provided that the period of the special training programme should be at least equivalent in value to the period of the required seagoing service it substitutes; or

.2 a period of up to two years' seagoing service on fishing vessels to be substituted by a period of approved seagoing service evidenced by an approved record book covered by the 1978 STCW Convention. (Note: the text is recommended in the clarifications of MSC/Circ.795)

.4 have passed an appropriate examination or examinations for the assessment of competency to the satisfaction of the Administration. Such examination or examinations should include the material set out in section 5.5. A candidate for examination who holds a valid certificate of competency issued in accordance with the provisions of the 1978 STCW Convention need not be re-examined in those subjects listed in section 5.5 which were passed at a higher or equivalent level for issue of the Convention certificate; and

.5 meet the applicable requirements of section 5.8 in performing designated radio duties in accordance with the Radio Regulations.

8.2 Mandatory minimum requirements for certification of chief engineer officers and second engineer officers of fishing vessels powered by main propulsion machinery of 750 kW propulsion power or more

Every chief engineer officer and second engineer officer serving on a seagoing fishing vessel powered by main propulsion machinery of 750 kW propulsion power or more should hold an appropriate certificate.

Every candidate for certification should:

.1 be not less than 18 years of age;

.2 satisfy the Administration as to medical fitness, particularly regarding eyesight and hearing;

.3 for certification as second engineer officer, have not less than 12 months' approved seagoing service in the engine-room on fishing vessels; however, this period may be reduced to not less than six months if the Administration requires special training which it considers to be equivalent to the approved seagoing service it replaces;

.4 for certification as chief engineer officer, have not less than 24 months' approved seagoing service on fishing vessels of which not less than 12 months should be served while qualified to serve as second engineer officer;

.5 have attended an approved practical fire-fighting course; and

.6 have passed an appropriate examination to the satisfaction of the Administration. Such examination should include the material set out in section 5.7 except that the Administration may vary the requirements for examination and seagoing service for officers of fishing vessels engaged in voyages in limited waters bearing in mind the power of the propulsion machinery and the effect on the safety of all fishing vessels which may be operating in the same waters.

8.2.3 Training to achieve the necessary theoretical knowledge and practical experience should take into account relevant international regulations and recommendations.*

8.2.4 The level of knowledge required under the different paragraphs of the appendices may be varied according to whether the certificate is being issued at chief engineer officer or second engineer officer level.

8.3 Mandatory minimum requirements for certification of personnel in charge of or performing radiocommunication duties on board fishing vessels

8.3.1 *Minimum requirements for certification of GMDSS radio personnel*†

8.3.1.1 Every person in charge of, or performing, radiocommunication duties on a vessel should hold an appropriate certificate or certificates issued or recognized by the Administration under the provisions of the Radio Regulations.

8.3.1.2 The minimum knowledge, understanding and proficiency required for certification under chapter 5, section 5.8.3.4, should be sufficient for radio personnel to carry out their radio duties safely and efficiently. Every candidate for certification should:

.1 be not less than 18 years of age;

.2 satisfy the Administration as to medical fitness, particularly regarding eyesight and hearing;

.3 meet the requirements of section 5.8.3.4; and

.4 be required to pass an examination or examinations to the satisfaction of the Administration.

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* The text of this section should be aligned with any future amendment to the 1995 STCW-F Convention.

† Refer to the Recommendation on radio maintenance guidelines for the global maritime distress and safety system related to areas A3 and A4 adopted by IMO resolution A.702(17).

8.4 Mandatory minimum requirements to ensure the continued proficiency and updating of knowledge for skippers, officers and engineer officers

8.4.1 Every skipper or officer holding a certificate who is serving at sea or intends to return to sea after a period ashore should, in order to continue to qualify for seagoing service, be required at regular intervals not exceeding five years to satisfy the Administration as to:

.1 medical fitness, particularly regarding eyesight and hearing; and

.2 seagoing service as skipper or officer of at least one year during the preceding five years: or

.3 ability to perform fishing vessel operational duties relating to the duties appropriate to the grade of certificate held which are considered to be at least equivalent to the seagoing service required in paragraph 8.4.1.2 or by:

.1 passing an approved test; or

.2 successfully completing an approved course or courses appropriate for skippers and officers who are serving on fishing vessels, especially for re-entrants to seagoing service on these vessels; or

.3 having completed approved seagoing service as an officer for a period of not less than three months on a fishing vessel in a supernumerary capacity, immediately prior to taking up the position for which the certificate is valid.

8.4.2 The refresher and updating courses required by this regulation should be approved by the Administration and include the text of recent changes in international regulations concerning the safety of life at sea and the protection of the marine environment.

8.4.3 The Administration should ensure that the texts of recent changes in international regulations concerning the safety of life at sea and the protection of the marine environment are made available to ships under its jurisdiction.

8.5 Mandatory minimum requirements to ensure the continued proficiency and updating of knowledge for GMDSS radio personnel

8.5.1 Every GMDSS radio personnel holding a certificate or certificates issued or recognized by the Administration should, in order continue to qualify for seagoing service, be required to satisfy the Administration as to the following:

.1 medical fitness, particularly regarding eyesight and hearing, at regular intervals not exceeding five years; and

.2 professional competence:

.1 by approved seagoing service involving radiocommunication duties of at least one year in total during the preceding five years; or

.2 by virtue of having performed functions relating to the duties appropriate to the grade of certificate held which are considered to be at least equivalent to the seagoing service required in paragraph 8.5.1; or

.3 by passing an approved test or successfully completing an approved training course or courses, at sea or ashore, which should include those elements which are of direct relevance to the safety of life at sea, and which are applicable for the certificate that the person is holding, in accordance with the requirements of the 1993 Torremolinos Protocol.

8.5.2 When new modes, equipment or practices are to become mandatory aboard vessels entitled to fly the flag of an Administration, they may require GMDSS radio personnel to pass an approved test or successfully complete an appropriate training course or courses, at sea or ashore, with particular reference to safety duties.

8.5.3 The Administration should ensure that the texts of recent changes in international regulations relating to radiocommunications and relevant to the safety of life at sea are available to ships entitled to fly its flag.

Chapter 9
FAO Code of Conduct for Responsible Fisheries

9.1 Principles and guidelines

9.1.1 Responsible fishing involves:

.1 fishing in such a manner that the total annual fishing mortality allows for the maintenance of the long-term sustainable yield;

.2 fishing in a manner that ensures the productive character of the environment and the biodiversity of the ecosystem are not threatened.

In this regard, nations should promote fishing practices which minimize:

.3 mortality in non-target species, as well as unwanted sizes and sexes of target species;

.4 unobserved fishing mortalities;

.5 undesirable environmental impacts of fisheries.

9.1.2 Responsible fishing practices should include proper care of the retained catch, documentation of retained and discarded catch, as well as information on the origin of catches. Stocks which have been depleted as a result of overfishing should be rehabilitated.

9.2 Responsible harvesting practices

9.2.1 *The management partnership*

9.2.1.1 Fisheries management should be an accountable partnership involving industry, science, conservation, Government and other interested parties.

9.2.2 *Resources assessment and inventory*

9.2.2.1 Governments should be responsible for the assessment and inventory of the resources within their jurisdiction. In the conduct of such assessments, Governments should not ignore the reservoir of information and survey capacity within the fishing industry. Conservation and allocation measures should be made on the best scientific and socio-economic information. In this sense, Governments are urged to be conservative and apply the precautionary approach as appropriate when the data and information regarding resources are uncertain. In giving effect to this

Code, countries should take into account the special requirements of developing countries and their need for adequate financial, scientific and technical co-operation and the importance of the sustainable development of food security.

9.2.3 *Overcapitalization and excessive fishing effort*

9.2.3.1 The establishment of an appropriate balance between fishing effort and resource capacity is a fundamental component of responsible fishing. Governments have exacerbated and continue to exacerbate waste and increase the impediments to change by the establishment of national subsidies and tax-relief programs which foster investment in world fisheries. However, in some instances subsidies may be appropriate to promote conversion to more selective fishing gears, licence buybacks and early retirement programs.

9.2.4 *Discarding by-catch*

9.2.4.1 The worldwide practice of discarding by-catch has negative socio-economic, biological and environmental implications. All fishing countries and stakeholders should take action and co-operate on an international level to minimize losses through discards. Techniques currently used to address this issue include:

.1 reduction in the levels of fishing;

.2 time area closures;

.3 the development of more selective fishing gears and/or fishing modes;

.4 rationalization of regulatory regimes;

.5 broadening the use and promoting the trade of currently unwanted discarded species;

.6 outlawing of wasteful fishing practices;

.7 development of handling methods that increase survival of discarded species.

9.2.5 *Lost fishing gear*

9.2.5.1 Lost or abandoned gears are known to continue fishing and thus add to the fishing mortality imposed on susceptible species. Actions to minimize gear losses are needed. Potential solutions include:

.1 Better, more consistent marking of gear. FAO report 485 proposes a marking system to indicate to other fishermen and seafarers the presence of gear and the direction of the sets.

.2 Gear improvements to better withstand the elements. Time-release mechanisms to create escape areas (windows) or

neutralize the gears' functional aspects should be required for gears which are likely to ghost fish when lost.

.3 Tending of nets and limiting gear deployment to levels that can reasonably be recovered in emergencies and/or within the time authorized for fishing.

.4 Reporting of lost gear (numbers and location) to national management bodies.

9.2.6 *Habitat damage*

9.2.6.1 Certain fishing gears which come into contact with the sea-bed can disturb or damage the habitat and affect the associated benthic communities. The long-term impact of this damage upon fish productivity, marine community structure and biodiversity have been little researched and remain poorly known.

9.2.6.2 No new fishing method should be introduced to an area until data from experimental fishing with the new method have been obtained and have been found to provide reliable estimates of physical disturbance to habitat. If the data indicate substantial disturbance to habitat, the fishing method should not be deployed on a commercial scale until modifications have been developed.

9.2.6.3 Any fishing method used in an area that involves substantial disturbance to habitat should be excluded from representative closed areas of the fishing ground in order to conserve part of the habitat in its undisturbed state. If the entire fishing ground has already been subject to major disturbance, closed areas should be established to permit recovery of part of the habitat.

9.2.7 *Marine reserves*

9.2.7.1 Governments are urged to consider marine reserves as a management tool that can help to maintain the resource base.

9.2.8 *Fish as food*

9.2.8.1 Priority should be given to harvesting fisheries resources for human consumption.

9.2.9 *Economic*

9.2.9.1 Despite the biological basis of fisheries, management should take into consideration the socio-economic nature of traditional, small-scale and individual fisheries. Therefore it is imperative that managers and policy makers adopt the bio-economic social approach in regulating fisheries through fleet optimization and other appropriate strategies taking advantages of the bio-economic models. A cautious and considered approach to the

issue of subsidies, which have a bearing on overcapitalization and overfishing, may be adopted to avoid the deleterious effects of existing and expansionary fisheries.

9.2.10 *Developing fisheries*

9.2.10.1 Entry into new developing fisheries should be based on a management plan that establishes initial harvest and effort levels. The fishery should be scientifically studied and monitored until the extent of the resource has been determined. The fishing mortality (including discard mortality) rate should be determined to be at an acceptable level before additional controlled and monitored fishing effort is permitted.

9.2.11 *Discarding of fishing gear*

9.2.11.1 Suggested strategies for improving compliance of laws concerning discarding of fishing gear at sea include:

- **.1** education;
- **.2** development and adoption of onboard technology for handing of unwanted/damaged gear;
- **.3** port infrastructure to support collection/disposal of unwanted/damaged fishing gear;
- **.4** substitution of environmentally friendly products to fishing operations;
- **.5** regulatory framework to deal with violators.

9.2.12 *Vessel/Gear sector conflicts*

9.2.12.1 Gear and vessel interactions and conflicts are dual in nature – e.g., conflicts which occur as a result of multiple maritime users transiting a given fishing area and those which arise between different gear types.

9.2.12.2 The first set of conflicts is best resolved by insuring that fishers of all types are conversant with established domestic and international rules of the road, appropriate vessel lights and other visual signals indicating vessel activities and/or specified transit sectors, etc.

9.2.12.3 Conflicts between gear types are often resolved by solutions proposed by the fishers, which in turn should be supported by fishery management and Government action.

9.2.13 *National responses*

9.2.13.1 Education and training of fishers as to the existence of the Code of Conduct for Responsible Fisheries and how to conduct fishing in conformance with the Code should be undertaken by national Governments in conjunction with other interested parties.

9.3 Responsible fishing gear/Selectivity

9.3.1 *Definition of selectivity*

9.3.1.1 Fishing selectivity is defined as "The ability to target and capture fish by size and species during harvesting operations, allowing by-catch to be released unharmed. By-catch may include small (or juvenile) fish, non-target fish species, sea birds and other marine organisms encountered during fishing."

9.3.2 *Expectations of selectivity*

9.3.2.1 Selectivity cannot solve the problems of overcapitalization or overfishing; however, the use of selective fishing gear can contribute to the optimal use of marine resources.

9.3.3 *Status of selective gears*

9.3.3.1 Fishing tactics and fishing methods have evolved which are inherently selective and fishermen are fully aware of how these tactics and the rigging of fishing gear can be used to increase or decrease the selectivity of the fishing gears. However, in a global context, it is difficult to categorize the numerous different fishing methods as either "dirty" or "clean" in an environmental sense (with the possible exceptions of poison and explosives which are never appropriate). Examples of the use of any fishing gear can be quoted as causing a negative impact on the environment. The same fishing gear can also be found to be very effective, with little or no impact, under different circumstances.

9.3.4 *Identifying the problem*

9.3.4.1 Administrations should compile an inventory of their fishing fleets, catalogue of fishing gears used, the authorizations to fish and details of the catch and by-catch in relation to the available stocks. Research facilities and personnel should be employed to collect and analyze the data on an ongoing basis and provide an assessment to determine whether there is a need for selectivity. If a need is identified, industry and fishers will have to participate with scientists, technologists and managers to determine the most appropriate selective gear and technology to harvest fish stocks in a sustainable manner.

9.3.5 *By-catch: the failure of selectivity*

9.3.5.1 The lack of selective fishing measures manifests itself in unacceptably high by-catch quantities which are sometimes discarded, resulting in morally unacceptable losses in the global food supply.

9.3.5.2 Countries should encourage/enforce use of selective gears and avoid regulations that contribute to the by-catch problem. Industry must fully adopt selective gear. Notwithstanding the need or desirability for increased

market utilization of by-catch, avoidance of waste through the adoption of selective fishing measures should be promoted.

9.3.6 *Selectivity by size*

9.3.5.2 Size selectivity in mobile gear can be achieved by mesh size in the cod-end, which has traditionally been chosen to reflect the size of the target species. Recent developments in trawl selectivity allow the escape of non-target species by devices and panels in other parts of the net. Fixed gear such as pots can achieve maximum size by the entrance and mesh size or bar space, while longlines tend to catch the larger fish in the populations. Small pelagic fish tend to school together in large schools of the same size and species. This means that size and species selectivity is not a problem in many pelagic fishing gears (midwater trawls, purse seines). Opportunities to improve selectivity lie in further research including the optimum sizes for capture.

9.3.7 *Selectivity by species*

9.3.7.1 Species selectivity can be achieved by such devices as the Nordmore grate or by separator panels when only a limited amount of species are present and the behaviour of the species is different. Problems occur in mobile gear when the size and behaviour of the target species and by-catch are similar. Greater species selectivity can be achieved by exploiting the behavioural differences between species (e.g., fish and shrimp). It is noted that fish behaviour is an important influence on the selectivity of fishing gears. It is emphasized that research is needed in the area and that assistance to developing countries is required in this respect.

9.3.8 *Survival of escaping fish*

9.3.8.1 Evidence indicates that demersal fish species have high rates of survival after passing through the cod-end. Pelagic fish tend to be more sensitive to damage, but it is noted that such fish are not usually subject to mesh-size selectivity. Survival rates should be considered when introducing any new technology.

9.3.9 *Introduction of successes*

9.3.9.1 Administrations should take note of the successful introduction of selective gear in other countries. The by-catch problem in several fisheries has been reduced by the introduction of selective devices. There are examples. In the North Atlantic, a 95% reduction of by-catch has been achieved by using the Nordmore Grate.

9.3.10 *Adoption of new technologies*

9.3.10.1 Adopting new or modified technologies, non-technical selectivity measures or other alternatives must be realistic. Voluntary acceptance is the

key to success; however, for complete acceptance, incentives, regulation and enforcement may be necessary. This must be balanced with efforts in education, training and the promotion of selectivity. Ongoing evaluation of performance is required. Administrations and industry must be equally committed for any adoption to be successful.

9.3.11 *Information sharing*

9.3.11.1 Information sharing and co-operation among countries and fishing sectors is essential for the successful use of selectivity measures.

9.3.12 *Shared fish stocks*

9.3.12.1 Where fish stocks are shared and use of selectivity measures is required, these measures must be common to each country.

9.3.13 *Socio-economic issues*

9.3.13.1 The socio-economic context of a fishery must be considered in relation to the introduction of fishing gear selectivity measures. While an introduction of gear might be technically and economically feasible in the long term, serious difficulties for the community can be created if measures are implemented suddenly. This can be a concern in fisheries where traditionally, economic returns or employment depend on some by-catch or where a fishery is vulnerable to any reduction in target catch and economic returns are marginal.

9.3.14 *Regional transfer of technical measures*

9.3.14.1 The design of gear or selective devices intended for a particular application are not necessarily transferable between fisheries of regions. The combined effects of towing speed, temperature, species characteristics and harvesting strategies/gear types together produce significant regional differences in the need and solution for selectivity. Therefore re-testing of devices and/or approaches is required prior to adoption in a new region. Trials of selective gears should also have both technical and biological dimensions. The transfer of methodology to developing countries may be desirable.

9.4 Energy optimization

9.4.1 Energy is essential to economic and social development and improved quality of life. Much of the world's energy, however, is currently produced and consumed in ways that could not be sustained if technology were to remain constant and if overall quantities were to increase substantially.

9.4.2 There are considerable differences in energy optimization needs between developed and developing fisheries and between large-scale and small-scale fisheries.

9.4.3 To ensure that an optimization technique is applicable, the following should be considered:

.1 real needs identified;

.2 economic feasibility;

.3 socially acceptable technology with no negative impact on the community;

.4 equitable access to technology;

.5 long-term, continuous availability of energy, materials, service and maintenance;

.6 existence of operating skills;

.7 educational, instructional and technology transfer capabilities;

.8 fisheries development achieved with respect to the environment as a whole.

9.4.4 Administrations, owners, managers and fishers should take into account the following guidelines in the planning, management and conduct of fish harvesting and post-harvesting operations.

9.4.4.1 *Fishing vessels*

Owners and managers should ensure that:

.1 energy-optimization concepts are incorporated into the construction and maintenance of fishing vessel hulls;

.2 new hull designs include energy-saving features such as higher length/beam ratio, bulbous bows;

.3 vessel hulls are routinely cleaned and coated with antifouling paint;

.4 alternative and innovative energy-efficient designs, such as multi-hulls are considered;

.5 vessel weight is reduced in new construction through the use of alternative materials such as aluminium and FRP;

.6 existing hulls are retrofitted with established energy-saving concepts such as bulbous bows.

9.4.4.2 *Propulsion and auxiliary systems*

Energy-optimization concepts should be incorporated, wherever feasible, into the installation, operation, and maintenance of propulsion and auxiliary systems. Owners and managers should:

.1 ensure engines and propellers are matched to vessel type and operation;

.2 consider installing ducted propellers and controllable pitch propellers;

.3 consider sail-assisted propulsion;

.4 consider incorporating waste heat recovery technology in larger vessels;

.5 consider using alternative fuels, for possible reduction in atmospheric and marine pollution.

9.4.4.3 *Navigation and detection*

Owners, managers and fishers should ensure that energy optimization is achieved through the use of navigation and detection aids and should make:

.1 maximum use of compass, charts and electronic aids;

.2 maximum use of acoustic and oceanographic data, fish behaviour and migratory patterns to optimize fuel consumption during fishing operations.

