNATTENDED MACHINERY SPACES

Regulation 24

General

- (a) The provisions of Regulations 24 to 32 are additional to all applicable Regulations of the International Convention for the Safety of Life at Sea, 1974. The arrangements provided shall be such as to ensure that the safety of the ship in all sailing conditions, including manoeuvring, is equivalent to that of a ship having the machinery spaces manned.
- (b) Measures shall be taken to the satisfaction of the Administration to ensure that the equipment is functioning in a reliable manner and that satisfactory arrangements are made for regular inspections and routine tests to ensure continuous reliable operation.
- (c) Ships shall be provided with documentary evidence to the satisfaction of the Administration of their fitness to operate with periodically unattended machinery spaces.

Regulation 25***Fire Safety*****(a) *Fire prevention***

- (i) Where necessary, fuel oil and lubricating oil pipelines shall be screened or otherwise suitably protected to avoid as far as is practicable oil spray or oil leakages on hot surfaces or into machinery air intakes. The number of joints in such piping systems shall be kept to a minimum. Special consideration shall be given to high pressure fuel oil pipes; where practicable, leakages from such piping systems shall be collected and arrangements for an alarm be given.
- (ii) Where daily service fuel oil tanks are filled automatically, means shall be provided to eliminate overflow spillages. Similar consideration shall be given to other equipment treating automatically flammable liquids, e.g. oil fuel purifiers, which whenever practicable shall be installed in a special space reserved for purifiers and their heaters.
- (iii) Where oil fuel daily service tanks or settling tanks are fitted with heating arrangements, a high temperature alarm shall be provided if the flashpoint of the oil fuel can be exceeded.

(b) *Fire detection*

- (i) An approved fire detection system based on the self-monitoring principle and including facilities for periodical testing shall be installed in periodically unattended machinery spaces.
- (ii) This fire detection system shall be designed and the detectors so positioned as to detect rapidly the onset of fire in any part of these spaces and under any normal conditions of operation of the machinery and variations of ventilation as required by the possible range of ambient temperatures. Except in spaces of restricted height and where their use is specially appropriate, detection systems using only thermal detectors shall not be permitted. The detection system shall initiate audible and visual alarms distinct in both respects from any other system not indicating fire, in sufficient places to ensure its being heard and observed on the bridge and by a responsible engineer officer. When the bridge is unmanned the alarm shall sound in a place where a responsible person will be on duty. After installation the system shall be tested under varying conditions of engine operation and ventilation. The fire detection system shall be fed automatically from an emergency source of power by a separate feeder if the main source of power fails.
- (iii) Incipient fires in scavenging air belts of main propelling engines shall be detected and alarmed, unless the Administration considers this to be unnecessary in a particular case.
- (iv) Internal combustion engines of 3000 hp and above or having cylinders of more than 300 millimetres bore shall be protected against crankcase explosions by the provision of oil mist detectors.
- (v) Fire in boiler air supply casings and exhausts (uptakes) shall be detected and arrangements for an alarm be given, unless the Administration considers this to be unnecessary in a particular case.

(c) *Fire fighting*

- (i) An approved fixed fire-extinguishing system shall be provided in all ships that are otherwise not required to have this provision by Regulation 52(g), (h), (i) of the International Convention for the Safety of Life at Sea, 1974.

- (ii) Provisions shall be made for immediate water delivery from the fire main system at a suitable pressure, due regard being paid to the possibility of freezing, either by:
 - (1) remote starting arrangements of one of the main fire pumps. One of the starting positions shall be on the navigating bridge and one at the fire control station, if any; or
 - (2) permanent pressurization of the fire main system by one of the main fire pumps.

For ships of less than 1600 tons gross tonnage the Administration may waive this requirement if the arrangement of the machinery space accesses makes it unnecessary.

- (iii) The Administration shall give special consideration to maintain the fire integrity of the machinery spaces, the location and centralization of the fire-extinguishing system controls, the required shut-down arrangements (e.g. ventilation, fuel pumps, etc.) and may require additional fire-extinguishing appliances and other fire-fighting equipment and breathing apparatus.

Regulation 26

Protection against Flooding

- (a) Bilge wells in machinery spaces shall be located and monitored in such a way that the accumulation of liquids is detected at normal angles of trim and heel; they shall be large enough to easily accommodate the normal drainage during the unattended period.
- (b) In cases where the bilge pumps start automatically, means shall be provided to indicate if the influx of liquid is greater than the pump capacity or if the pump is operating more frequently than would normally be expected. In these cases, smaller bilge wells to cover a reasonable period of time may be permitted. Where automatically controlled bilge pumps are provided, special attention shall be given to oil pollution prevention requirements.
- (c) The controls of any valve serving a sea inlet, a discharge below the water-line or a bilge injection system shall be so sited as to allow adequate time for operation in case of influx of water to the space, having regard to the time which could be taken to reach and operate such controls. The level to which the space could become flooded with the ship in the fully loaded condition shall be considered and this may require control from a position above such level.

Regulation 27

Bridge Control of Propulsion Machinery

- (a) Under all sailing conditions, including manoeuvring, the speed, direction of thrust and, if applicable, the pitch of the propeller shall be fully controllable from the navigating bridge.
- (b) The remote control mentioned under paragraph (a) of this Regulation shall be performed by a single control device for each independent propeller, with automatic performance of all associated services, including, where necessary, means of preventing overload of the propelling machinery.
- (c) The main propulsion machinery shall be provided with an emergency stopping device on the navigating bridge and independent from the bridge control system referred to in paragraph (a) of this Regulation.