9.4.4.4 *Operations*

9.4.4.4.1 Energy optimization should be a guiding factor in developing vessel and fleet strategies.

9.4.4.4.2 Vessels should be operated at the most effective speed for the fishing operation.

9.4.4.4.3 Computer simulation packages should be considered as an aid to operational planning and vessel analysis.

9.4.4.5 *Fishing gear*

9.4.4.5.1 Energy efficiency should be an integral part of fishing gear design, operation and maintenance.

9.4.4.5.2 Fishing gear should be designed and selected according to vessel propulsion systems, targeted fish behaviour and deck handling capabilities.

9.4.4.5.3 Gear should be properly maintained during fishing operations.

9.4.4.5.4 Materials that improve gear performance should be used.

9.4.4.5.5 Energy consumption should be monitored.

9.4.4.6 *Processing and handling*

Several factors can result in efficient energy consumption:

.1 deck design for optimal product handling and gear operation;

.2 quality improvement;

.3 chilling, refrigeration and preserving capabilities should match harvest rate;

.4 optimum use of insulation.

9.4.4.7 *Resource management*

9.4.4.7.1 Harvest-management plans should take into account energy-saving guidelines developed.

9.4.4.7.2 Fishery managers should recognize that management techniques such as quota systems, vessel and gear regulations can have a major impact on energy optimization in fishing operations.

9.4.4.8 *Protection of the atmosphere*

9.4.4.8.1 Provision should be made for reducing dangerous substances in exhaust gas emissions. Vessels should be fitted with energy-optimization devices and equipment to reduce the emission of ozone-depleting substances.

9.4.4.8.2 Marine machinery should be effectively operated and maintained to ensure exhaust emissions of CO_2, NO_X and SO_X do not exceed regulation levels (Guidelines for the Application of the Montreal Protocol to the Vienna Convention).

9.4.4.8.3 Provision should be made for phasing out CFCs in the refrigeration systems of fishing vessels. Ensure those in shipbuilding and the fishing industry are informed of the timeframe.

9.4.4.8.4 Appropriate action should be taken for the refit of existing vessels and for the inclusion of alternative refrigerants to CFCs and to halon in fire-fighting installations in specifications for new vessels.

9.4.4.8.5 International guidelines should be followed for the disposal of CFCs.

APPENDICES

Appendix 1

Training in radar observation and plotting syllabus for recommended training programme

1 General

1.1 The following training programme should be undertaken to fulfil the minimum knowledge requirements of sections 5.3.4, 5.4.4 and 5.5.3 of this Document. In order to achieve the practical aims of this programme, demonstrations of, and practice in, radar observation should be undertaken where appropriate on functional marine radar equipment, including the use of simulators or other effective means approved by the Administration. Plotting exercises should preferably be undertaken in real time in order to increase awareness of the hazards of the improper use of radar data and to improve plotting techniques to achieve a standard of radar plotting commensurate to that necessary for the safe execution of collision avoidance manoeuvring under actual seagoing conditions. Both the capabilities and limitations of radar as an aid to navigation, collision avoidance and fishing should be dealt with.

2 Theory

2.1 *Factors affecting performance and accuracy*

2.1.1 Elementary understanding of the principles of radar; range and bearing measurement. Characteristics of the radar set which determine the quality of the radar display; the radar antenna; polar diagrams; the effects of power radiated in directions outside the main beam; non-technical description of the radar system including variations in the features encountered in different types of radar sets. Performance monitors. Equipment factors which affect maximum and minimum detection ranges and accuracy of information.

2.1.2 Marine radar performance specification (IMO resolution A.477 (XII)).

2.1.3 Effects of the siting of the radar antenna, shadow sectors and arcs of reduced sensitivity, false echoes, effects of antenna height on detection ranges, etc. Siting radar units and storing spares near magnetic compasses; magnetic safe distance.

2.1.4 Radiation hazards. Safety precautions to be taken in the vicinity of antenna and open waveguides.

2.2 *Detection of misrepresentation of information including false echoes and sea returns*

2.2.1 A knowledge of the limitations to target detection is essential to enable the observer to estimate the dangers of failure to detect targets. The following factors should be emphasized:

.1 performance standards of the equipment;

.2 brilliance, gain and video processor control settings;

.3 radar horizon;

.4 size, shape, aspect and composition of targets;

.5 effects of the motion of the ship in a sea-way;

.6 propagation conditions;

.7 meteorological conditions, sea clutter and rain clutter;

.8 anti-clutter control settings;

.9 shadow sectors;

.10 radar-to-radar interference.

2.2.2 Factors which might lead to faulty interpretation: false echoes, effects of nearby pylons and large structures, effects of power lines crossing rivers and estuaries, echoes from distant targets occurring on second or later traces.

2.2.3 Aids to interpretation: corner reflectors, radar beacons. Detection and recognition of land targets; the effects of topographical features; effects of pulse length and beam width. Radar-conspicuous and -inconspicuous targets; factors which affect the echo strength from targets.

3 Practice

3.1 *Setting up and maintaining displays*

3.1.1 The various types of radar display mode; unstabilized ship's-head-up relative motion, ship's-head-up and north-up stabilized relative motion, true motion.

3.1.2 The effects of errors on the accuracy of information displayed; effects of compass errors on stabilized and true-motion displays, effects of log errors on a true-motion display, effects of inaccurate speed settings on a true-motion display.

3.1.3 Methods of detecting inaccurate speed settings on true-motion controls. Effects of receiver noise limiting ability to display weak echo returns, effects of saturation by receiver noise, etc. Adjustments of operational controls; criteria which indicate optimum points of adjustment, importance of proper sequence, etc. Effects of maladjusted controls, detection of maladjustments and correction of controls:

.1 affecting detection ranges;

.2 affecting accuracy.

3.1.4 Dangers of using radar equipment with maladjusted controls.

3.1.5 Need for frequent regular checking of performance, relationship of performance indicator to range performance of the radar set.

3.2 *Range and bearing*

3.2.1 Methods of measuring ranges; fixed range markers, variable range marker. Accuracy of each method and the relative accuracy of the different methods. How range data are displayed; ranges at stated intervals, digital counter, graduated scale, etc. Methods of measuring bearings; rotatable cursor on transparent disc covering the display, electronic bearing cursor and other methods. Bearing accuracy. Inaccuracies due to: parallax, heading marker displacement, centre maladjustment, how bearing data are displayed, graduated scale, digital counter, etc.

3.2.2 Need for regular checking of the accuracy of ranges and bearing, methods of checking for inaccuracies and correcting or allowing for inaccuracies.

4 Plotting techniques and relative motion concepts

4.1 Practice in manual plotting techniques including the use of reflection plotters should have the objective of establishing a thorough understanding of the interrelated motion between own ship and other ships, including the effects of manoeuvring to avoid collision. At the preliminary stages of this training, simple plotting exercises should be designed to establish a sound appreciation of plotting geometry and relative motion concepts. The degree of complexity of exercises should increase throughout the training course until the trainee has mastered all aspects of the subject. Competence can best be enhanced by exposing the trainee to real-time exercises performed on a simulator or using other effective means.

4.2 *Identification of critical echoes*

4.2.1 Position fixing by radar from land targets and sea marks.

4.2.2 Accuracy of position fixing by ranges and by bearings.

4.2.3 Importance of cross-checking accuracy of radar against other navigational aids.

4.2.4 The importance of recording ranges and bearings at frequent and regular intervals when using radar as an aid to collision avoidance.

4.3 *Course and speed of other ships*

4.3.1 Different methods by which course and speed of other ships can be obtained from recorded ranges and bearings:

.1 unstabilized relative plot;

.2 stabilized relative plot; and

.3 true plot.

4.3.2 Relationship between visual and radar observations; detail, accuracy of estimates of course and speed of other ships. Detection of changes in movements of other ships.

4.4 *Time and distance of closest approach of crossing, meeting or overtaking ships*

4.4.1 Use of recorded data to obtain:

.1 measurement of closest approach distance and bearing;

.2 time to closest approach.

4.4.2 The importance of frequent, regular observations.

4.5 *Detecting course and speed changes of other ships*

4.5.1 Effects of changes of course or speed by other ships on their tracks across the display.

4.5.2 Delay between change of course or speed and detection of that change.

4.5.3 Hazards of small changes as compared with substantial changes of course or speed in relation to rate and accuracy of detection.

4.6 *Effects of changes in own ship's course and speed or both*

4.6.1 On a relative-motion display; effects of own ship's movements, effects of other ships' movements; advantages of compass stabilization of a relative display.

4.6.2 Effects of changes in own ship's course and speed or both on a true-motion display.

4.6.3 Effects of inaccuracies; of speed and course settings on a true-motion display, of compass stabilization data driving a stabilized relative-motion display.

4.6.4 Effects of changes in course or speed by own ship on tracks of other ships on the display.

4.6.5 Relationship of speed to frequency of observations.

Appendix 2
Training in automatic radar plotting aids (ARPA)

1 General

1.1 Skippers and officers in charge of a navigational watch on fishing vessels carrying ARPA should be capable of demonstrating a knowledge of the fundamentals and operation of ARPA equipment and the interpretation and analysis of information obtained from this equipment.

1.2 Training facilities should include simulators or other effective means approved by the Administration capable of demonstrating the capabilities, limitations and possible errors of ARPA.

1.3 The facilities mentioned above should provide a capability such that trainees undergo a series of real-time exercises where the displayed radar information, at the choice of the trainee or as required by the instructor, is either in the ARPA format or in the basic radar format. Such flexibility of presentation will enable realistic exercises to be undertaken, providing for each group of trainees the widest range of displayed information available to the user and thus consolidating his ability to use effectively either basic radar or ARPA systems.

1.4 The ARPA training programme should include all items listed in sections 3 and 4 below.

2 Training programme development

2.1 Skippers and officers in charge of a navigational watch should understand the factors involved in decision-making based on the information supplied by ARPA in association with other navigational data inputs, having a similar appreciation of the operational aspects and of system errors of modern electronic navigational systems. This training should be progressive in nature.

3 Theory and demonstration

3.1 *The possible risks of over-reliance on ARPA*

3.1.1 Appreciation that ARPA is only an aid to navigation and that its limitations, including those of its sensors, make over-reliance on ARPA dangerous, in particular using it to keep a look-out. Need to comply at all times with the Basic principles to be observed in keeping a navigational watch on board fishing vessels (IMO resolution A.484(XII)).

3.2 *The principal types of ARPA systems and their display characteristics*

3.2.1 Knowledge of the principal types of ARPA systems in use; their various display characteristics and an understanding of when to use ground- or sea-stabilized modes and north-up, course-up or head-up presentations.

3.3 *IMO performance standards for ARPA*

3.3.1 An appreciation of the Performance Standards for automatic radar plotting aids (ARPA) (IMO resolution A.422 (XI)), in particular the standards relating to accuracy.

3.4 *Factors affecting system performance and accuracy*

3.4.1 Knowledge of ARPA sensor input performance parameters – radar, compass and speed inputs; effects of sensor malfunction on the accuracy of ARPA data.

3.4.2 Effects of the limitations of radar range and bearing discrimination and accuracy; the limitations of compass and speed input accuracies on the accuracy of ARPA data.

3.4.3 Knowledge of factors which influence vector accuracy.

3.5 *Tracking capabilities and limitations*

3.5.1 Knowledge of the criteria for the selection of targets by automatic acquisition.

3.5.2 Factors leading to the correct choice of targets for manual acquisition.

3.5.3 Effects on tracking of "lost" targets and target fading.

3.5.4 Circumstances causing "target swap" and its effects on displayed data.

3.6 *Processing delays*

3.6.1 The delays inherent in the display of processed ARPA information, particularly on acquisition and re-acquisition or when a tracked target manoeuvres.

3.7 *When and how to use the operational warnings, their benefits and limitations*

3.7.1 Appreciation of the uses, benefits and limitations of ARPA operational warnings; correct setting, where applicable, to avoid spurious interference.

3.8 *System operational tests*

3.8.1 Methods of testing for malfunctions of ARPA systems including functional self-testing.

3.8.2 Precautions to be taken after a malfunction occurs.

3.9 *Manual and automatic acquisition of targets and their respective limitations*

3.9.1 Knowledge of the limits imposed on both types of acquisition in multi-target scenarios, effects on acquisition of target fading and target swap.

3.10 *When and how to use true and relative vectors and typical graphic representation of target information and danger areas*

3.10.1 Thorough knowledge of true and relative vectors; derivation of targets' true courses and speeds.

3.10.2 Threat assessment; derivation of predicted closest point of approach and predicted time to closest point of approach from forward extrapolation of vectors; the use of graphic representation of danger areas.

3.10.3 Effects of alterations of course or speed or both of own ship or targets or both own ship and targets on predicted closest point of approach and predicted time to closest point of approach and danger areas.

3.10.4 Effects of incorrect vectors and danger areas.

3.10.5 Benefit of switching between true and relative vectors.

3.11 *When and how to use information on past position of targets being tracked*

3.11.1 Knowledge of the derivation of past positions of targets being tracked, recognition of historic data as a means of indicating recent manoeuvring of targets and as a method of checking the validity of the ARPA's tracking.

4 Practice

4.1 *Setting up and maintaining displays*

4.1.1 The correct starting procedure to obtain the optimum display of ARPA information.

4.1.2 Choice of display presentation; stabilized relative-motion displays and true-motion displays.

4.1.3 Correct adjustment of all variable radar display controls for optimum display of data.

4.1.4 Selection, as appropriate, of required speed input to ARPA.

4.1.5 Selection of ARPA plotting controls, manual and automatic acquisition, vector and graphic display of data.

4.1.6 Selection of the time scale of vectors and graphics.

4.1.7 Use of exclusion areas when automatic acquisition is employed by ARPA.

4.1.8 Performance checks of radar, compass, speed input sensors and ARPA.

4.2 *System operational tests*

4.2.1 System checks and determining data accuracy of ARPA including the trial manoeuvre facility by checking against basic radar plot.

4.3 *When and how to obtain information from ARPA display*

4.3.1 Demonstrate ability to obtain information in both relative- and true-motion modes of display, including:

- **.1** identification of critical echoes;
- **.2** speed and direction of target's relative movement;
- **.3** time to, and predicted range at, target's closest point of approach;
- **.4** course and speeds of targets;
- **.5** detecting course and speed changes of targets and the limitations of such information;
- **.6** effect of changes in own ship's course or speed or both; and
- **.7** operation of the trial manoeuvre.

4.4 *Application of the International Regulations for Preventing Collisions at Sea, 1972, as amended*

4.4.1 Analysis of potential collision situations from displayed information, determination and execution of action to avoid close-quarter situations in accordance with the International Regulations for Preventing Collisions at Sea, 1972, as amended.

Appendix 3
Radar and ARPA simulator course

1 Introduction

1.1 Radar is an aid to navigation and, when properly used, will provide information of value to safe navigation. However, a number of serious collisions have occurred as a result of misinterpretation of the information provided by radar.

2 Objectives

2.1 To provide facilities for skippers and officers in charge of a navigational watch to appreciate how radar and ARPA can be safely used to avoid collisions at sea, their limitations and the hazards of failing to recognize those limitations.

3 The radar and ARPA simulator course

3.1 *Outline*

3.1.1 The course consists of a series of collision-avoidance and navigational exercises in which ships, navigational marks and land are indicated on a marine radar display, the movements of ships being controlled by a marine radar simulator.

3.2 *Equipment*

3.2.1 The simulator should include two or more stations, each with separate helm and engine controls (each station is referred to as "own ship"). In addition, for demonstrating ARPA, the simulator should be capable of simulating 20 or more ship targets.

3.2.2 In view of the increasing number of high-speed surface craft and the expense of trying to adapt existing simulators to take account of this, it is advisable for consideration to be given to the inclusion of a high-speed facility for "own ship" and at least one target when placing an order for a new simulator.

3.2.3 Each "own ship" radar display, together with its control panel, should be installed in a room or cubicle which should also have a plotting table, plotting instruments, reflection plotter, plotting charts, etc.

3.2.4 At least one of the "own ship" radar displays shall be of a type which complies with the Performance Standards for automatic radar plotting aids (ARPA) (IMO resolution A.422 (XI)). The simulator input to the ARPA display shall be such that the ARPA display is capable of being used by the trainee to achieve the practical objectives for ARPA training as laid down in appendix 2.

3.2.5 The display may be one employing an integrated ARPA or a separate ARPA display may be provided in addition to a marine radar display.

3.2.6 An "X/Y" plotter or other graphic terminal with recording facilities should be provided.

3.3 *Length of course*

3.3.1 The course should be of sufficient duration to provide for introduction, explanation of the course, demonstration of equipment and a critical review of what the course has achieved in addition to the exercises for collision avoidance and related discussions for each. It has been found that, with the instructional equipment available and with the methods of instruction so far used, about 36 hours adequately covers the course requirements. The length of the course must, however, be related to the number of students and the type of equipment available.

3.4 *Plan of course*

3.4.1 The course should be designed for mature students with seagoing experience, skippers and mates, many of whom will have extensive experience in the use of radar. The environment in which the course is conducted must be conducive to learning through participation rather than formal classroom teaching or lectures.

3.4.2 Each student in turn should take part in a number of collision-avoidance exercises in which the student will be required to observe the movements of ships as seen on a radar display and form an appreciation of the collision risks involved and actions taken by those ships to avoid collision. The actions taken by "own ships" to avoid collision will be the responsibility of each student in turn.

3.4.3 Following every exercise there should be a discussion amongst all the students, when the exercise should be analysed and actions taken criticized.

3.4.4 Discussions may be followed by demonstrations of the effects of any alternative actions which could have been taken or which were suggested in the discussion. Demonstrations to compare other types of display presentation with that used in the exercise may also be held.

3.4.5 Students should be divided into groups of two or three for each exercise, at least one member of each group being designated skipper and

one the observing officer. Designations should be changed to allow every student at least one turn in command of the "own ship" display.

3.5 *Exercises*

3.5.1 Exercises should be realistic and include those factors which have been criticized by courts, the effects of the Collision Regulations and other factors involved in the use of radar and ARPA as aids to avoid collisions. There should be a clear lesson to be learned from every exercise.

3.5.2 One or more of the following factors should be included in each exercise so that when an error of judgement occurs such factors will be emphasized:

.1 the effects of incomplete or inaccurate information, including the limitations of ARPA data;

.2 the hazards of making assumptions or acting on scanty information;

.3 hazards of an unsafe speed;

.4 the effects of speed and distance on the time available to fully appreciate the developing collision situation, take positive action and correct that action if it is found to be inadequate;

.5 the hazards of failing to comply with those rules of the Collision Regulations which apply in poor visibility;

.6 the advantages of keeping a running plot of a developing situation and the precautions needed if information which can only be obtained from a plot is incomplete or not available;

.7 the dangers of small and cumulative alterations of course or speed or both.

3.5.3 Each exercise, with the discussion that follows and any necessary demonstration, should be planned to occupy not more than one half day. No exercise should continue after decisions have been taken and the dangerous situation has been resolved.

3.5.4 It is essential that all exercises should be clear and uncomplicated. Many of the serious collisions in which the use made of radar has been criticized have, in retrospect, appeared to have occurred after an approach unhampered by other traffic. Any complications which arose were due to the actions of one or both of the ships which collided. Nearly all these serious collisions occurred after a period of approach which commenced where the two ships were ahead or nearly ahead of each other and steering courses within 30° of being reciprocals. The various errors of judgement made during the approach period are of types which would not occur if the Collision Regulations had been followed.

3.5.5 Exercises based on typical collision cases which also involve application of the Collision Regulations are instructive, indicate clearly lessons in the safe use of radar and provide a sound base for discussion. To consolidate correct passage planning and watchkeeping procedures required for effective navigation control in confined waters with heavy traffic, intensive ARPA exercises should be included which involve the approaches to and passage through such waters. However, such tactical exercises which are so complex as cannot be readily analysed using radar only should be avoided in "own ships" not provided with ARPA facility.

3.5.6 It is sometimes advantageous to have an initial exercise during which students are encouraged to use the techniques they have been using at sea, even to make mistakes. After the exercise, plotting techniques should be briefly explained and students observing on the ARPA display or displays should be encouraged to plot, in order to confirm ARPA output data.

3.5.7 The designated skipper of "own ship" must have absolute discretion to use any techniques to obtain radar or ARPA information and manoeuvre "own ship".

3.5.8 Comments and criticism should be reserved until the exercises are completed and it should then, preferably, come from members of the class rather than from the lecturer.

3.6 *Discussion*

3.6.1 After each exercise the class should be assembled for discussion. Records of the exercise should be used, at this time, for analysis.

3.6.2 The discussion should be informal. It should be opened by the lecturer with a brief explanation and analysis of the exercise, but the lecturer should not seek to impose his views. The lecturer should, by guiding the discussion, encourage students to criticize the action taken by "own ships", generally air their views and listen to the comments of fellow students.

3.6.3 Discussion can be fostered by creating the right atmosphere; this is more readily achieved round a table on which models can be manoeuvred to illustrate a point being made than in formal classroom surroundings.

3.6.4 When there are suggestions in favour of alternative avoiding action, the effects of such action can be demonstrated on the radar displays with the aid of the simulator.

3.6.5 Only by free and full discussion of the significant points and lessons illustrated in the exercise can real benefit be obtained from the course.

3.6.6 Experimentation and much effort will be required of the person in charge of the course in order to evolve the best techniques for stimulating and sustaining discussion.

Appendix 4
Radar simulator course

1 Introduction

1.1 Radar is an aid to navigation and, when properly used, will provide information of value to safe navigation. However, a number of serious collisions have occurred as a result of misinterpretation of the information provided by radar.

2 Objectives

2.1 To provide facilities for skippers and mates to appreciate how radar can be safely used to avoid collisions at sea, its limitations and the hazards of failing to recognize those limitations.

2.2 The following training programme should be undertaken to fulfil the minimum knowledge requirements of section 5.2.4 of this Document.

3 The radar simulator course

3.1 *Outline*

3.1.1 The course consists of a series of collision-avoidance and navigational exercises in which ships, navigational marks and land are indicated on a marine radar display, the movements of ships being controlled by a marine radar simulator.

3.2 *Equipment*

3.2.1 The simulator should include two or more stations, each with separate helm and engine controls (each station is referred to as "own ship").

3.2.2 In view of the increasing number of high-speed surface craft and the expense of trying to adapt existing simulators to take account of this, it is advisable for consideration to be given to the inclusion of a high-speed facility for "own ship" and at least one target when placing an order for a new simulator.

3.2.3 Each "own ship" radar display, together with its control panel, should be installed in a room or cubicle which should also have a plotting table, plotting instruments, reflection plotter, plotting charts, etc.

3.2.4 An "X/Y" plotter or other graphic terminal with recording facilities should be provided.

3.3 *Length of course*

3.3.1 The course should be of sufficient duration to provide for introduction, explanation of the course, demonstration of equipment and a critical review of what the course has achieved in addition to the exercises for collision avoidance and related discussions for each. It has been found that, with the instructional equipment available and with the methods of instruction so far used, about 36 hours adequately covers the course requirements. The length of the course must, however, be related to the number of students and the type of equipment available.

3.4 *Plan of course*

3.4.1 The course should be designed for mature students with seagoing experience, skippers and mates, many of whom will have extensive experience in the use of radar. The environment in which the course is conducted must be conducive to learning through participation rather than formal classroom teaching or lectures.

3.4.2 Each student in turn should take part in a number of collision avoidance exercises in which the student will be required to observe the movements of ships as seen on a radar display and form an appreciation of the collision risks involved and actions taken by those ships to avoid collision. The actions taken by "own ships" to avoid collision will be the responsibility of each student in turn.

3.4.3 Following every exercise there should be a discussion amongst all the students when the exercise should be analysed and actions taken criticized.

3.4.4 Discussions may be followed by demonstrations of the effects of any alternative actions which could have been taken or which were suggested in the discussion. Demonstrations to compare other types of display presentation with that used in the exercise may also be held.

3.4.5 Students should be divided into groups of two or three for each exercise, at least one member of each group being designated skipper and one the observing officer. Designations should be changed to allow every student at least one turn in command of the "own ship" display.

3.5 *Exercises*

3.5.1 Exercises should be realistic and include those factors which have been criticized by courts, the effects of the collision regulations and other factors involved in the use of radar as an aid to avoid collision. There should be a clear lesson to be learned from every exercise.

3.5.2 One or more of the following factors should be included in each exercise so that when an error of judgement occurs such factors will be emphasized:

- **.1** the effects of incomplete or inaccurate information;
- **.2** the hazards of making assumptions or acting on scanty information;
- **.3** hazards of an unsafe speed;
- **.4** the effects of speed and distance on the time available to fully appreciate the developing collision situation, take positive action and correct that action if it is found to be inadequate;
- **.5** the hazards of failing to comply with those rules of the collision regulations which apply in poor visibility;
- **.6** the advantages of keeping a running plot of a developing situation and the precautions needed if information which can only be obtained from a plot is incomplete or not available.
- **.7** the dangers of small and cumulative alterations of course or speed or both.

3.5.3 Each exercise, with the discussion that follows and any necessary demonstration, should be planned to occupy not more than one half day. No exercise should continue after decisions have been taken and the dangerous situation has been resolved.

3.5.4 It is essential that all exercises should be clear and uncomplicated. Many of the serious collisions in which the use made of radar has been criticized have, in retrospect, appeared to have occurred after an approach unhampered by other traffic. Any complications which arose were due to the actions of one or both of the ships which collided. Nearly all these serious collisions occurred after a period of approach which commenced where the two ships were ahead or nearly ahead of each other and steering courses within 30° of being reciprocals. The various errors of judgement made during the approach period are of types which would not occur if the collision regulations had been followed.

3.5.5 Exercises based on typical collision cases which also involve application of the collision regulations are instructive, indicate clearly lessons in the safe use of radar and provide a sound base for discussion.

3.5.6 It is sometimes advantageous to have an initial exercise during which students are encouraged to use the techniques they have been using at sea, even to make mistakes. After the exercise, plotting techniques should be briefly explained.

3.5.7 The designated skipper of "own ship" must have absolute discretion to use any techniques to obtain radar information and manoeuvre "own ship".

3.5.8 Comments and criticism should be reserved until the exercises are completed and it should then, preferably, come from members of the class rather than from the lecturer.

3.6 *Discussion*

3.6.1 After each exercise the class should be assembled for discussion. Records of the exercise should be used, at this time, for analysis.

3.6.2 The discussion should be informal. It should be opened by the lecturer with a brief explanation and analysis of the exercise but the lecturer should not seek to impose his views. The lecturer should, by guiding the discussion, encourage students to criticize the action taken by "own ships", generally air their views and listen to the comments of fellow students.

3.6.2 Discussion can be fostered by creating the right atmosphere; this is more readily achieved round a table on which models can be manoeuvred to illustrate a point being made than in formal classroom surroundings.

3.6.4 When there are suggestions in favour of alternative avoiding action, the effects of such action can be demonstrated on the radar displays with the aid of the simulator.

3.6.5 Only by free and full discussion of the significant points and lessons illustrated in the exercise can real benefit be obtained from the course.

3.6.6 Experimentation and much effort will be required of the person in charge of the course in order to evolve the best techniques for stimulating and sustaining discussion.

Appendix 5
Training in operating electronic systems for fishing and navigation

1 The objective of this training is to enable the trainee to be aware of the basic principles of operation of the various electronic equipment for fishing and navigation fitted on fishing vessels; to correctly operate this equipment and to develop an understanding of the accuracy, limitations and use in the context of overall requirements for fishing and navigation.

2 Practical exercises are an essential feature of the course. Exercises should be designed to enable trainees to demonstrate ability to operate equipment and correctly use the information obtained.

3 Where appropriate, training should be provided on the following systems:

.1 *Echo sounders*

The objectives of this course should be to operate echo-sounding equipment and correctly interpret the information on the display. The course content should include basic principles of vessel-borne echo-sounders, types in use at sea, the principal components of general purpose navigational echo-sounding equipment, precautions to be observed in use and accuracy to be expected.

.2 *Loran*

The objectives of this course should be to select the appropriate Loran chain, operate a Loran receiver, interpret correctly the information on the display, apply error corrections, plot Loran co-ordinates to fix position, and determine expected accuracy. The course content should include basic principles and description of the Loran system and typical receivers in use aboard fishing vessels, sources and causes of errors, corrections and expected accuracy, coverage areas and Loran charts.

.3 *Satellite navigator*

The objectives of this course should be to operate the receiver, plot the position and determine expected accuracy. The course content should include basic principles and description of satellite navigation systems, typical receivers in use aboard fishing vessels, sources and causes of errors, corrections and expected accuracy, coverage areas.

.4 *Equipment used for fish finding*

The objectives of this course should be to operate echo-sounders, temperature probes, trawl probes, sonar and other equipment used for fish finding and to correctly interpret the information obtained from the equipment on display. The course content should include the basic principles of using and maintaining such equipment and methods of estimating an amount of catch based on the use of:

.4.1 *Echo-sounders for fishing purposes, including:*

- principles of echo-sounders;
- placement of the transducer;
- echogram paper;
- interpretation of echograms;
- noise and its causes;
- different types of echo-sounders and their special advantages;
- use of different frequencies;
- length of pulse and discrimination of targets;
- maintenance;
- paper shifting;
- control of speed;
- calculation of errors in measurements of depth;
- use of whitelines;
- headline transducers and other net mounted sensing devices; and
- means of expanding sections of the echo-sounder display.

.4.2 *Sonar, including:*

- construction and basic principles of sonar;
- main components;
- classification;
- search methods;
- interpretation of echograms;
- types of sonar equipment;
- obtaining maximum useful information from the equipment;
- calculation of distances and angles for catching certain species;
- doppler effect;
- deviation of sonar signals due to difference in water temperature; and

- interference to sonar signals due to weather, sea and positioning of the transducers.

.4.3 *Other equipment used for fish finding*

- construction and basic principles;
- main components;
- method of use and interpretation of information provided; and
- factors affecting performance.

Appendix 6
Aids to navigation (buoys, navigational marks, light vessels, etc.)

1 The principles and rules of the International Association of Lighthouse Authorities (IALA) Maritime Buoyage System, System "A" or System "B" or both, as appropriate for the waters in which the fishing vessels for which the skippers and mates are being trained will operate.

2 Where further information can be obtained, e.g. charts, light lists, sailing directions.*

3 The danger of placing implicit reliance upon floating navigational aids.

4 The danger of operating too close to navigational aids.

* Until the IALA buoyage system is universally implemented, this item should include whatever information can be obtained on national buoyage systems.

Appendix 7
Meteorology and oceanography

1 Meteorological terms and definitions.

2 The use and application of meteorological instruments in common use on board fishing vessels.

3 The basic principles of the general circulation of the atmosphere.

4 The formation, movement and effects of pressure systems, related to the area in which the trainee will operate.

5 The interpretation of weather messages and charts.

6 The practical use of weather information and information on conditions giving rise to ice formation.

7 Knowledge of tides, currents and water temperature and their effect on safety of navigation and fishing operations.

8 Sources available from which to obtain weather reports and the types of report available.

9 Factors affecting the development of waves.

Appendix 8
Basic training of fishing vessel personnel in fire fighting

1 Basic fire-fighting training should include at least the following theoretical and practical elements:

2 Theory

2.1 The three elements of fire and explosion (the fire triangle):
- **.1** fuel;
- **.2** oxygen; and
- **.3** source of ignition.

2.2 Ignition sources:
- **.1** chemical;
- **.2** biological; and
- **.3** physical.

2.3 Flammable materials:
- **.1** flammability;
- **.2** ignition point;
- **.3** burning temperature;
- **.4** burning speed.,
- **.5** thermal value;
- **.6** lower flammable limit (LFL);
- **.7** upper flammable limit (UFL);
- **.8** flammable range;
- **.9** inerting;
- **.10** static electricity;
- **.11** flashpoint; and
- **.12** autoignition.

2.4 Fire hazard and spread of fire:
- **.1** by radiation;
- **.2** by convection; and
- **.3** by conduction.

2.5 Reactivity.

2.6 Classification of fire and applicable extinguishing agents.

2.7 Main causes of fire on board ships:
- **.1** oil leakage in engine-room;
- **.2** cigarettes;
- **.3** overheating (bearings);
- **.4** galley appliances (stoves, flues, fryers, hotplates, etc.);
- **.5** spontaneous ignition (wastes, etc.);
- **.6** hot work (welding, cutting, etc.);
- **.7** electrical apparatus (short circuit, non-professional repairs); and
- **.8** reaction, self-heating and autoignition.

2.8 Fire detection:
- **.1** fire and smoke detection systems; and
- **.2** automatic fire alarm.

2.9 Fire-fighting equipment:
- **.1** fixed installations on board and locations:
- **.1.1** fire mains, hydrants;
- **.1.2** international shore connection;
- **.1.3** smothering installations, carbon dioxide (CO_2) foam;
- **.1.4** halogenated hydrocarbons;
- **.1.5** automatic sprinkler system;
- **.1.6** emergency fire pump, emergency generator;
- **.1.7** chemical powder applicants; and
- **.1.8** general outline of required and available mobile apparatus;
- **.2** outfits and personal equipment, location on board:
- **.2.1** fire-fighter's outfit, personal equipment;
- **.2.2** breathing apparatus;
- **.2.3** resuscitation apparatus;
- **.2.4** smoke helmet or mask; and
- **.2.5** fireproof lifeline and harness;
- **.3** general equipment:
- **3.1** fire hoses, nozzles, connections, fire axes;
- **.3.2** portable fire extinguishers; and
- **.3.3** fire blankets.

2.10 Construction and arrangements:

- **.1** escape routes;
- **.2** class A, B and C divisions (where appropriate); and
- **.3** inert gas systems.

2.11 Ship fire-fighting organization:

- **.1** general alarm;
- **.2** fire control plans, muster stations and duties of individuals;
- **.3** communications, including ship-shore when in port;
- **.4** personnel safety procedures;
- **.5** periodic on-board drills; and
- **.6** patrol systems.

2.12 Practical knowledge of resuscitation methods.

2.13 Fire-fighting methods:

- **.1** sounding the alarm;
- **.2** locating and isolating;
- **.3** jettisoning;
- **.4** inhibiting;
- **.5** cooling;
- **.6** smothering;
- **.7** extinguishing; and
- **.8** reflash watch.

2.14 Fire-fighting agents:

- **.1** water – solid jet, spray, fog, flooding;
- **.2** foam – high, medium and low expansion;
- **.3** carbon dioxide (CO_2);
- **.4** halon;
- **.5** aqueous film-forming foam (AFFF); and
- **.6** dry chemicals, powder.

3 Practice

3.1 All fishing vessel personnel should undergo the following practical training and satisfy the Administration that they possess the ability to:

- **.1** use various types of portable fire extinguishers;
- **.2** use self-contained breathing apparatus;

- **.3** extinguish smaller fires – e.g., electrical fires, oil fires, propane fires;
- **.4** extinguish extensive fires with water (jet and spray nozzles);
- **.5** extinguish fires with foam, powder or any other suitable chemical agent;
- **.6** fight fire in smoke-filled enclosed spaces wearing self-contained breathing apparatus;
- **.7** extinguish fire with water fog, or any other suitable fire-fighting agent, in an accommodation room or simulated engine-room with fire and heavy smoke;
- **.8** extinguish oil fire with fog applicator and spray nozzles, dry chemical powder or foam applicators; and
- **.9** effect a rescue in a smoke-filled space wearing breathing apparatus.

4 All fishing vessel personnel should satisfy the Administration that they are aware of the necessity of maintaining a state of readiness on board.

5 The practical training listed should take place in spaces which provide truly realistic training conditions (e.g., simulated conditions on board fishing vessels) and, whenever possible and practical, should also be carried out in darkness.

Appendix 9
Proficiency in survival craft

The curriculum should include:

1 Types of emergency situations which may occur, such as collisions, fire, foundering.

2 Principles of survival including:

- **.1** value of training and drills;
- **.2** need to be ready for any emergency;
- **.3** actions to be taken when called to survival craft stations;
- **.4** actions to be taken when required to abandon the fishing vessel;
- **.5** actions to be taken when in the water;
- **.6** actions to be taken when aboard a survival craft;
- **.7** main dangers to survivors.

3 Special duties assigned to each fishing vessel personnel as indicated in the muster list, including the differences between the signals calling all fishing vessel personnel to survival craft and to fire stations.

4 Types of life-saving appliances normally carried on board fishing vessels.

5 Construction and outfit of survival craft and individual items of their equipment.

6 Particular characteristics and facilities of survival craft.

7 Various types of devices used for launching survival craft.

8 Methods of launching survival craft into a rough sea.

9 Action to be taken after leaving the fishing vessel.

10 Handling survival craft in rough weather.

11 Use of painter, sea anchor and all other equipment.

12 Apportionment of food and water in survival craft.

13 Methods of helicopter rescue.

14 Use of the first aid kit and resuscitation techniques.

15 Radio devices carried in survival craft, including emergency position indicating radio beacons.

16 Effects of hypothermia and its prevention, use of protective covers and protective garments.

17 Methods of starting and operating a survival craft engine and its accessories together with the use of fire extinguisher provided.

18 Use of emergency boats and motor lifeboats for marshalling liferafts and rescue of survivors and persons in the sea.

19 Beaching a survival craft.

20 Possible problems following launching of survival craft when the vessel's fishing gear is in the water.

Appendix 10
Training of fishing vessel personnel in personal survival techniques

1 Prospective fishing vessel personnel should be instructed in the following:

.1 types of emergencies which may occur, such as collisions, fire and foundering;

.2 types of life-saving appliances normally carried on fishing vessels;

.3 need to adhere to the principles of survival;

.4 value of training and drills;

.5 need to be ready for any emergency and to be constantly aware of:

.5.1 the information in the muster list, in particular:

.1 their specific duties in any emergency;

.2 their own survival craft station; and

.3 the signals calling all fishing vessel personnel to their survival craft or fire stations;

.5.2 location of their own and spare lifejackets;

.5.3 location of fire alarm controls;

.5.4 means of escape;

.5.5 consequences of panic;

.6 actions to be taken when called to survival craft stations, including:

.6.1 putting on suitable clothing;

.6.2 donning a lifejacket; and

.6.3 collecting additional protection such as blankets, time permitting;

.7 actions to be taken when required to abandon a fishing vessel, such as:

.7.1 how to board survival craft from fishing vessel and water; and

.7.2 how to jump into the sea from a height and reduce the risk of injury when entering the water;

.8 actions to be taken when in the water, such as:

.8.1 how to survive in circumstances of:

.1 fire or oil on the water;

.2 cold conditions;

.3 shark-infested waters; and

.8.2 how to right a capsized survival craft;

.9 actions to be taken when aboard a survival craft, such as:

.9.1 getting the survival craft quickly clear of the fishing vessel and fishing gear;

.9.2 protection against cold or extreme heat;

.9.3 using a drogue or sea anchor;

.9.4 keeping a look-out;

.9.5 recovering and caring for survivors;

.9.6 facilitating detection by others;

.9.7 checking equipment available for use in the survival craft and using it correctly; and

.9.8 remaining, so far as possible, in the vicinity; and

.10 main dangers to survivors and the general principles of survival including:

.10.1 precautions to be taken in cold climates;

.10.2 precautions to be taken in tropical climates;

.10.3 exposure to sun, wind, rain and sea;

.10.4 importance of wearing suitable clothing;

.10.5 protective measures in survival craft;

.10.6 effects of immersion in water and of hypothermia;

.10.7 importance of preserving body fluids;

.10.8 protection against seasickness;

.10.9 proper use of fresh water and food;

.10.10 effects of drinking seawater;

.10.11 means available for facilitating detection by others; and

.10.12 importance of maintaining morale.