- (d) Propulsion machinery orders from the navigating bridge shall be indicated in the engine control room or at the manoeuvring platform as appropriate.
- (e) Remote control of the propulsion machinery shall be possible only from one station at a time; at one control station interconnected control units are permitted. There shall be at each station an indicator showing which station is in control of the propulsion machinery. The transfer of control between navigating bridge and machinery spaces shall be possible only in the machinery space or machinery control room.
- (f) It shall be possible to control essential machinery and the propelling machinery locally, even in the case of failure in any part of the automatic or remote control systems.
- (g) The design of the remote automatic control system shall be such that in case of its failure an alarm will be given and the preset speed and direction of thrust is maintained until local control is in operation, unless the Administration considers it impracticable.
- (h) Indicators shall be fitted on the navigating bridge for:
- (i) Propeller speed and direction in case of fixed pitch propellers.
 - (ii) Propeller speed and pitch position in case of controllable pitch propellers.
- (i) The number of automatic consecutive attempts which fail to produce a start shall be limited to safeguard sufficient starting air pressure. An alarm shall be provided to indicate low starting air pressure set at a level which still permits main engine starting operations.

Regulation 28

Communication

A reliable means of vocal communication shall be provided between the engine room, control room or manoeuvring platform as appropriate, the navigating bridge and the engineer officers' accommodation.

Regulation 29

Alarm System

- (a) An alarm system shall be provided which shall indicate any fault requiring attention.
- (b) (i) The alarm system shall sound in the engine room an audible alarm and indicate visually each separate alarm function at a suitable position.
- (ii) The alarm system shall have a connexion to the engineers' public rooms and to each of the engineers' cabins through a selector switch, to ensure connexion to at least one of those cabins. Administrations may permit equivalent arrangements.
- (iii) Audible and visual alarm shall be activated on the navigating bridge for any situation requiring action of the officer on watch or which should be brought to his attention.
- (iv) The alarm system shall as far as is practicable be designed on the fail-to-safety principle.
- (v) The alarm system shall activate the engineers' alarm required by Regulation 16 if an alarm function has not received attention locally within a limited time.

- (c) (i) The alarm system shall be continuously powered with automatic change-over to a stand-by power supply in case of loss of normal power supply.
- (ii) Failure of the normal power supply of the alarm system shall be alarmed.
- (d) (i) The alarm system shall be able to indicate at the same time more than one fault and the acceptance of any alarm shall not inhibit another alarm.
- (ii) Acceptance at the position mentioned in sub-paragraph (b)(i) of this Regulation of any alarm condition shall be indicated at the positions where it was shown. Alarms shall be maintained until they are accepted and the visual indications shall remain until the fault has been corrected, when the alarm system shall automatically reset to the normal operating condition.

Regulation 30

Special Requirements for Machinery, Boiler and Electrical Installations

The special provisions for the machinery, boiler and electrical installations shall be in agreement with the requirements of the Administration and shall contain at least the following provisions:

(a) *Main source of electrical power*

- (i) On ships where the electrical power can normally be supplied by one generator, there shall be provided suitable load shedding arrangements to ensure the integrity of supplies to services required for propulsion, steering and to ensure the safety of the ship. To cover the case of loss of the generator in operation, there shall be adequate provisions for automatic starting and connecting to the main switchboard of a stand-by generator of sufficient capacity to permit propulsion and steering and ensure the safety of the ship with automatic re-starting of the essential auxiliaries including, where necessary, sequential operations. The Administration may waive this requirement in ships of under 1,600 tons gross tonnage, if they think it is impracticable.
- (ii) If the electrical power is normally supplied by more than one generating set simultaneously in parallel operation, there shall be provisions (by load shedding, for instance) to ensure that in case of loss of one of these generating sets, the remaining ones are kept in operation without overload to permit propulsion and steering, and to ensure the safety of the ship.

(b) *Change-over function*

Where stand-by machines are required for other auxiliary machinery essential to propulsion, automatic change-over devices shall be provided. An alarm shall be given on automatic change-over.

(c) *Automatic control and alarm system*

- (i) The control system shall be such that through the necessary automatic arrangements the services needed for the operation of the main propulsion machinery and its auxiliaries are ensured.
- (ii) Means shall be provided to keep the starting air pressure at the required level if internal combustion engines are used for main propulsion.
- (iii) An alarm system complying with Regulation 29 shall be provided for all important pressures, temperatures, fluid levels, etc.

- (iv) An adequate centralized location shall be arranged with the necessary alarm panels and instrumentation indicating any alarmed fault.

Regulation 31

Safety Systems

A safety system shall be provided so that serious malfunction in machinery or boiler operations, which presents an immediate danger, shall initiate the automatic shut down of that part of the plant and an alarm shall be given. Shut down of the propulsion system shall not be automatically activated except in cases which could lead to complete breakdown, serious damage or explosion. Where arrangements for overriding the shut down of the main propelling machinery are fitted, these shall be such as to preclude inadvertent operation. If used, it shall be visually indicated.

Regulation 32

Passenger Ships

Passenger ships shall be specially considered by Administrations as to whether or not their machinery spaces may be periodically unattended and if so whether additional requirements to those stipulated in these Regulations are necessary to achieve equivalent safety to that of normally attended machinery spaces.

RESOLUTION A.325(IX) adopted on 12 November 1975
RECOMMENDATION CONCERNING REGULATIONS FOR
MACHINERY AND ELECTRICAL INSTALLATIONS IN
PASSENGER AND CARGO SHIPS