2 Prospective fishing vessel personnel should be given practical instruction in at least the following:

.1 donning a lifejacket or immersion suit or both correctly;

.2 entering the water from a height wearing a lifejacket;

.3 swimming while wearing a lifejacket;

.4 keeping afloat without a lifejacket;

.5 boarding lifeboats from a fishing vessel and water while wearing a lifejacket or immersion suit or both;

.6 assisting others to board survival craft;

.7 operation of survival craft equipment including basic operation of portable radio equipment;

.8 streaming a drogue or sea anchor; and

.9 evacuation by helicopter.

Appendix 11

Skippers and officers in charge of a navigational watch: emergency procedures

1 The curriculum for skippers and officers in charge of a navigational watch training in emergency procedures should include as appropriate for the type of fishing vessel concerned:

.1 preparation of contingency plans for response to emergencies;

.2 assessment of damage and damage control;

.3 precautions when beaching a fishing vessel;

.4 action to be taken prior to, and after, grounding;

.5 floating a grounded fishing vessel, with and without assistance;

.6 action to be taken following a collision;

.7 temporary plugging of leakages;

.8 precautions for the protection and safety of persons other than the fishing vessel personnel in emergency situations;

.9 limiting damage and salving the fishing vessel following a fire or explosion;

.10 abandoning the fishing vessel;

.11 emergency steering including use of auxiliary steering gear, rigging and use of jury steering and the means of rigging a jury rudder, where practicable;

.12 arrangements for towing and being taken in tow, in an emergency;

.13 rescuing of persons from a vessel in distress or from a wreck;

.14 assisting a vessel in distress;

.15 man-overboard procedures;

.16 an appreciation of the ways in which action can best be taken when emergencies arise in port. This should include, but not be limited to:

.1 fire on own or nearby vessel or on adjacent port facilities; and

.2 need to proceed to sea in the event of an adverse weather forecast or other compelling reason;

.17 actions to be taken when fishing and the nets or fishing gear become entangled on an underwater obstruction;

.18 actions to be taken when the nets or fishing gear become entangled with those of another fishing vessel;

.19 action to be taken under severe ice accretion;

.20 actions to be taken when stability is unexpectedly adversely affected;

.21 other emergencies that can occur in fishing operations; and

.22 medical evacuation by helicopter.

Appendix 12

Fishing vessel personnel: emergency procedures

1 Fishing vessel personnel should have sufficient knowledge of the emergency situations which could arise on fishing vessels. This knowledge should include, but not necessarily be limited to, the following:

.1 knowledge of the fishing vessel's contingency plans for response to emergencies and the fishing vessel personnel's relevant duties;

.2 action to be taken following fire or collision;

.3 abandoning the fishing vessel;

.4 rescuing persons; and

.5 man-overboard procedures.

Appendix 13
Engineer officers: emergency procedures

1 Engineer officers should have sufficient knowledge of all the engine-room plant and systems as will enable them, as far as possible, to maintain the integrity of the engine-room and, as necessary, the continued operation of the plant. They should also have knowledge of methods available to make port upon failure of various components of the main and auxiliary prime movers or steering equipment.

2 This knowledge should include, but not necessarily be limited to, the following:

.1 isolation of main engine units in the event of malfunction and the action necessary to continue safe operation;

.2 alternative service systems for main engines and auxiliaries;

.3 action to be taken in the event of ingress of seawater into the engine-room;

.4 procedure to be followed in the event of partial or total electrical failure;

.5 procedures for abandoning the fishing vessel and emergency escape routes;

.6 emergency steering, changeover to local or alternative remote control or controls;

.7 the correct use of personal safety equipment during emergencies;

.8 organization of engine-room personnel and facilities to assist in damage control when and where necessary;

.9 all emergency procedures in the event of fire;

.10 procedures to follow to minimize the after effects of fire or explosion in the engine-room; and

.11 emergencies with fishing gear winches, release of fishing gear, etc.

Appendix 14
Training of skippers and officers in charge of a navigational watch in fishing vessel manoeuvring and handling

1 The training and theoretical knowledge required of skippers and officers in charge of a navigational watch should include the following:

.1 manoeuvres when approaching pilot vessels or stations with due regard to weather, tide, headreach and stopping distances;

.2 handling fishing vessels in rivers, estuaries, sandbars, etc., having regard to the effects of current, wind and restricted water on the response to the helm;

.3 manoeuvring in shallow water, including the reduction in keel clearance due to the effect of rolling and pitching;

.4 interaction, between passing ships and the fishing vessel suction and between own fishing vessel and nearby banks (canal effect);

.5 berthing and unberthing under various conditions of wind and tide with and without tugs;

.6 choice of anchorage, anchoring with one or two anchors in limited anchorages and factors involved in determining the length of anchor cable to be used;

.7 dragging, clearing fouled anchors;

.8 dry-docking, both with and without damage;

.9 management and handling of fishing vessels in heavy weather, including assisting a ship, vessel or aircraft in distress, towing operations, means of keeping an unmanageable fishing vessel out of a sea trough, lessening drift and use of oil;

.10 precautions in manoeuvring for launching boats or liferafts in bad weather;

.11 methods of taking on board survivors from lifeboats or liferafts;

.12 ability to determine the manoeuvring and engine characteristics of major types of fishing vessels with special reference to stopping distances and turning circles at various draughts and speeds;

.13 the importance of navigating at reduced speed to avoid damage caused by own fishing vessel's bow or stern wave;

.14 where appropriate, practical measures to be taken when navigating in:

.1 ice or conditions of ice accretion on board; and

.2 tropical waters, among coral reefs, etc.;

.15 the use of, and manoeuvring in, traffic separation schemes;

.16 manoeuvring the fishing vessel during fishing operations with special regard to factors which could adversely affect the fishing vessel's safety during such operations; and

.17 transferring fish at sea from one fishing vessel to another.

Appendix 15
Training of engineer officers in fishing vessel manoeuvring and handling

1 Engineer officers should be aware of the necessity of effective communications between bridge and engine-room and rapid response to bridge orders and the limitation to this speed of response imposed by the characteristics of the machinery.

2 Engineer officers should have sufficient knowledge including, but not necessarily limited to, the following:

.1 various means of on-board communication;

.2 preparation of the plant for manoeuvring;

.3 alternative methods of engine and steering control;

.4 transient characteristics of the propulsion plant and emergency overriding actions under conditions of extreme danger to the fishing vessel or personnel;

.5 safe procedures during manoeuvring and handling under normal or abnormal conditions.

Appendix 16
Fishing vessel construction and stability

1 Training and knowledge of skippers, officers in charge of a navigational watch and, where applicable, engineer officers should include the following:

.1 strength and construction of hull and superstructure

.2 strength and purpose of division bulkheads in fish holds;

.3 watertight and weathertight doors and watertight integrity;

.4 hatchway closures;

.5 effect of water on deck;

.6 purpose and maintenance of freeing ports in bulwarks on open deck;

.7 effect of free surface in tanks and in fish holds;

.8 effect of wet fishing nets, etc., on deck;

.9 effect of the weight of fish on deck and on shelves in fish hold;

.10 for fishing vessels operating in areas where ice accretion is likely to occur, the effect of ice accretion, means for removing ice;

.11 understanding of stability information and inclining test;

.12 full understanding of the dangerous effect of external forces from fishing and other gear – e.g., when catching obstructions on the sea-bed or when gear is acting on a high point in the vessel;

.13 full understanding of the effect of severe wind and rolling in associated sea conditions, especially in following seas;

.14 possible effects on stability of modifications to the fishing vessel or of changes in its fishing gear;

.15 use and effect of anti-rolling devices (stabilizers).

Appendix 17
Syllabus for training in basic immediate action on encountering an accident or other medical emergency on board fishing vessels

This first basic level of instruction should be given to all fishing vessel personnel for service on seagoing fishing vessels early in their vocational training, and preferably during pre-sea training or by means of a short-term training course, to enable them to take immediate action upon encountering an accident or other medical emergency. The following syllabus is intended to enable any fishing vessel personnel to take basic immediate action at the scene of an accident or other medical emergency until the arrival of a person with first aid skills or the person in charge of medical care on board.

1 General principles

1.1 The trainee should be capable of the following the sequence of immediate measures to be taken in cases of emergency.

1.1.1 *Emergency checklist:*

.1 assessment of accident situation;

.2 assessment of own hazard;

.3 unconsciousness;

.4 respiratory arrest;

.5 cardiac arrest;

.6 severe bleeding;

.7 rescue of casualty;

.8 notification of emergency.

2 Body structure and functions

2.1 The trainee should have an understanding of the structure and functions of the human body relevant to this level of training.

3 Positioning of casualty

3.1 The trainee should be capable of applying the appropriate procedure of positioning in an emergency, including:

.1 the recovery position; and

.2 the resuscitation position.

4 The unconscious casualty

4.1 The trainee should be capable of recognizing the signs and hazards of unconsciousness and applying the appropriate measures, including:

.1 keeping the air passage clear;

.2 positioning of an unconscious casualty;

.3 action in case of respiratory or cardiac arrest; and

.4 no food, liquid or other substances by mouth.

5 Resuscitation

5.1 The trainee should be capable of recognizing the necessity of immediate resuscitation and applying it alone and with the assistance of a further person for a minimum period of 10 minutes, including:

.1 control of respiration;

.2 function of reclined position of head;

.3 mouth-to-mouth respiration;

.4 mouth-to-nose respiration; and

.5 cardiac arrest: methods of and limiting factors relating to cardiac massage including cardiopulmonary resuscitation (CPR).

6 Bleeding

6.1 The trainee should be capable of recognizing the hazards of bleeding and of applying the appropriate basic measures, including:

.1 internal/external bleeding;

.2 shock (see paragraph 7 below);

.3 external pad and pressure to site;

.4 positioning of patient; and

.5 application and dangers of tourniquet.

7 Management of shock

7.1 The trainee should be capable of recognizing the main reasons for and signs of shock and applying the appropriate measures of basic shock management, including:

.1 recognition: colour of face, pulse – rate and character; and

.2 most essential measures of shock management, including stopping of bleeding, protection from cooling, early intake of ample fluids if patient is conscious, positioning of patient, no smoking, no alcohol and no active rewarming.

8 Burns and scalds, accidents caused by electric current

8.1 The trainee should be capable of recognizing the signs of burns and scalds and accidents caused by electric current and applying the appropriate measures, including:

.1 burns and scalds – cool area as quickly as possible;

.2 chemical burns – removal of clothes, rinsing with ample water;

.3 chemical burns of eyes – rinsing of eyes with ample water; and

.4 electric current accidents – hazards of rescuer, isolation of casualty, protection from collapse, control of vital functions.

9 Rescue and transportation of casualty

9.1 The trainee should be capable of applying appropriate transportation alone or with the assistance of a third person, taking into account confined spaces and differing heights on board, including:

.1 temporary *ad hoc* aids for transport;

.2 stretcher transport;

.3 transport on a chair;

.4 transport with a triangular cloth;

.5 transport as illustrated in IMGS; and

.6 hazards of transport in cases of injury of pelvis and spine.

10 Other topics

10.1 The trainee should be capable of improvising bandages by means available, and of using the bandaging materials in the emergency kit.

10.2 The trainee should be aware of the dangers of entering enclosed spaces – dangerous gases, lack of oxygen, etc. – and should be capable of taking necessary precautions.

Appendix 18

Syllabus for elementary training in immediate effective action in the case of accidents or illnesses likely to occur on board fishing vessels

This second-level short-term training course is intended to give specified personnel elementary training in medical care to enable them to take immediate effective action in the case of accidents or illnesses likely to occur on board a fishing vessel. The syllabus is intended to equip specified personnel with knowledge of first aid, and is based on the assumption that there may also be on board a person with more advanced training in medical care and techniques (i.e., to the level of appendix 19) or that professional medical assistance will be available from ashore or other ships. The identity or rank of the "specified personnel" may vary according to national arrangements, but under certain systems of certification all skippers and officers in charge of a navigational watch are required to undergo training in first aid at first certificate level. The syllabus is intended to cover the subjects contained in the first aid section of the IMGS or similar national medical guide.

The following training is intended for personnel regardless of the type of fishing vessel in which they may be engaged.

1 Basic immediate action

1.1 It is assumed that trainees will have successfully completed the basic immediate action training referred to in appendix 17, and the opportunity should be taken to repeat and emphasize the major points in that appendix.

2 First aid kit

2.1 The trainee should be familiar with the contents of the fishing vessel's first aid kit as required by national regulations, and their use.

3 Body structure and function

3.1 *The skeletal system*

3.1.1 The trainee should be capable of recognizing the function of the skeletal system, the major parts of the skeleton and the different kinds of bones, by means of a chart or a dummy or both.*

* Reference to use of chart or a dummy does not exclude other suitable means of demonstrating the subject – e.g., audio-visual aids.

3.2 *The muscular system*

3.2.1 The trainee should be capable of recognizing the major muscles of the human body, by means of chart or a dummy or both.*

3.3 *The respiratory system*

3.3.1 The trainee should be capable of recognizing the location and function of the lungs (gas exchange, respiratory rate (composition of inspired/expired air)).

3.4 *The digestive system and abdomen*

3.4.1 The trainee should have an elementary knowledge of the digestive system and abdominal organs.

4 Toxicological hazards on board – poisoning and chemical burns

4.1 The trainee should be capable of recognizing the actions of toxic substances on the human body, symptoms and how to apply appropriate first aid measures, including:

- **.1** symptoms and clinical aspects of poisoning;
- **.2** first aid in case of poisoning by ingestion, inhalation or skin contact;
- **.3** therapy in the case of acid and caustic solutions swallowed;
- **.4** acid and caustic burns, symptoms and treatment; and
- **.5** first aid in cases of poisoning arising from fish handling.

5 Examination of patient

5.1 The trainee should be capable of detailed casualty observations, based upon medical precepts, including:

- **.1** a diagnosis consisting of a large variety of individual facts, partly obtainable from medical history, specific questions, physical examination; and
- **.2** means of information: history, general appearance and examination.

* Reference to use of chart or a dummy does not exclude other suitable means of demonstrating the subject – e.g., audio-visual aids.

6 Spinal injuries

6.1 The trainee should be capable of recognizing the symptoms of spinal injuries, possibly complicated by unconsciousness, and of applying the appropriate first aid measures, including:

.1 control of sensitivity and movement in extremities; and

.2 rescue transport and treatment in the case of suspected fracture of the spine.

7 Burns, scalds, effects of heat and cold

7.1 The trainee should be capable of recognizing the signs of burns and scalds, heatstroke, hypothermia and frostbite and of applying the appropriate first aid measures, including:

.1 definition, complications and therapy of the general condition of burns;

.2 burns/scalds: difference between grade 1, 2, 3 burns and scalds, sterile dressing, first aid;

.3 effects of heat: proper positioning in shade, increased fluid requirement, careful cooling of body; and

.4 hypothermia and frostbite: possibilities of rewarming, difference between burn and frostbite, damage of tissue, first aid.

8 Fractures, dislocations and muscular injuries

8.1 The trainee should have a practical first aid knowledge of how to diagnose and treat fractures, dislocations and muscular injuries, including:

.1 types of fracture; open, closed, complicated and greenstick;

.2 treatment and immobilization of injured part;

.3 special requirements for treating pelvic and spinal injuries; and

.4 symptoms and therapy of sprains, strains and dislocations.

9 Medical care of rescued persons, including distress, hypothermia and cold exposure

9.1 The trainee should have basic knowledge and skill in the case of rescued persons and be capable of recognizing problems in his care, with particular regard to hypothermia, including:

.1 hypothermia: rescue and care of hypothermic persons, precautions against heat loss, effect of wind and humidity;

.2 congelation (cold injury, immersion foot, etc.);

.3 seasickness: cause, therapy;

.4 sunburn: cause, therapy, prophylaxis, effect; and

.5 dehydration and nutrition in rescue situations: frequent errors, hazards.

10 Radio medical advice

10.1 The trainee should be aware of the availability of radio medical advice and methods of obtaining such advice.

11 Pharmacology

11.1 The trainee should be capable of recognizing the main terms of general pharmacology; he should be capable of recognizing the basic principles of antibiotics, antiseptics, analgesics and chemotherapeutics and how to apply them.

12 Sterilization

12.1 The trainee should be capable of recognizing the terms "disinfection" and "sterilization" and to apply appropriate measures.

13 Cardiac arrest, drowning and asphyxia

13.1 The trainee should understand the causes and treatment of cardiac arrest, drowning and asphyxia, including:

.1 ability to apply mouth-to-mouth resuscitation and knowledge of occasions when it cannot be used; and

.2 ability to apply cardiopulmonary resuscitation and a knowledge of limiting factors relating to its use.

Appendix 19

Syllabus for more advanced medical training in the use of the International Medical Guide for Ships (IMGS) or similar national guides

This third-level training course is for more advanced medical training in the use of the IMGS or similar national medical guides and enables skippers and officers in charge of a navigational watch on fishing vessels engaged in operations beyond the range at which evacuation for medical treatment is available to participate effectively in co-ordinated schemes for medical assistance and to provide the sick or injured with a satisfactory standard of medical care while they remain on board.

Where practicable, this training may include practical training at a hospital or similar establishment.

1 First aid

1.1 It is assumed that trainees will have successfully completed the first aid training prescribed in appendix 18. The opportunity can be taken to revise and reinforce the major points in that appendix, including:

- **.1** body structure and function;
- **.2** toxicological hazards on board; and
- **.3** examination of patient.

1.2 In addition to the contents of appendix 18, training should include:

- **.1** simple laboratory tests: measure of urine volume, use and evaluation of sticks, collection of blood for smear, preparation of urethral smear; and
- **.2** additional emphasis should be given to the concepts of clinical examination and medical history taken under seagoing conditions, with particular emphasis on the importance of radio medical advice.

2 Care of casualty

2.1 *Head and spinal injuries*

2.1.1 The trainee should be capable of recognizing the symptoms of head and spinal injuries; care of an unconscious casualty (no anaesthetics/

sedatives); rescue, transport and treatment in the case of suspected spinal fracture, hazard of paralysis.

2.2 *Injuries of ear, nose, throat and eyes*

2.2.1 The trainee should be capable of recognizing symptoms of injuries in this region and applying the appropriate treatment, including:

- **.1** diagnosis, cause, treatment of ear, nose and throat injuries; and
- **.2** injuries of the eye region, injuries of the external eye, aftercare, removal of loose foreign bodies through the use of moistened cotton bud or loop.

2.3 *External and internal bleeding*

2.3.1 The trainee should be capable of recognizing the causes, symptoms and dangers of internal and external bleeding and of applying appropriate measures.

2.4 *Burns, scalds and frostbite*

2.4.1 The trainee should be capable of recognizing the signs of burns, scalds and frostbite, possible complications, and applying the appropriate treatment, including:

- **.1** definition, complications and treatment of burns: general aspects, first aid, further treatment (sterile dressing, shock prophylaxis, fluid balance, antibiotic prophylaxis), pain relief;
- **.2** burns/scalds: difference between grade 1, 2, 3 burns and scalds, first aid, further treatment; and
- **.3** frostbite: difference between burns and frostbite, damage to tissue, first aid, further treatment.

2.5 *Fractures, dislocations and muscular injuries*

2.5.1 The trainee should have a practical knowledge of how to diagnose and treat fractures, dislocations and muscular injuries, including:

- **.1** types of fracture: open, closed, complicated and undisplaced fractures;
- **.2** methods to be employed for the immobilization of the injured part, prevention of infection;
- **.3** special requirements for treating pelvic and spinal injuries; and
- **.4** cause, symptoms and treatment of sprains, strains, and dislocations.

2.6 *Wounds, wound healing and infection*

2.6.1 The trainee should be capable of recognizing the different kinds of wounds and the approximate course of wound healing and should be able to apply the different techniques of wound treatment, preventive measures and treatment of infection, including:

.1 types of wound;

.2 wound healing;

.3 prevention of infection: aseptic procedures, wound cleaning, stopping of bleeding, dressing, immobilization and tetanus prevention; and

.4 infected wounds: inflammation, sources of infection and treatment.

2.7 *Pain relief*

2.7.1 The trainee should be capable of recognizing the general principles of pain relief and anaesthesia and of applying simple procedures, including:

.1 non-medicinal relief: psychological, relaxation, positioning, cooling and warmth;

.2 medicinal treatment: application, risks of abuse, characteristics of remedies; and

.3 non-invasive local anaesthesia.

2.8 *Techniques of sewing and clamping*

2.8.1 The trainee should be capable of applying simple technical measures to stop bleeding and to close wounds, including:

.1 surgical arrest of bleeding and ligature; and

.2 surgical treatment of wound, sutures and removal of sutures, setting and removal of clamps.

2.9 *Management of acute abdominal conditions*

2.9.1 The trainee should be capable of recognizing the signs and symptoms of acute abdominal conditions, such as but not limited to appendicitis, peritonitis, intestinal obstruction, acute urinary retention, abdominal trauma and of applying emergency treatment and recognizing the need for radio medical advice.

2.10 *Minor surgical treatment*

2.10.1 The trainee should be capable of undertaking minor surgical treatment of localized skin infections and injuries and applying the appropriate dressing and medication.

2.11 *Dressing and bandaging*

2.11.1 The trainee should be capable of applying simple dressings, bandages and tubular gauze dressings.

3 Aspects of nursing

3.1 The trainee should be capable of recognizing the general principles of nursing, including:

.1 observation of patient;

.2 patient's behaviour;

.3 cardinal symptoms: skin, respiration, excretion, pulse, blood pressure, body temperature; and

.4 recording of body temperature and other clinical information.

3.2 *Nursing care*

The trainee should be familiar with simple nursing care, including control of pain, injections (subcutaneous and intramuscular only), washing and cold sponging.

4 Diseases

4.1 *Medical conditions and emergencies*

4.1.1 The trainee, where necessary with the aid of radio medical advice, should be capable of recognizing medical emergencies and other conditions likely to be encountered on board a fishing vessel and affecting the following systems:

.1 disorders of mental and central nervous system;

.2 disorders of digestive system and abdominal organs;

.3 diseases of heart, cardiovascular and respiratory system;

.4 diseases of genito-urinary system;

.5 diseases of eyes, skin and ear, nose and throat;

.6 diseases of musculo-skeletal system and joints;

.7 poisoning and allergic reactions;

.8 emergency resuscitative procedures.

4.1.2 The trainee should also be capable of dealing effectively with these conditions, with reference to the IMGS or a similar national medical guide and with radio medical advice until more expert help becomes available or the patient recovers.

4.2 *Sexually transmitted diseases*

4.2.1 The trainee should be capable of recognizing the most important venereal diseases, performing urethral smear and urine tests and applying basic medical treatment and counselling.

4.3 *Tropical and infectious diseases*

4.3.1 The trainee should be capable of recognizing infectious diseases and of applying the basic medical treatment, including:

- **.1** definition and characteristics of infectious diseases;
- **.2** diseases caused by viruses (influenza, pneumonia, etc.);
- **.3** diseases caused by bacteria (salmonellosis, typhoid, cholera, etc.);
- **.4** diseases caused by parasites (dysentery, malaria, etc.);
- **.5** tropical diseases in addition to malaria; and
- **.6** treatment, prevention and isolation, where needed.

4.3.2 Particular emphasis should be placed on the causes, treatment and prevention of gastro-intestinal illnesses on board.

5 Alcohol and drug abuse

5.1 The trainee should be capable of recognizing misuse of alcohol, signs of alcohol dependence and withdrawal damage and of applying appropriate measures.

5.2 The trainee should have a knowledge of potentially addictive drugs and narcotics, including the most frequently encountered substances and their effects on the individual.

5.3 The trainee should be aware of the availability and importance of alcohol and drug counselling.

6 Dental care

6.1 The trainee should have a basic knowledge of dental care and the principles of mouth hygiene and be capable of applying appropriate emergency treatment, including temporary fillings.

7 Gynaecology and pregnancy

7.1 The trainee should have basic knowledge of:

- **.1** pregnancy: signs, side effects, complications;
- **.2** miscarriage; and
- **.3** awareness of diseases and disorders peculiar to women.

8 Medical care of rescued persons, including distress, hypothermia and cold exposure

8.1 Paragraph 9 of appendix 18 should be revised and reinforced.

9 Death at sea

9.1 The trainee should be capable of recognizing the general principles of care of the dying or dead persons, including:

- **.1** signs of death, examination of corpse, time of death, keeping corpse on board; and
- **.2** burial at sea.

10 External assistance

10.1 *Radio medical advice*

10.1.1 The trainee should be capable of putting into use the general principles of radio medical advice, including:

- **.1** how to obtain radio medical advice;
- **.2** national and international radio medical advice systems;
- **.3** modes of contact (telephony, telegraphy, telex, etc.);
- **.4** objective of radio medical advice and the function of advisory services;
- **.5** difficulties for the advising doctor; and
- **.6** use of the appropriate checklist and the medical section of the International Code of Signals.

10.2 *Transportation of the ill and injured*

10.2.1 The trainee should be capable of recognizing the problems of transport of the ill and injured, and of using the approved stretcher. He should also be aware of procedures for helicopter evacuation.

10.3 *Medical care of ill fishermen*

10.3.1 The trainee should be capable of recognizing the principles of co-operation with port health authorities or outpatient wards in ports, including:

- **.1** language barriers and cultural differences; and
- **.2** detailed medical records.

11 Environmental control on board fishing vessels

11.1 *Hygiene*

11.1.1 The trainee should be capable of recognizing the main principles of shipboard hygiene and health education on board fishing vessels, including:

.1 personal hygiene;

.2 hygiene problems;

.3 potable water;

.4 sewage disposal;

.5 ventilation and air-conditioning;

.6 food hygiene; and

.7 aspects of healthy living.

12 Disease prevention

12.1 *Disinfection, disinfestation, deratting*

12.1.1 The trainee should be capable of recognizing the general principles and procedures of protection against transmission of diseases and control of epidemics, including:

.1 protection against and the control of epidemics;

.2 regulations regarding waste and sewage disposal; and

.3 definition and methods of disinfection and deratting.

12.2 *Vaccinations*

12.2.1 The trainee should be aware of different kinds of necessary vaccinations applicable in seafaring and the general principles of protection.

13 Keeping of records, regulations

13.1 *Keeping of medical records*

13.1.1 The trainee should be familiar with the general principles of the keeping and contents of medical records, including medical log, dangerous drugs register, doctor's reports, reporting to port health authorities, communications with medical doctors in port.

13.2 *International and national maritime medical regulations*

13.2.1 The trainee should recognize the meaning of international and national health regulations regarding seafaring, including regulations and recommendations from WHO, IMO and ILO related to fishing vessels.

14 Medicines and medical equipment

14.1 The trainee should be familiar with the contents of the fishing vessel's medicine chest and the dosage level, side effects and actions of the medicines and drugs, which it contains.

14.2 The trainee should be familiar with the medical equipment on board and its use.

15 Surgical equipment, instruments and supplies

15.1 The trainee should be capable of using the surgical equipment and instruments available on board and of recognizing and applying the appropriate measures of disinfection and sterilization.

Appendix 20
Engineer officers – main and auxiliary prime movers

1 Training facilities should include sectional models or simulators, audio-visual training aids, actual equipment and such other training equipment as approved by the Administration. Where possible, tours of manufacturers' plants, shop instructions and shipyard visits should be used to supplement classroom instruction.

2 Engineer officers should have adequate knowledge of procedures and techniques in order to understand the machinery in their charge. These should include the following:

2.1 *Production of components*

.1 Properties of various materials employed in the production of components and the methods of manufacture of such components.

2.2 *Construction and assembly*

.1 Constructional details of the machinery and respective functions of the component parts and their clearances.

.2 Method of dismantling and assembling the machinery.

2.3 *Instruction manuals*

.1 Use of instruction manuals which should be understood and clearly followed for both the operation and maintenance of the machinery.

2.4 *Installation on board fishing vessels*

.1 Machinery seating, chocking, alignment and connection to associated shafting, etc.

.2 Fitting of piping.

2.5 *Test and trials*

.1 Procedures to be carried out prior to startup, during shutdown, no-load trials and full-load conditions.

.2 Trials and testing of control equipment and safety devices.

2.6 *Safe operating procedures*

.1 Knowledge of normal operating pressures and temperatures to maintain safe operating conditions while manoeuvring or at sea.

.2 Procedures for safe operation of fuel and combustion systems.

.3 Procedures to be carried out during emergency operations.

.4 The effective use of safety guards in way of all hot parts and moving parts for the safety of personnel.

.5 Procedures to be carried out to ensure that damage to the machinery does not result from overspeeding, overloading or lack of lubrication and cooling.

Appendix 21

Engine-room personnel – main and auxiliary prime movers

1 Engine-room personnel whose duties may require it should have a practical knowledge of procedures and techniques in order to understand machinery. These should include the following:

1.1 *Construction and assembly*

.1 Familiarization with the construction of the machinery and its component parts.

.2 Methods of dismantling and assembling machinery.

.3 Understanding of instructional information available to engine-room fishing vessel personnel for the operation and maintenance of machinery.

1.2 *Safe operating procedures*

.1 Awareness of pressures and temperatures relative to their duties.

.2 Actions to be taken during emergency operations.

.3 The effective use of safety guards in way of all hot parts and moving parts for the safety of personnel.

.4 Precautions to be taken to ensure that damage to the machinery does not result from overspeeding, overloading or lack of lubrication and cooling.

Appendix 22

Engineer officers – boilers and pressure vessels

1 The knowledge of engineer officers should include:

1.1 *Construction*

.1 An understanding of the methods and nature of construction of the various types of boilers, economizers, air heaters, pressure vessels and associated equipment, and knowledge of all the safety devices fitted to each type.

1.2 *Boiler fittings, mountings and steam piping*

.1 Constructional details of boiler fittings and mountings.

.2 Constructional details of steam piping.

1.3 *Boiler operation*

.1 Safe procedures for raising steam, normal operation and shutdown.

.2 Precautions to be taken when coupling boilers and warming through steam lines to avoid water-hammer.

.3 Methods of determining water level.

.4 Procedures for safe operation of fuel and combustion systems.

.5 Procedures for water testing and interpretation of results, together with any remedial action necessary.

.6 Boiler uptake fires, their cause and methods of extinction.

1.4 *Air receivers and fittings*

.1 Constructional details of fittings and mountings.

.2 Associated safety devices fitted.

1.5 *Other heat exchangers and pressure tanks*

.1 Constructional details of pressure vessels.

.2 Constructional details of the necessary fittings.

.3 Safe operational procedures for putting units into service and taking them out of service.

Appendix 23
Engine-room personnel – boilers and pressure vessels

1 Engine-room personnel whose duties may require it should have a basic knowledge of certain procedures and techniques in order to understand the operation and general maintenance of boilers and pressure vessels. These should include the following:

1.1 *Construction*

.1 Familiarization with construction of the various types of boilers, economizers, air heaters, pressure vessels and associated equipment and the knowledge of all the safety devices fitted to each type.

1.2 *Boiler operation*

.1 Safe procedures for raising steam, normal operation and shutdown.

.2 Knowledge of dangers and precautions to be taken when coupling boilers and warming through steam lines to avoid water-hammer.

.3 Methods of determining water level.

.4 Procedures for safe operation of fuel and combustion systems.

.5 The use of properly treated boiler water.

.6 Boiler uptake fires, their cause and methods of extinguishment.

.7 Operation and location of the various boiler fittings.

.8 Ability to recognize apparent malfunctions and to promptly report these to the engineer officer in charge of the watch.

Appendix 24
Engineer officers – pumping and piping systems

1 The need for rapid and efficient use of pumping systems under all conditions is essential. Engineer officers should have a thorough knowledge of the piping system and pumping units and protective devices involved, including the following:

1.1 *Fire mains*

.1 Fire main piping for hydrants, sprinkler systems, water curtains, foam-generating systems, etc.

.2 Main and emergency fire and sprinkler pumps, sea suctions, discharge manifolds, including remote control and automatic control of systems.

.3 Maintenance of the system, including pressure tank safety devices, relief valves, draining of system during cold conditions, etc.

.4 Pump cross-connection fittings and safety features.

1.2 *Bilge pumping*

.1 Bilge suction piping and fittings including strainers, screw-down non-return valves, valves and manifolds, etc.

.2 Main bilge, direct bilge and emergency bilge suction lines and the spaces which they drain.

.3 Cross-connections of pumping systems and safety features.

1.3 *Discharge overboard*

.1 Use of oily water separators in conjunction with bilge and ballast discharge overboard.

.2 Monitoring of discharge with a view to compliance with regulations regarding pollution of the sea, coastal waters, inland and harbours.

.3 Use of holding tanks for containing wastes until able to pump into shore facilities.

1.4 *Boiler feed systems, where appropriate*

.1 Source of supply of feed water.

.2 Storage tanks, feed pumps, pre-heaters, feed water treatment.

.3 Control of feed pumps by automatic and safety devices and emergency make-up feed.

.4 Precautions to prevent boiler water contamination through drain and fuel systems.

1.5 *Ballasting and deballasting*

.1 Procedures which are followed for stability reasons when ballasting or deballasting fuel or ballast tanks under the direction of the skipper.

.2 Precautions to be taken when pumping out tanks or other spaces which have contained any material which could constitute a pollutant or fire hazard.

1.6 *Oil fuel and lubricants*

.1 The use of pumping equipment, instrumentation and the care to be taken when bunkering or transferring oil to avoid spillage or fire hazard.

.2 Pertinent Government regulations covering these systems.

.3 Procedures to be adopted when treating or centrifuging fuel or lubricating oils.

.4 Importance of maintaining systems tight and in a clean condition. Recognition of the potential hazards associated with oil leakage and gas accumulation in confined spaces.

.5 Lubricating oil contamination, sources and effects on machinery.

.6 Safety and shut-off devices associated with fuel oil and lubricating oil systems.

1.7 *Compressed-air systems*

.1 Operation and maintenance of compressed air piping and fittings, including safety valves, bursting discs, water traps, reducing valves, etc.

.2 Knowledge of the importance of properly securing and supporting the piping and the use of flexible sections of pipe.

1.8 *Piping systems*

.1 Recognition of the importance of expansion pieces and the proper securing and support of piping and the use of flexible sections of pipe.

1.9 *Evaporators, where appropriate*

.1 Types and correct operating conditions, including testing of water produced.

1.10 *Fish pumps and associated equipment*

.1 Where appropriate, knowledge of construction, principles and capabilities, maintenance and repair of fish pumps and associated equipment.

Appendix 25
Engine-room personnel – pumping and piping systems

1 Engine-room personnel whose duties may require it should have a sufficient knowledge to perform their duties on the piping systems, pumping units and protective devices involved, including the following:

1.1 *General*

.1 Methods of measuring pipe and pipe fittings.

.2 Methods of replacing pipes and pipe fittings.

.3 Knowledge of the importance of expansion pieces and the proper securing and support of piping and the use of flexible sections of pipe.

.4 Procedures to be followed in pump servicing.

1.2 *Fire mains*

.1 Procedures to be taken in starting up and placing fire pumps on line.

1.3 *Bilge, ballast, fresh water and sanitary pumps*

.1 The function, operation and servicing of these pumps.

1.4 *Boiler feed systems, where appropriate*

.1 Source of supply of feed water.

.2 Storage tanks, feed pumps, pre-heaters.

.3 Methods of providing normal and make up feed.

.4 Precautions to prevent boiler water contamination.

.5 Operation and servicing of boiler equipment necessary for the supply of water to the boilers.

1.5 *Liquid cargo pumping systems*

.1 Safety precautions for entering cargo pump-rooms.

.2 The use of safety equipment and special tools.

1.6 *Oil fuel and lubricants*

.1 Operation of the fuel oil system, including the procedures of storage and transfer of fuel oil.

.2 Hazards involved and precautions to be taken against flashbacks, the accumulation of oil in furnaces and in bilges, on floor plates and on tank tops, leaks in fuel oil heaters and pipe connections, choked strainers and faulty burner tips.

.3 Principles of operation of lubricating systems.

.4 Safety and shut-off devices associated with fuel oil systems.

1.7 *Evaporators, where appropriate*

.1 Types and correct operating conditions.

1.8 *Protection of the marine environment*

.1 Precautions to prevent pollution of the marine environment.

Appendix 26

Engineer officers – automatic and remote control systems

1 The engineer officers should understand the overall concepts of automatic control and remote control in order to be familiar with the following:

1.1 *Operation*

- **.1** The components on the bridge and in machinery spaces.
- **.2** The manual overrides and how to bring them into effect quickly when required to do so.
- **.3** All the control and monitoring systems and the ability to read and interpret the information they provide.

1.2 *Electric*

- **.1** Normal and emergency power supply and distribution.
- **.2** Switching arrangements for main propulsion and auxiliary machinery including standby and emergency equipment.
- **.3** Control and monitoring systems.

1.3 *Electronic*

- **.1** Main and standby supply and distribution.
- **.2** Control arrangements for main propulsion and auxiliary machinery including standby and emergency equipment.
- **.3** Control and monitoring systems.

1.4 *Hydraulics*

- **.1** Main and standby hydraulic power and servo-mechanism units.
- **.2** Operation, calibration, testing, maintenance and cleanliness of the system.

1.5 *Pneumatics*

- **.1** Main and standby pneumatic units and servo-mechanisms.
- **.2** Operation, calibration, testing, maintenance, cleanliness and dryness of system.

Appendix 27

Engine-room personnel – automatic and remote control systems

1 Engine-room personnel should be aware of:

- **.1** the overall concept of automatic and remote control;
- **.2** the types of control equipment in use relative to their duties.

Appendix 28
Electrical equipment and installations

1 Those responsible for electrical equipment and installations should have the necessary knowledge of the various items of equipment for which they are responsible. They should be competent to run generating plants and be familiar with the protective devices associated with them. They should have adequate knowledge of and be familiar with the following:

1.1 *Generation*

- **.1** Operation of AC and DC generators and paralleling of generators.
- **.2** Generator instrumentation and control.
- **.3** Protection of generators.
- **.4** Automatic starting of emergency generators.
- **.5** Batteries – construction, care and maintenance.
- **.6** Battery chargers, charging of batteries and the precautions to be taken, in particular, when batteries are on charge.

1.2 *Distribution*

- **.1** Switchboards, wiring and protective devices.
- **.2** Circuit breakers and fuses.
- **.3** Distribution of power from main and emergency switchboards and distribution panels.
- **.4** Shore connections.

1.3 *Electrical systems*

- **.1** The construction, operation and maintenance of the power, control, alarm, monitoring and communication systems.

1.4 *Personal protection*

- **.1** The use of adequate protective equipment and clothing and the safety precautions to be taken.

Appendix 29
Fish-processing and freezing systems

1 Those responsible for fish-processing equipment and freezing systems should have the necessary knowledge of the procedures and techniques in order to understand the operation and general maintenance of this equipment. These should include the following:

1.1 *Construction and assembly*

- **.1** Familiarization with the construction of the equipment and systems and their component parts.
- **.2** Methods of dismantling and assembling the equipment and systems.
- **.3** Understanding of instructional information for the operation and maintenance of the equipment and systems.

1.2 *Safe operating procedures*

- **.1** Awareness of pressures, temperatures and liquids relative to their duties.
- **.2** Actions to be taken during emergency operations.
- **.3** The effective use of safety guards in way of moving parts for the safety of personnel.
- **.4** Precautions to be taken to ensure that damage to the equipment and systems does not result from overloading or lack of lubrication and cooling.

Appendix 30
Engineer officers – use of tools

1 It is essential that engineer officers should have sound knowledge of types of tools and equipment and their use in the maintenance and repair of the fishing vessel's machinery. Knowledge should include, but not be limited to, the following:

- **.1** correct use and care of hand tools;
- **.2** safe use and care of portable power tools;
- **.3** safe use and care of workshop power tools such as lathes, drilling machines, grinding wheels, milling machines, etc.;
- **.4** safe use and care of oxy-acetylene and electric-arc welding equipment;
- **.5** procedures involved in the use of special tools and equipment for specific overhaul or maintenance tasks;
- **.6** safe use of all lifting devices, including chain blocks and overhead cranes;
- **.7** the observance of safe working practices in:
  - **.1** the use of staging;
  - **.2** opening up, dismantling and re-assembling of machinery parts; and
  - **.3** use of standard warning devices in work areas or where applicable.

Appendix 31
Engine-room personnel – use of tools

1 It is essential that engine-room personnel whose duties may require it should have a sound knowledge of the types of tools and their use in the maintenance and repair of the fishing vessel's machinery. Knowledge should include, but not be limited to, the following:

- **.1** correct use and care of hand tools;
- **.2** safe use and care of portable tools and workshop power tools;
- **.3** safe use of lifting devices;
- **.4** the observance of safe working practices in:
  - **.1** the use of staging;
  - **.2** display of warning signs; and
  - **.3** opening, dismantling and re-assembling of machinery parts.

Appendix 32
Practical training of fishers

1 Emergency procedures

1.1 The training in emergency procedures on board fishing vessels should be in accordance with appendix 12.

1.2 Personal survival training should be in accordance with appendix 10.

1.3 Where appropriate, training for proficiency in survival craft should be in accordance with appendix 9.

1.4 Fire-fighting training should be in accordance with paragraphs 3, 4 and 5 of appendix 8.

1.5 Practical training should be given to enable a fisher to use in an emergency the communication equipment fitted on fishing vessels.

2 Bridge duties

2.1 Training should be provided to give:

.1 basic knowledge of magnetic and gyro-compasses and methods of changing over from hand steering to automatic pilot and vice versa;

.2 the ability to steer and understand helm orders;

.3 the ability to keep a proper look-out and to report true and relative bearings of objects;

.4 an ability to use the types of logs in use on board the fishing vessels concerned; and

.5 ability in the use of depth recorders.

3 Ropework and net-mending

3.1 Training should be provided to give:

.1 ability to use common knots and to make rope and wire splices;

.2 ability to carry out repairs to damaged nets; and

.3 knowledge of ropes, wires and cordage in common use in fishing vessels.

4 Fishing methods

4.1 Practical training should be in accordance with appendix 34.

5 Handling and stowage of catch

5.1 Practical training in these matters should be in accordance with appendix 35.

6 Maintenance of fishing equipment

6.1 The practical training should be in accordance with appendix 36.

7 Health, safety and personal hygiene

7.1 Practical training in accordance with appendix 18 should be given, including a practical appreciation of health hazards and the need to practise personal hygiene.

7.2 Training in health and safety as it relates to safe practices on fishing vessels should take into account the relevant chapters in part A of the Code of Safety for Fishermen and Fishing Vessels.

Appendix 33
Marine insurance

It is essential that skippers have sufficient knowledge of marine insurance to enable them to protect themselves and owners of the fishing vessel from possible financial loss. Knowledge should include, but not be limited to, the following:

1 Skippers should have an understanding of their responsibilities in regard to liability for total or partial loss of vessel, machinery or personnel.

2 The various ways to insure against the legal liabilities of fishing vessels and how to cover their needs, equipment and fishing gear for total loss, partial loss or damage. Instruction should include applicable national and international practices. Instruction should also cover the practical application of insurance, in particular, the underwriting system, insurance brokerage, the salvage associations and protection and indemnity associations (clubs).

3 The relationship between the insurance underwriters and fishing vessel classification societies and the importance to the underwriters of maintenance of standards in construction and periodic vessel survey programmes. Knowledge of how to conduct themselves in the event of an incident in which their fishing vessel may be involved. Such knowledge should include:

.1 how to repudiate liability;

.2 how to arrange for surveys or joint surveys;

.3 how to make a statement giving particulars of the incident;

.4 how to prepare accounts;

.5 how to make a claim;

.6 the consequences of the Lloyd's Standard Form of Salvage Agreement and the sistership clause. Owners in particular should be introduced to the role of the average adjuster;

.7 what is an insured peril;

.8 what is meant by lack of due diligence on the part of owners or managers;

.9 the laws related to marine pollution and what by-laws may apply locally.

Appendix 34
Fishing methods and fishing gear

Training should be given to all fishers to understand the operation and knowledge of such fishing gear as may be appropriate to conditions set out in paragraph 6.29. As appropriate, they should have sufficient knowledge of the purpose of the various types of gear listed below, their design, materials needed, construction, application, fishing vessel type needed, deck layout, machinery, fish-finding techniques, fishing strategy, fishing techniques and gear operation, ancillary operations and techniques, which include landing and handling catch on board, and elements of resource management. The training should also include the safe utilization of such gear and emergency procedures. The types of fishing gear listed below are taken from *FAO Fisheries Technical Paper No. 222.*

Fishing gear category	**ISSCFG Code**
Surrounding nets	01.0.0
With purse lines (purse seines)	01.1.0
one-boat-operated purse seines	01.1.1
two-boat-operated purse seines	01.1.2
Without purse lines (lampara)	01.2.0
Seine nets	02.0.0
Beach seines	02.1.0
boat or vessel seines	02.2.0
Danish seines	02.2.1
Scottish seines	02.2.2
pair seines	02.2.3
Trawl nets	03.0.0
Bottom trawls	03.1.0
beam trawls	03.1.1
otter trawls	03.1.2
pair trawls	03.1.3
nephrops trawls	03.1.4
shrimp trawls	03.1.5
Midwater trawls	03.2.0
otter trawls	03.2.1
pair trawls	03.2.2
shrimp trawls	03.2.3
otter twin trawls	03.3.0

Fishing gear category	ISSCFG Code
Dredges	04.0.0
boat dredges	04.1.0
hand dredges	04.2.0
Lift nets	05.0.0
portable lift nets	05.1.0
boat-operated lift nets	05.2.0
shore-operated stationary lift nets	05.3.0
Falling gear	06.0.0
cast nets	06.1.0
falling gear	06.2.0
Gill nets and entangling nets	07.0.0
set gill nets (anchored)	07.1.0
drift nets	07.2.0
encircling gill nets	07.3.0
fixed gill nets (on stakes)	07.4.0
trammel nets	07.5.0
combined gill and trammel nets	07.6.0
gill nets and entangling nets (not specified)	07.7.0
Traps	08.0.0
stationary uncovered pound nets	08.1.0
pots	08.2.0
fyke nets	08.3.0
stow nets	08.4.0
barriers, fences, weirs, etc.	08.5.0
aerial traps	08.6.0
Hooks and lines	09.0.0
handlines and pole-lines (hand operated)	09.1.0
handlines and pole-lines (mechanized)	09.2.0
set lines	09.3.0
drifting long lines	09.4.0
long lines (not specified)	09.5.0
trolling lines	09.6.0
Grappling and wounding	10.0.0
harpoons	10.1.0
Harvesting machines	11.0.0
pumps	11.1.0
mechanized dredges	11.2.0

Appendix 35
Handling, stowage and care of the catch

1 As fresh fish is an extremely perishable food, training should be available to provide all fishers with a practical knowledge of handling, stowage and care of the catch on board fishing vessels so as to ensure that it is maintained in optimum condition. Fishers should understand that fish which has been subject to a certain amount of spoilage cannot be restored to its original condition. Training of fishers should therefore aim to ensure that every effort is made to avoid spoilage. Training should include:

1.1 *Hygienic operating practices*

- **.1** Personal hygiene.
- **.2** Preparation of the deck to receive the catch, including:
  - **.1** importance of using clean seawater for washing;
  - **.2** washing all decks, boards, stanchions and any equipment which is likely to be in contact with the fish; and
  - **.3** the advantages in the use of disinfectant, recommended types and levels of application.
- **.3** Preparation of the fish hold or stowage area to receive the catch after it has been prepared and washed, including:
  - **.1** ensure adequate ventilation of fish hold or stowage area;
  - **.2** washing and cleaning (as for the deck);
  - **.3** checking pounds and pound boards;
  - **.4** disinfecting as appropriate;
  - **.5** ensuring that the ice supply is ready to cool the fish as quickly as possible.
- **.4** Cleaning of the deck between hauls or catches, including:
  - **.1** cleaning all dirt, slime and waste from gutting, etc.; and
  - **.2** washing deck with clean seawater.

1.2 *Landing the catch on deck*

- **.1** An understanding of the importance of rapid handling, sorting and rejection of damaged or spoiled fish.
- **.2** Understanding of the need to avoid the effects of sun and wind on the catch and large quantities of fish being piled on deck for long periods.

1.3 *Preparation of the catch for stowage*

.1 Instruction in the importance of bleeding, gutting and washing prior to early stowage.

.2 If catches are large, the reasons for and against quick stowage rather than full protective preparation.

.3 The importance of quick stowage with associated chilling in preference to long periods on deck at high ambient temperatures.

1.4 *Stowage of the catch*

.1 Knowledge of the advantages and disadvantages of various stowage systems including bulk, shelving, boxing, chilled seawater; the use and value of insulated fish boxes on small craft.

.2 Special conditions for the preparation, stowage or freezing of shrimp, other crustacea or cephalapods.

.3 Stowage of frozen fish products and avoidance of damage arising from frozen stowage.

1.5 *Appreciation of factors affecting seafood quality*

.1 Parasites.

.2 Pathogenic bacteria.

.3 Viruses.

.4 Biotoxins.

.5 Biogenic amines (e.g., histamines).

.6 Chemicals.

1.6 *Quality assurance*

.1 The hazard analysis critical control point (HACCP) system:

.1 identification of possible hazards;

.2 critical control points;

.3 criteria, target levels and tolerance levels for each CCP;

.4 monitoring systems for CCPs;

.5 corrective actions;

.6 verification;

.7 record keeping.

.2 Application of the ISO-9000 series and certification.

Note: Personnel on fishing vessels with processing plant (excluding freezing plant) should undergo training appropriate for shore-based workers in similar employment.

1.7 *Understanding of factors leading to and avoidance of fish spoilage*

.1 Parts of fish where spoilage may arise in the early stages after being caught.

.2 Recognition of fish spoilage by observation and smell.

.3 Prevention of spoilage.

.4 Importance of cooling in prevention of spoilage.

.5 Correct use of ice.

.6 Assessment of ice requirements.

.7 Other cooling methods:

.1 freezing and cold storage;

.2 super chilling;

.3 refrigerated seawater.

.8 Problems associated with various cooling methods and cold storage.

.9 Other methods of preservation of catch on board the fishing vessel – e.g., use of salt and chemicals.

1.8 *Effect on a fishing vessel's stability in landing, handling and stowing the catch*

.1 Understanding of the dangers in mishandling a catch when it is being landed on deck and remaining there and the changes in the fishing vessel's stability which may arise during stowage.

.2 The effects of changes in centre of gravity and free surface effect should be understood by all handling the catch (this should be particularly stressed where fishing methods may result in very large catches at any one time).

.3 The need to avoid blocking freeing ports with the catch.

Appendix 36
Maintenance of fishing equipment

1 Training should be given to all fishers in the understanding and knowledge of all fishing equipment they are likely to use, including how to make the equipment and how to maintain it. In particular they should know:

.1 netting yarns, both natural and man-made, their chemical composition, physical properties, characteristics, care and numbering systems;

.2 comparison between natural and synthetic twines and ropes; advantages, disadvantages and selection of the most suitable for a particular purpose; testing elasticity, knot stability, abrasion resistance, colour, breaking load of knotted and knotless netting;

.3 combination and wire ropes, construction and breaking strain, use, handling, care and selection of most suitable type of rope for a particular gear; and

.4 floats, sinkers, ironworks, tools, etc., associated with different fishing gear – e.g., shackles, chains, links, snap rings, trawl doors and other net opening devices; blocks and tackle used in lifting fishing gear.

2 Fishing gear construction

2.1 Practical training should be given to ensure that fishers are able to select the correct twines and ropes, tie the common knots, splice rope and wire rope, use the correct tools for net making, make a netting gauge, braid and set up nets correctly.

2.2 For construction of certain fishing gear, fishers should understand the geometry of the fishing gear, shaping a piece of netting by increasing, decreasing, beatings, fly meshes, double meshes and selvedges and by cutting and using the correct ratio for obtaining the desired shape.

3 Net assembly

3.1 For assembling fishing gear, fishers should be capable of braiding pieces into the desired shape or know how to cut out such shapes from sheet netting and join them by different methods such as lacing, marling,

stapling and mending. They should recognize the purpose of support lines and hanging ratios. Hanging and rigging fishing nets should include:

.1 surrounding nets;

.2 seine nets;

.3 trawl nets;

.4 dredges;

.5 lift nets;

.6 falling gear;

.7 gill nets and entangling nets;

.8 traps;

.9 hooks and lines;

.10 grappling and wounding gear; and

.11 harvesting machines.

3.2 An expanded list of fishing gear is set out in appendix 34.

4 Maintenance of fishing gear and deck equipment

4.1 Fishers should be able to carry out essential repairs to fishing gear and repair tears or holes in netting, which will involve practice in correct cutting out, trimming, lacing, braiding in new net and inserting a patch or replacement of a whole section.

4.2 Fishers should have a knowledge of the construction, application and purpose of each piece of deck equipment associated with a particular type of fishing gear. They should understand the importance of its care and maintenance. Such deck equipment includes, but is not restricted to:

.1 trawl gallows;

.2 gantries;

.3 bollards;

.4 power blocks;

.5 pursing blocks;

.6 winches;

.7 booms;

.8 derricks;

.9 net drums and side rollers; and

.10 line and trap haulers.

5 Ancillary equipment

5.1 Fishers should be instructed in the importance of aids to fishing operations, their purpose, construction, function and use and the maintenance that is necessary from time to time. Such aids would include:

.1 fishing lures;

.2 fish aggregation devices;

.3 fishing lights;

.4 lightboats; and

.5 artificial reefs.

Appendix 37
Port operations

1 Port regulations

1.1 Knowledge of relevant rules and regulations concerning safety, manoeuvring, berthing and unberthing, pilot requirements and prevention of pollution in port.

1.2 Customs and immigration procedures.

1.3 Special rules regarding heavy traffic, signals, fog, storm warnings, etc.

2 Preparations for sea and for arriving in port

2.1 Preparations for sea, including bunkering, provisioning, preparing of gear, checking of safety equipment and appliances, weather reports, fish-finding and navigational equipment and auxiliaries, status and health of fishing vessel personnel and general information on fishing possibilities and the fishing ground.

2.2 Preparations for arriving in port, including preparation of gear and auxiliaries for berthing (i.e., otterboards, gallows, davits, or any rig which might cause damage to piers or other vessels), clearing and cleaning of fishing gear and deck equipment, checking of navigational and fish-finding equipment, preparing a list of additional gear material, spare parts, provisions and safety appliances.

3 Unloading of the catch ashore or to another vessel, including checking of all safety components in relation to lifting out or pumping the catch from the fishing vessel. Cleaning and disinfecting of equipment used for discharging the catch. The necessary procedures when discharging the catch is delayed or where all the catch cannot be unloaded at the same time.

Appendix 38
Engine and associated training for small fishing vessels

This group of fishing vessels covers a range of sizes using a wide variety of propulsion units: from outboard motors for the smallest fishing vessels to sophisticated and supercharged diesel engines. Therefore, it is not possible to define specific training courses, but Administrations should prepare courses appropriate to national needs. Such courses should cover:

1 Outboard engines;

2 Inboard engines:
- petrol driven
- diesel driven
- where appropriate, the various systems applicable to the larger engines.

1 Outboard engines

1.1 Principles of two- and four-stroke engines, related valve and crank positions, purpose and working of the flywheel, valves and scavenging, fuel system, ignition system, transmission, gearbox, lubrication, cooling and starting. Trouble identification, starting problems, running difficulties and the importance of and replacement of shear pins. Servicing and maintenance of outboard engines, inspection procedures, carburettor maintenance, engine mounting and procedures for laying up or storage.

2 Inboard engines

2.1 Understanding of safe operating procedures and emergency actions. Precautions to ensure that machinery is not damaged due to misuse, through overspeeding, overloading, lack of lubrication or by corrosion. Training should provide sufficient knowledge to strip or replace certain components at sea in order to enable the fishing vessel to return to port.

2.1.1 *Marine petrol engines*

2.1.1.1 Working principles of marine petrol engines. Two-stroke and four-stroke cycles. Piston positions, valve positions, timing, etc.; comparison with the operation of diesel engines; engine capacity, bore, stroke and compression. Various engine parts and their function. Constructional details and arrangements of various engine parts. Operational problems and their detection.

.1 *Air and exhaust systems:* air filters, manifolds, exhaust pipes and silencers; use of pumps and blowers; supercharging and its effects on the engine; maintenance and care of the above.

.2 *Fuel systems:* types of fuel, storage and transfer systems, effects of dirt and water contamination, filters, separators, fuel pumps, carburettors and their maintenance, and combustion and ignition processes.

.3 *Cooling systems:* keel cooling, heat exchangers, radiators, control of overheating, advantages and disadvantages of various cooling systems, corrosion and use of sacrificial anodes.

.4 *Lubrication systems:* principles and purposes of lubrication; types of bearings and their fitting, care, maintenance and adjustment; types and grading of lubricating oils, use of grease, lubricating circuits, methods of lubrication, and seawater contamination and procedures after contamination.

.5 *Starting systems:* hand recoil, electric and compressed air starting; charging and draining of air reservoirs, dangers in using high-pressure bottles and dangers and detection of leakage from air start valves.

2.1.2 *Marine diesel engines*

2.1.2.1 As in 2.1.1.1 above. However, the difference between compression and electric spark ignition should be clearly understood – e.g., the difference in the fuels used; the weight of the engine block. The various systems will have similarity with those for petrol engines, but where they differ should be clearly understood.

3 Engine operation

3.1 Method of preparation of the various systems and checks prior to starting, which should include machinery, clutches, stern tube, propeller and steering gear. Checks during running to include machinery, stern tube and steering gear, sump levels, filters. Methods of fault detection, correction and emergency repairs.

4 Auxiliary machinery and propulsion systems

4.1 Clutches, gearboxes and power take-offs. Shafting, intermediate shafts, types of bearing, propeller shafts, stern tubes, stern tube bearings, stern glands and packing, shaft alignment checking and correction of misalignment. Propellers: fixed and variable-pitch propellers, damage to and repair of propellers.

4.1.1 *Pumps and pumping systems*

4.1.1.1 Construction, care and maintenance of all types of pumps used on fishing craft. Causes of loss of output, methods of priming, maintenance of priming devices. Arrangement of bilge water pumping systems, types of valve chest, causes of deterioration and leakage, temporary and permanent repairs.

4.1.2 *Air compressors*

4.1.2.1 General arrangement of single and multi-stage compressors, their care and maintenance and emergency repairs.

4.1.3 *Hydraulic systems*

4.1.3.1 Basic principles of power hydraulics, hydraulic fluids, systems for winches, steering gears, etc.; various ancillary units in hydraulic systems, fault-finding, care and maintenance.

4.1.4 *Steering gear systems*

4.1.4.1 Typical arrangements, including mechanical hydraulic and electro-hydraulic, steering gear control systems, emergency procedures, care and maintenance.

5 Electrotechnology

5.1 General principles of electricity: voltage, current, resistance and other electrical units. Basic principles of alternating and direct current. Effects of electrical current; conductors and insulators; lamps, cables and fuses. Batteries – construction, capacity, care and maintenance; preparation of new batteries for use, charging and discharging, operating precautions and dangers of explosion, short circuits, etc.

5.2 *Electrical systems*

5.2.1 General construction care and maintenance of alternating and direct current generators. Switchboards and shipboard circuitry, starters and their care and maintenance.

6 Refrigeration

6.1 Principles of refrigeration. The refrigeration circuit, types and properties of refrigerants. Identification and purpose of refrigeration circuit components, compressor, condenser, evaporator, oil separators, driers, expansion valves, cut-outs and thermostats. Correct operation, fault-finding and rectification.

7 Deck machinery and steering gears

7.1 Winches and windlasses, types, methods of operation, maintenance. Hydraulics (see section 4.4). Dismantling and checking for wear; precautions against dirt and moisture. Typical arrangements of steering gears; methods of control and method of changing to hand control. Emergency steering. Telemotor systems; method of charging and removal of air from the system.

Appendix 39
Sail training

1 Some fishing vessels use sails as an alternative or supplement to propulsion by machinery. Sails are also used to assist in the control of fishing vessels when manoeuvring during fishing operations.

2 Where necessary, courses of training should be provided as appropriate to give an understanding of the construction, design and use of sails. Such training should include, but not be limited to:

.1 materials for sails, their making and maintenance;

.2 types of sails and their rigging;

.3 advantages and disadvantages of different types of sailing rigs;

.4 sailing techniques and manoeuvring;

.5 safety factors in the use of sail; and

.6 specific uses of sail in fishing operations.

Appendix 40
FAO Code of Conduct for Responsible Fisheries

1 The following training programme should be undertaken to create an awareness of the greater responsibilities of fishers and the role that the FAO Code of Conduct for Responsible Fisheries has in this regard. The Code sets out principles and international standards of behaviour for responsible practices with a view to ensuring the effective conservation, management and development of living aquatic resources, with due respect for the ecosystem and biodiversity. The Code of Conduct for Responsible Fisheries allocates responsibilities not only to fishers but to administrators, scientists and fisheries managers. It is the objective of this training course to inform fishers of their responsibilities and the responsibility of others in implementing the FAO Code of Conduct for Responsible Fisheries. Training should include:

2 Principles and guidelines

2.1 Responsible fishing involves fishing in a manner that:

the total annual fishing mortality allows for the maintenance of the long-term sustainable yield and ensures the productive character of the environment and biodiversity of the environment is not threatened.

3 Responsible harvesting practices

.1 by-catch and discarding;

.2 lost fishing gear;

.3 habitat damage;

.4 marine reserves;

.5 utilization of fish food;

.6 discarding of fishing gear;

.7 vessel/gear conflicts.

4 Responsible fishing gear/Selectivity:

.1 definition of selectivity;

.2 limitations of selectivity;

.3 status of selective gears;

.4 by-catch: the failure of selectivity;

.5 selectivity by size;

.6 selectivity by species;

.7 survival of escaping fish;

.8 successful introductions of selective gears.

5 Energy optimization:

.1 navigation and detection;

.2 fishing operations;

.3 fishing gear;

.4 processing and handling;

.5 resource management;

.6 protection of the atmosphere.

6 Duties of States:

.1 duties of all States;

.2 flag State duties;

.3 port State duties.

Appendix 41
Fatigue

Summary: Fatigue is dangerous. It is difficult to detect and difficult to manage. Fatigued persons do not realise they are fatigued and do not react adequately to situations. They may suffer physically and mentally from a range of conditions not apparently related to fatigue. Excessively long periods without sleep produce performance effects equivalent to those produced by the use of alcohol to the legal blood alcohol limit for driving a motor vehicle in many countries. Fatigue can be cured by sleep. Drugs and stimulants do not work. Rest without sleep is not a substitute.

1.1 Introduction

1.1.1 Fatigue has been recognized around the world as a contributor to many transportation occurrences. There have been many occurrences where fatigue has been suspected of contributing to or causing transportation and industrial accidents; however, that connection was difficult to justify because the vital links between the unsafe acts and decisions which led to the accidents and the fatigue state of the people involved were not made.

1.1.2 The reasons for not making the links have varied. At one time, fatigue was discounted as a potential cause for human error; indeed, a common myth existed that fatigue could be prevented by characteristics of personality, intelligence, education, training, skill, compensation, motivation, physical size, strength, attractiveness or professionalism. Also, the lack of scientifically accepted information on how fatigue affects not only mood and feelings, but individual and team performance as well, constrained investigators and analysts. Further, guidance on how to investigate for fatigue and build the links between a person's recent history and potential impairment has been lacking. Unlike alcohol and drugs which can be measured by, for example, blood tests, there is no unequivocal physical or chemical test which can tell us that a person was impaired to a certain extent by fatigue.

1.2 Objectives

1.2.1 To provide a description of the basic concepts of sleep and fatigue.

1.2.2 To describe common fatigue-related performance effects.

1.2.3 To achieve a common understanding about terms such as *fatigue,** *sleep debt, circadian rhythm* and other commonly used but potentially ambiguous terms.

Note: The fatigue concerns addressed in this paper arise from two systemic physiological causes: sleep deficit and circadian rhythms, both of which can be affected by work and rest schedules.

2 Sleep and fatigue

2.1 Essentially every aspect of human performance can be degraded by sleep loss and sleepiness, including physical, psychomotor, and mental performance; mood can be affected, and attitudes toward risk-taking and safety can change. This section deals with issues relating to sleep and fatigue and includes the basic concepts of alertness, the biological clock, sleep/wake cycles, the nature and function of sleep, quantity and quality of sleep, sleep disorders/disturbances, irregular schedules and their impact on alertness, circadian dysrhythmia and the effects of fatigue on performance.

2.1.1 *Alertness and fatigue*

- Alertness and fatigue can be viewed as a continuum with peak mental alertness on one end and sleep on the other.
- Alertness is the optimal activated state of the brain.
- Fatigue has its basis in the combined interaction of the circadian rhythm in alertness/sleepiness and the effects of inadequate sleep. As fatigue increases, the brain appears to fall asleep involuntarily, against the will of the operator, especially (but not exclusively) when the performance demands involve sustained attention and monotony. Thus, the effects of fatigue on performance are based in changes in brain function.
- Alertness enables us to make conscious decisions about what to attend to in our environment and what to exclude.
- Whenever alertness is affected by fatigue, human performance can be significantly impaired.
- Alertness cycles closely follow the body temperature cycle, with peak alertness occurring when the body temperature is the highest (near midday) and low alertness occurring when the body temperature is lowest (between 3:00 and 5:00 a.m.).
- Alertness can be influenced by a number of factors: sense of danger, interest or opportunity; muscular activity; time of day on the circadian clock; sleep bank balance; controlled, strategic napping; ingested nutrients and chemicals; and environmental

* Words in italics in the text are defined or explained in the glossary of common terms.

light, temperature, humidity, sound and aroma, as discussed below.

- Imminent danger or just surviving a near miss will pull us from a drowsy state; an interesting challenge, an exciting idea, and anything else that is new and different will keep us awake. On the other hand, if the job is boring or monotonous, our alertness fades.
- Any type of muscular activity helps to keep us alert; running, walking, stretching or even chewing gum can stimulate our level of alertness.
- Our circadian clock makes us sleepy or alert on a regular schedule whether we are working or not.
- Sound and restful sleep makes deposits in our "sleep bank" and sustained wakefulness makes withdrawals. When the bank balance is too low, the pressure to sleep has a dampening effect on our level of alertness.
- Controlled, strategic naps can improve alertness and performance.
- Alertness may be enhanced by the chemicals and nutrients we ingest or inhale.
- Bright lights can have dramatic effects on suppressing sleepiness and resetting our circadian clock.
- Cool, dry air can increase alertness while heat can bring on the desire for sleep.
- Music and other irregular sounds can help us stay alert while soothing sounds can put us to sleep.
- Some aromas such as peppermint seem to make us more alert.

2.1.2 *Biological clock*

- Our biological clock regulates the daily cycle of activity and inactivity.
- In normal conditions, our biological clock is locked to 24 hours by the onset of day and night, by clock times and by social activities.
- Because of that, our body functions and energy levels are automatically higher after sunrise and lower after sunset.
- The intrinsic 25-hour cycle of the human biological clock is automatically reset forward by an hour each morning by the light of dawn so that it adapts to the 24-hour schedule of day and night.

- In general, our 25-hour clock can be reset about two hours each day, allowing us to live comfortably on a 23 to 27-hour day.

2.1.3 *Sleep/Wake cycle*

- In normal conditions, the sleep/wake cycle follows a 24-hour rhythm with approximately one third of this time spent sleeping.
- Although individual rhythms vary, everybody's cycle has two distinct peaks and dips.
- The big dip is at night, with the time of our lowest alertness in the hours just before dawn, between 3:00 and 5:00 a.m.; the other dip occurs in the mid-afternoon, between 3:00 and 5:00 p.m.
- During the dips, it can be particularly difficult to maintain alertness.
- During the peaks, sleep is difficult and often of poor quality; that is, it does not provide the same restorative value as sleep during maximum sleepiness.
- The sleep/wake cycle can be thought of as a "credit" and "deficit" system in which a person is given two points for every hour asleep up to a maximum of 16 points and has one point deducted for every hour awake.
- You cannot store sleep; the fewer points you have, the more ready you are for sleep.
- Normally, a person will sleep when he or she has little or no sleep credit (zero points) and will then sleep for about eight hours (16 points credit).
- This will be followed by a wakeful period of about 16 hours (16 points deducted).
- Thus, recuperative sleep makes deposits in our "sleep bank" and sustained wakefulness makes withdrawals.

2.1.4 *The nature and function of sleep*

- Sleep is an active process; when we are asleep, we are in an altered state of consciousness.
- Normally when we sleep, we move through *sleep stages* in specific cycles.
- The nightly pattern of light sleep, deep sleep and *rapid eye movement (REM)* sleep episodes is called *sleep architecture*.

- Stage 1 sleep is a transitional phase between waking and sleeping. We spend about 10 minutes in stage 1. *Microsleeps* occur during stage 1 sleep.
- Stage 2 is a light level of sleep such that, if we are awakened during it, we are likely to feel alert and refreshed. We spend about 15 minutes of sleep in stage 2 (about 50% of sleep is in stage 2).
- Stage 3 is the onset of delta sleep, a deeper stage of sleep in which we spend about 15 minutes.
- Stage 4 is the deepest stage of sleep; if awakened from it, we are likely to feel groggy and disoriented and suffer from *sleep inertia*, a condition of impaired functioning which can last from 10 minutes to as long as one hour.
- REM sleep occurs after about 70 to 80 minutes of sleep. This is the dreaming stage.
- The cycle of stages 1 to 4 sleep and REM sleep repeats during the course of the night in 90-minute cycles, each succeeding cycle containing greater amounts of REM sleep.
- An eight-hour sleep will contain about four or five bouts of REM sleep. Most stage 4 sleep is accomplished early in the night.
- If deprived of either stages 3 and 4 and REM sleep, a person will show rebound effects, in that that particular type of missed sleep will be made up in subsequent sleep, suggesting the body has some requirement for these types of sleep.

2.1.5 *Quantity of sleep*

- Everyone's sleep needs are unique; however, over 90% of the population needs between 7.5 and 8.5 hours of sleep per 24-hour day.
- Alertness and performance are directly related to quantity of sleep.
- *Acute sleep loss* results when one is awake without any sleep beyond the normal 14- to 16-hour waking day; the longer one is awake, the greater the effect on performance.
- *Chronic undersleeping* can lead to *cumulative sleep debt*. This occurs when insufficient quantity of sleep continues over several consecutive days.
- Once sleep debt or fatigue builds, only sleep can maintain or restore performance levels.

- A person deprived of sleep for an extended period, such as by staying up all night and then not being able to obtain any significant sleep the next day, will usually take two normal nights of sleep to fully recover.
- Sleep requirements do not change with age; sleep patterns do change with age.
- As people age, they tend to become less able to tolerate changes in schedule; it is not unusual for such changes to become noticeable at age 40.
- Younger people often obtain less sleep; they tend to be more flexible and adjust more easily to irregular schedules.
- In general, there is no absolute amount of sleep that must be achieved. You should obtain enough sleep to be alert the next day.

2.1.6 *Quality of sleep*

- All sleep is not of the same quality and does not provide the same fully recuperative benefits.
- Quality sleep is restorative sleep. Alertness and performance are directly related to quality of sleep.
- In order to feel well rested and alert, the various stages of sleep have to occur in their proper proportions.
- When we are getting quality sleep, we move through the sleep stages in specific cycles, each of which lasts about 90 minutes.
- Quality, recuperative sleep requires four to five uninterrupted sleep cycles.
- The stage of sleep from which we awaken determines our condition on arousal. Thus, the most effective length of time for a nap is about 20 minutes, which does not allow us to reach a deep level of sleep (stages 3 or 4) from which we emerge impaired.
- Naps of 30 to 60 minutes do not provide us more restorative sleep than 20-minute naps; however, a two-hour nap will more than double the restorative sleep of a single-hour nap because two hours is long enough to come out of deep sleep.
- Just being tired is not enough to ensure a good sleep. It is the timing of sleep, not the amount of time awake, that is critical to sleep duration.
- If your time of sleep is out of synch with your body clock, it is difficult to sleep properly. Thus, time of day is an important component of sleep quality because regardless of how long we

have gone without sleep, our body continues to follow our circadian rhythm in ability to sleep.

2.1.7 *Sleep disorders/disturbances*

- More than 5% of the population suffer from sleep disorders, and many of them are unaware of it.
- *Sleep apnea* is one cause of excessive daytime sleepiness.
- A person who suffers from sleep apnea can wake up several times during sleep, often without realizing it.
- *Narcolepsy* is a disease of uncontrollable sleep attacks that occur sometimes several times a day. The cause of narcolepsy is unknown, although it may be genetic.
- *Insomnia*, which is more of a sleep disturbance than a disorder, is believed to be a problem for 15% to 30% of the adult population.
- Insomnia sufferers complain about experiencing difficulty in falling asleep and staying asleep, about waking too early and about poor quality of sleep. Daytime complaints include fatigue, sleepiness, poor performance, aches and anxiety.
- *Clinical insomnia* describes the condition when a person has difficulty in sleeping under normal, regular conditions and in phase with his body rhythm. It is an inability to sleep when the physiological system is calling for sleep.
- *Situational insomnia* describes the condition when a person has difficulty in sleeping in a particular situation – e.g., when the biological rhythms are disturbed, or one is trying to sleep in a strange environment. This often occurs when the brain and the body are not in the sleeping phase.

2.1.8 *Irregular schedules*

- The circadian clock is perfectly synchronized to the traditional pattern of daytime wakefulness and night-time sleep.
- The main problem with shift work is that it desynchronizes the body rhythms.
- Although our circadian clocks can adjust by an hour or two a day, they cannot immediately shift 8 or 12 hours as many schedules require.
- It takes several days for the body to adjust to a new schedule and during that time our bodies are out of synch with the world around us. Our body clocks are waking us up when we need to sleep and putting us to sleep when we need to be awake.

- Workers who are required to sleep during the day are more likely to experience shortened sleep and frequent awakenings.
- During daytime sleep, the more restorative types of sleep – that is, the deeper sleep stages 3 and 4 and REM sleep – are shortened. Therefore, reduction of time spent in stages 3 and 4 and REM sleep means that the individual will still feel fatigued despite having spent six or eight hours asleep.
- The individual may think that, because he or she has had six to eight hours' sleep, he or she must be well rested. That is why an individual's assessment of his/her alertness/fatigue level alone is insufficient when attempting to determine whether fatigue is an underlying factor.
- If the shift work is not stable – that is, the person is not on the schedule long enough to adjust – then the individual will not resynchronize.
- Workers who are on straight night-shift work – i.e., permanent assignment to an eight-hour night shift – typically never adjust to their biological clocks because each week during their time off they revert back to a day schedule.

2.1.9 *Circadian dysrhythmia (jet lag)*

- *Jet lag*, a maladjustment of body rhythms, occurs after travel across time zones. It occurs primarily because the internal circadian rhythm is out of phase with local time, creating desynchronization and resulting in sleep deprivation.
- The extent and degree of jet lag symptoms depend upon the number, rate and direction of time zone changes.
- We can more easily adjust to westbound travel, which extends our day because our internal biological clock naturally gravitates to a 25-hour day.
- It takes longer to resynchronize circadian rhythms after eastbound travel because they must be shortened (which is against their natural tendency to run long) in order to match the local environment.
- Extreme jet lag would be caused by crossing, for instance, 11 time zones on a 10-hour flight. Most people would require a minimum of a week to adjust.
- In general, the greatest difficult in adjustment results from crossing 12 time zones, the least from crossing one time zone.

2.1.10 *Effects of fatigue on performance*

- When a person is suffering from fatigue, his or her performance on the job will be affected.
- During night-time hours, and to a lesser extent during the mid-afternoon dip, most types of human performance, whether manual dexterity, mental arithmetic, reaction time or cognitive reasoning, are significantly impaired.
- The most extreme form of fatigue is uncontrollable sleep, i.e., falling asleep against the will of the individual. The sleep period can be a microsleep, a nap or a long sleep episode. While asleep, a person is "perceptually isolated" – i.e., they are unaware of what is going on around them.
- Motivation can overcome the effects of fatigue for short periods, but motivational effect is limited and can end with little or no warning.
- Fatigue can affect a person's ability to respond to stimuli, from a failure to respond altogether to slowed reactions to normal, abnormal or even emergency stimuli. In a fatigued state, it can take longer to perceive stimuli, longer to interpret or understand them and longer to react to them once they have been identified.
- Fatigue affects the ability to judge distance, speed and time.
- Fatigue can have a profound effect upon problem-solving ability. In studies to determine the effects of fatigue on problem-solving ability, it was found that after 18 hours awake, people showed a 30% decrement in performance and after 48 hours, the impairment averaged 60%.
- Fatigue can lead to forgetting or ignoring normal checks or procedures, reversion to old "habits" and inaccurate recall of operational events.
- Mood is likely to be affected by fatigue, the effects of which are that people are less likely to converse, are less likely to perform low-demand tasks, are more irritable, are more distracted by discomfort, and can display a "don't care" attitude.
- Fatigue can reduce attention, the effects of which are that people overlook or misplace sequential task elements, become preoccupied with single tasks or elements, are less vigilant and are less aware of their poor performance.
- When alertness is impaired, people may fix their focus on a minor problem when there is a risk of a major one; may fail to anticipate danger; may display automatic behaviour syndrome; may fail to appreciate the gravity of a problem or situation; may

display flawed logic; and may apply inappropriate corrective actions.

- Fatigue can result in reduced motivation to perform well. This can translate into a willingness to take risks and a laxity in safety that would not normally be tolerated when alert.

3 Classification of fatigue factors in related groups

3.1 In the case of fishing vessel personnel, among the most commonly recognized and documented causes of fatigue are poor quality of rest, excessive workload, noise and interpersonal relationships. The contributory causes of fatigue will vary depending on operational circumstances. Some factors will be more manageable than others. Such factors can be grouped as follows:

3.1.1 Management ashore and aboard the fishing vessel and responsibilities of Administrations:

- scheduling of work and rest periods;
- manning levels;
- assignment of duties;
- shore–ship–shore support and communication;
- standardization of work procedures;
- voyage planning;
- watchkeeping practices;
- management policy;
- in-port operations;
- recreational facilities;
- administrative duties.

3.1.2 Fishing-vessel-specific factors:

- level of automation;
- reliability of equipment;
- motion characteristics;
- vibration, heat and noise levels;
- quality of working and living environment;
- fishing vessel design.

3.1.3 Personnel-specific factors:

- thoroughness of training;
- experience;

- personnel composition – cohesiveness;
- personnel competency and quality.

3.1.4 External environmental factors:

- weather;
- port conditions;
- ice conditions;
- density of vessel traffic;
- fishing operations.

4 General discussion

4.1 *Management ashore, aboard ship, and also the responsibilities of Administrations*

4.1.1 The prevention of fatigue in the areas of scheduling of work on board the fishing vessel and rest periods, manning levels, watchkeeping practices and assignment of duties could largely be accomplished by sensible shore-based management and on-board management techniques. It is also recognized that Administrations have an equally important role to play with respect to legislation leading to acceptance, implementation and enforcement in those areas covered by international conventions. Guidelines and provisions should take into account the relationships between work and rest periods to ensure adequate rest. These considerations should include a review of the voyage length, length of port stay, length of service and individual fishing vessel personnel members, periods of responsibility and watchkeeping practices.

4.1.2 It is essential that management should provide clear, concise written policy guidance to ensure that the fishing vessel's personnel are familiar with the vessel's operational procedures, voyage length, destination, internal and external communication practices and vessel familiarization procedures.

4.1.3 Management should recognize that personnel joining a fishing vessel need to be adequately rested before assuming on-board duties.

4.2 *Ship-specific factors*

4.2.1 In designing or modifying fishing vessels, existing requirements, recommendations, standards and publications pertaining to the listed factors should be taken into account. Additionally, allowance should be made in designing fishing vessels for the adoption of ergonomic practices to prevent fatigue from these factors.

4.3 *Personnel-specific factors*

4.3.1 Thoroughness of training is considered to be important in the prevention of fatigue. Fitness for duty, including medical fitness, proper working experience and the qualifications and quality of fishing vessel personnel are also considered important in this context.

4.3.2 It is important that management recognize the potential problems stemming from the employment of multinational personnel on the same vessel, a practice that may result in language barriers and in social, cultural and religious isolation, all of which may lead to safety problems.

4.3.3 Special emphasis should be placed by management on issues of interpersonal relationships, loneliness, social deprivation and increased workloads that may occur as a result of small complements of fishing vessel personnel.

4.3.4 Boredom can contribute to fatigue, and it is therefore necessary to provide fishing vessel personnel with appropriate stimulation.

4.4 *External environmental factors*

4.4.1 In respect of the listed external environmental factors, it should also be recognized that they could contribute to fatigue.

5 Glossary of common terms

ABS — Automatic behaviour syndrome (ABS) is a state of fatigue in which we are essentially sleeping with our eyes open. While able to perform simple or familiar tasks, we are unable to respond quickly to more critical tasks and situations. In sleep lab studies participants experiencing ABS show brain waves characteristic of sleep.

Acute sleep loss — This type of fatigue is associated with physical or mental activity between two regular sleep periods.

Alertness — The optimal activated state of the brain. Without alertness, there can be no attentiveness, and without attentiveness performance is affected. Selection, training and motivation are ineffective if the human brain is not alert. Alertness is a dynamic state and may vary from second to second. When people are alert, they have a better awareness of what is happening around them and are able to think and take action.

Biological clock — Also referred to as our internal clock, or our circadian clock, our biological clock is a group of nerve cells located in the brain which regulates the precise timing of body functions including daily cycles of alertness and

Biological clock (cont.) — sleepiness. The biological clock sustains circadian rhythm. Studies have identified major characteristics of our biological clock:

1. It is an internal physiological system that measures the passage of time; it is not a passive responder to environmental cues although it is affected by external cues, such as light and dark.
2. It has its own daily cycle length, which is close to but not exactly 24 hours.
3. When exposed to normal environmental cues, such as the day–night cycle, the organism adapts to a 24-hour day.
4. When cues of the normal day–night cycle are not available, the organism's own internal cycle length determines its cycle.

Chronic undersleeping — This type of fatigue refers to sleeping less each day than one's biological need for sleep. Chronic undersleeping can lead to cumulative sleep debt.

Chronobiology — That branch of science that studies rhythms of life that are an outgrowth of biological systems. Chronobiology is based upon repetitive measurement of naturally occurring physiological phenomena.

Circadian disruption — Disturbance of the circadian rhythm. Circadian disruption can result from trans-meridian travel, irregular work schedules, or failing to get adequate sleep during the night. It can lead to difficulty sleeping at appropriate times, problems maintaining alertness and fatigue. The body will adjust, but slowly. Adjustment can be very complex because, although we often speak of the circadian rhythm, there are actually several circadian rhythms and they do not necessarily adjust at the same rate.

Circadian rhythm — Over time, the daily cycle of light and dark has become hardwired into our brains in the form of a biological clock. This biological clock controls various chemical and neurological systems which affect sleep, eating, digestion and other essential functions. One of the most important features of circadian rhythms for safety is that people are programmed to be awake during the day and sleep at night. We do adjust to new schedules, but slowly. The night worker who reverts to daytime activity has to begin the adjustment all over again when he/she returns to work after a couple of days off duty.

Entrainment

A process of synchronization whereby the intrinsic 25-hour cycle of the human biological clock is automatically reset forward by an hour each morning by the light of dawn so that it adapts to the 24-hour schedule of day and night.

Fatigue

Fatigue is used as a catch-all term for a variety of different experiences, such as physical discomfort from overworking a group of muscles, difficulty concentrating, difficulty appreciating potentially important signals and problems staying awake. In the context of an investigation, fatigue is important if it potentially reduces efficiency, erodes the safety margin or otherwise impairs cognitive or physical performance.

Free running

When freed from the usual daily time cues provided by daylight and darkness, the biological clock runs under its own day length. Humans allowed to free run typically have a 25-hour-day cycle, hence the term "circadian rhythm".

Insomnia

Insomnia is a general term that describes a number of problems that prevent sleep. It is viewed as a sleep disturbance rather than a sleep disorder, although it may be precipitated by a sleep disorder such as sleep apnea or narcolepsy. While about 12% of the general population suffer from insomnia, two thirds of workers with irregular schedules complain about insomnia.

Insomnia – clinical

Describes the condition when a person has difficulty in sleeping under normal, regular conditions and in phase with his body rhythm. It is an inability to sleep when the physiological system is calling for sleep.

Insomnia – situational

Difficulty in sleeping in a particular situation e.g., when the biological rhythms are disturbed, or one is trying to sleep in a strange environment. This often occurs when the brain and the body are not in the sleeping phase. There are wide differences between individuals in their ability to sleep out of phase with their biological rhythms and in their tolerance to sleep disturbances.

Jet lag

A brief maladjustment experienced when a change of time zone causes biological rhythms to become out of phase with new local time.

Microsleep

Very short period of sleep lasting from a fraction of a second to two or three seconds. Although EEG recordings can confirm their existence, the person is not generally aware of them. This makes the phenomenon particularly dangerous. They have been shown in tests to correlate with periods of low performance and they occur most frequently during conditions of fatigue. Microsleeps are not helpful in reducing sleepiness.

REM sleep

This is the stage of sleep, occurring several times in a normal night, during which the brain is very active. It is associated with rapid eye movement (REM) and dreaming. The purpose of REM sleep is not known, although experiments have shown that it may be related to memory consolidation.

Restorative rest

Restorative rest is sleep. People who do not get enough sleep, or whose sleep is of poor quality, become fatigued and their performance suffers. The only way to restore performance decrements caused by fatigue is to sleep. Rest without sleep will not suffice. Interrupted or poor-quality sleep will not restore alertness. How much sleep is needed depends on the severity of the fatigue and the demands of the situation. Napping can be an effective short-term tactic. In cases of severe sleep deprivation or accumulated sleep debt, two nights of normal sleep will usually be sufficient to restore normal alertness levels.

Sleep

Sleep architecture

The nightly pattern of light sleep, deep sleep and REM sleep episodes is often called sleep architecture. Disturbing normal sleep architecture has the same effects as sleep deprivation or sleep debt. The pattern of sleep, not just the quantity of sleep, is important for maintaining alertness. Sleep architecture can be disturbed by drugs, alcohol, awakenings due to outside disturbances or sleep-related pathology.

Sleep debt

Everyone has a minimum sleep requirement to maintain alertness and a reasonable level of functioning. There are differences between people, but over 90% of the population needs between 7.5 and 8.5 hours of sleep per day. If they obtain less than their requirement, they develop a sleep debt. Sleep debt is cumulative. That is, missing an hour of sleep per day for four days results in about the same degree of impairment as missing four hours of sleep one night. When a sleep debt is combined with circadian disruption, or a long day, the effects can be very serious. The extent of someone's impairment

Sleep debt (cont.)

cannot be assessed without their recent sleep history. Looking only at the current day could lead us to underestimate the level of fatigue of a person who had accumulated a significant sleep debt during the preceding week. This is why investigators are encouraged to obtain at least a 72-hour history for the principal participants in an occurrence.

Sleep inertia

A transition period of performance impairment that occurs immediately upon awakening from deep sleep. Sleep inertia is affected by a variety of factors, but most importantly by duration of deep sleep and circadian time of the sleep. Typically, the impairment is modest and short-lived due to gradual awakening from sleep. It can be more severe, however, if the arousal from sleep is abrupt and during the first half of the night. It is most dramatic if the sleeper has been sleep-deprived and is forced to awaken and function after only a few hours of deep recovery sleep. In such cases, the impairment in performance of a cognitive task, such as mental arithmetic, problem-solving or dealing with an emergency during sleep inertia, exceeds that seen prior to sleeping by a factor of 10.

Sleep stages

Sleep is not a passive state but rather a complex activity. Although the body is quiet, the brain is active. The brain goes through several phases of sleep, starting with light sleep and becoming progressively deeper. After the deepest stage is reached, REM sleep episodes occur in a fairly regular pattern. It appears that all stages of sleep are required in order to maintain or restore alertness.

Soporific environment

Some environments are more stimulating than others. A soporific environment is one that makes it easy to fall asleep, or hard to stay alert. Environmental factors which make it easy to doze include comfortable temperature, low light, quiet or low-level white noise and a general lack of activity or stimulation. The environment itself is not sufficient to induce sleep. People only sleep during circadian lows or when they have a sleep debt. When a sleep need exists, however, a soporific environment can make it hard to stay awake and be alert.

Zeitgebers

German for "time givers", *zeitgebers* are the daily time cues that serve to synchronize our circadian rhythms.

Appendix 42

Principles to be observed in keeping an engineering watch

1 This appendix is based on requirements of the 1978 STCW Convention, as amended in 1995, and modified to suit the requirements of fishing vessel personnel.

1.1 The term *engineering watch* as used in this section means either a person or a group of personnel comprising the watch or a period of responsibility for a person during which the physical presence in machinery spaces of that person may or may not be required.

1.2 The person in charge of the engineering watch is the chief engineer officer's representative and is primarily responsible, at all times, for the safe and efficient operation and upkeep of machinery affecting the safety of the vessel and is responsible for the inspection, operation and testing, as required, of all machinery and equipment under the responsibility of the engineering watch.

2 Watch arrangements

2.1 The composition of the engineering watch should, at all times, be adequate to ensure the safe operation of all machinery affecting the operation of the ship, in either automated or manual mode and be appropriate to the prevailing circumstances and conditions.

2.2 When deciding the composition of the engineering watch, the following criteria, *inter alia*, should be taken into account:

.1 the type of fishing vessel and the type and condition of the machinery;

.2 the adequate supervision, at all times, of machinery affecting the safe operation of the fishing vessel;

.3 any special modes of fishing operation dictated by conditions such as weather, ice, contaminated water, shallow water, emergency conditions, damage containment or pollution abatement;

.4 the qualifications and experience of the engineering watch;

.5 the safety of life, vessel, catch and port and protection of the environment;

.6 the observance of international, national and local regulations; and

.7 maintaining the normal running operations of the fishing vessel.

3 Taking over the watch

3.1 The person in charge of the engineering watch should not hand over the watch to the relieving person if there is reason to believe that the latter is obviously not capable of carrying out the watchkeeping duties effectively, in which case the chief engineer officer should be notified.

3.2 The relieved persons of the engineering watch should ensure that the members of the relieving engineering watch are apparently fully capable of performing their duties effectively.

3.3 Prior to taking over the engineering watch, the relieving person should satisfy themselves regarding at least the following:

.1 the standing orders and special instructions of the chief engineer officer relating to the operation of the fishing vessel's systems and machinery;

.2 the nature of all work being performed on machinery and systems, the personnel involved and potential hazards;

.3 the level and, where applicable, the condition of water or residues in bilges, ballast tanks, slop tanks, reserve tanks, freshwater tanks, sewage tanks and any special requirements for use or disposal of the contents thereof;

.4 the condition and level of fuel in the reserve tanks, settling tank, day tank and other fuel storage facilities;

.5 any special requirements relating to sanitary system disposals;

.6 condition and mode of operation of the various main and auxiliary systems, including the electrical power distribution system;

.7 where applicable, the condition of monitoring and control console equipment, and which equipment is being operated manually;

.8 where applicable, the condition and mode of operation of automatic boiler controls such as flame safeguard control systems, limit control systems, combustion control systems, fuel-supply control systems and other equipment related to the operation of steam boilers;

.9 any potentially adverse conditions resulting from bad weather, ice or contaminated or shallow water;

.10 any special modes of operation dictated by equipment failure or adverse ship conditions;

.11 the reports of engine-room ratings relating to their assigned duties;

.12 the availability of fire-fighting appliances; and

.13 the state of completion of the engine-room log.

4 Performing the engineering watch

4.1 The person in charge of the engineering watch should ensure that the established watchkeeping arrangements are maintained for the safe and efficient operation of the propulsion machinery and auxiliary equipment.

4.2 The person in charge of the engineering watch should continue to be responsible for machinery-space operations, despite the presence of the chief engineer officer in the machinery spaces, until specifically informed that the chief engineer officer has assumed that responsibility and this is mutually understood.

4.3 All members of the engineering watch should be familiar with their assigned watchkeeping duties. In addition, every member should, with respect to the fishing vessel they are serving in, have knowledge of:

.1 the use of appropriate internal communication systems;

.2 the escape routes from machinery spaces;

.3 the engine-room alarm systems and be able to distinguish between the various alarms with special reference to the fire-extinguishing media alarm; and

.4 the number location and types of fire-fighting equipment and damage control gear in the machinery spaces, together with their use and the various safety precautions to be observed.

4.4 Any machinery not functioning properly, expected to malfunction or requiring special service should be noted along with any action already taken. Plans should be made for any further action if required.

4.5 When the machinery spaces are in the manned condition, the person in charge of the engineering watch should at all times be readily capable of operating the propulsion equipment in response to needs for changes in direction or speed.

4.6 When the machinery spaces are in the periodic unmanned condition, the person in charge of the engineering watch should be immediately available and on call to attend the machinery spaces.

4.7 All bridge orders should be promptly executed. Changes in direction or speed of the main propulsion units should be recorded, except where an Administration has determined that the size or characteristics of a particular ship make such recording impracticable. The person in charge of the engineering watch should ensure that the main propulsion unit controls, when in the manual mode of operation, are continuously attended under standby or manoeuvring conditions.

4.8 Due attention should be paid to the ongoing maintenance and support of all machinery, including mechanical, electrical, electronic, hydraulic and pneumatic systems, their control apparatus and associated

safety equipment, all accommodation service systems equipment and the recording of stores and spare gear usage.

4.9 The chief engineer officer should ensure that the person in charge of the engineering watch is informed of all preventive maintenance, damage control or repair operations to be performed during the engineering watch. The person in charge of the engineering watch should be responsible for the isolation, bypassing and adjustment of all machinery under the responsibility of the engineering watch that is to be worked on, and should record all work carried out.

4.10 When the engine-room is put in a standby condition, the person in charge of the engineering watch should ensure that all machinery and equipment which may be used during manoeuvring is in a state of immediate readiness and that an adequate reserve of power is available for steering gear and other requirements.

4.11 The person in charge of an engineering watch should not be assigned or undertake any duties which would interfere with the supervisory duties in respect of the main propulsion system and ancillary equipment. They should keep the main propulsion plant and auxiliary systems under constant supervision until properly relieved, and should periodically inspect the machinery in their charge. They should also ensure that adequate inspection of the machinery and steering gear spaces are made for the purpose of observing and reporting equipment malfunctions or breakdowns or performing or directing routine adjustments, required upkeep and any other necessary tasks.

4.12 The person in charge of an engineering watch should direct any other member of the engineering watch to inform them of potentially hazardous conditions which may adversely affect the machinery or jeopardize the safety of life or of the ship.

4.13 The person in charge of the engineering watch should ensure that the machinery space watch is supervised, and should arrange for substitute personnel in the event of the incapacity of any engineering watch personnel. The engineering watch should not leave the machinery spaces unsupervised in a manner that would prevent the manual operation of the main engine controls.

4.14 The person in charge of the engineering watch should take the action necessary to contain the effects of damage resulting from equipment breakdown, fire, flooding, rupture, collision, stranding or other cause.

4.15 Before going off duty, the person in charge of the engineering watch should ensure that all events related to the main and auxiliary machinery which have occurred during the engineering watch are suitably recorded.

4.16 The person in charge of the engineering watch should co-operate with any engineer in charge of maintenance work during all preventive

maintenance, damage control or repairs. This should include but not necessarily be limited to:

- **.1** isolating and bypassing machinery to be worked on;
- **.2** adjusting the remaining plant to function adequately and safely during the maintenance period;
- **.3** recording, in the engine-room log or other suitable document, the equipment worked on and the personnel involved, and which safety steps have been taken and by whom, for the benefit of relieving person/s and for record purposes; and
- **.4** testing and putting into service, when necessary, the repaired machinery or equipment.

4.17 The person in charge of the engineering watch should ensure that any engine-room ratings who perform maintenance duties are available to assist in the manual operation of machinery in the event of automatic equipment failure.

4.18 The person in charge of the engineering watch should bear in mind that changes in speed, resulting from machinery malfunction, or any loss of steering may imperil the safety of the ship and life at sea. The bridge should be immediately notified in the event of fire and of any impending action in machinery spaces that may cause reduction in the ship's speed, imminent steering failure, stoppage of the ship's propulsion system or any alteration in the generation of electric power or similar threat to safety. This notification, where possible, should be accomplished before changes are made, in order to afford the bridge the maximum available time to take whatever action is possible to avoid a potential marine casualty.

4.19 The person in charge of the engineering watch should notify the chief engineer officer or skipper, when applicable, without delay:

- **.1** when engine damage or a malfunction occurs which may be such as to endanger the safe operation of the ship;
- **.2** when any malfunction occurs which, it is believed, may cause damage or breakdown of propulsion machinery, auxiliary machinery or monitoring and governing systems; and
- **.3** in any emergency or if in any doubt as to what decision or measures to take.

4.20 Despite the requirement to notify the chief engineer officer or skipper, where applicable, in the foregoing circumstances, the person in charge of the engineering watch should not hesitate to take immediate action for the safety of the ship, its machinery and personnel where circumstances require.

4.21 The person in charge of the engineering watch should give the watchkeeping personnel all appropriate instructions and information which

will ensure the keeping of a safe engineering watch. Routine machinery upkeep, performed as incidental tasks as a part of keeping a safe watch, should be set up as an integral part of the watch routine. Detailed repair maintenance involving repairs to electrical, mechanical, hydraulic, pneumatic or applicable electronic equipment throughout the ship should be performed with the cognizance of the person in charge of the engineering watch and chief engineer officer. These repairs should be recorded.

5 Engineering watchkeeping under different conditions and in different areas

5.1 *Restricted visibility*

5.1 The person in charge of the engineering watch should ensure that a permanent power source is available for sound signals and that at all times bridge orders relating to changes in speed or direction of operation are immediately implemented and, in addition, that auxiliary machinery used for manoeuvring is readily available.

6 Coastal and congested waters

6.1 The person in charge of the engineering watch should ensure that all machinery involved with the manoeuvring of the ship can immediately be placed in the manual mode of operation when notified that the ship is in congested waters. The person in charge of the engineering watch should also ensure that an adequate reserve of power is available for steering and other manoeuvring requirements. Emergency steering and other auxiliary equipment should be ready for immediate operation.

7 Ship at anchor

7.1 At an unsheltered anchorage, the chief engineer officer or person in charge of the engineering watch should consult with the skipper whether or not to maintain the same engineering watch as when under way.

7.2 When a fishing vessel is at anchor in an open roadstead or any other virtually "at sea" condition, the person in charge of the engineering watch should ensure that:

.1 an efficient engineering watch is kept;

.2 periodic inspection is made of all operating and stand-by machinery;

.3 main and auxiliary machinery is maintained in a state of readiness in accordance with orders from the bridge;

.4 measures are taken to protect the environment from pollution by the ship, and that applicable pollution prevention regulations are complied with; and

.5 all damage control and fire-fighting systems are in readiness.