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GUIDELINES FOR THE DESIGN, CONSTRUCTION AND OPERATION OF PASSENGER SUBMERSIBLE CRAFT

1 The Maritime Safety Committee, at its seventy-third session (27 November to 6 December 2000), having considered a proposal by the Sub-Committee on Ship Design and Equipment, approved the annexed Guidelines for the design, construction and operation of passenger submersible craft which have been developed to provide international standards for these craft and to facilitate their international movement, acceptance and safe operation as well as providing the highest practical standards of safety for passengers and crew on such craft.

2 The Guidelines are applicable to submersible craft adapted to accommodate passengers and are intended for underwater excursions with the pressure in the passenger compartment at or near one atmosphere.

3 The Guidelines do not address issues such as surface support and dive site, which may be critical to the safe operation of a passenger submersible craft. The Guidelines recognize the fact that State(s) may have specific or additional requirements in connection with the operation of passenger submersible craft in waters under their jurisdiction. In addition, a consultative process may need to be initiated between the State whose flag the craft is entitled to fly and the State(s) in whose waters the craft will operate.

4 Member Governments are invited to bring these Guidelines to the attention of all parties involved in the design, construction and operation of passenger submersible craft.

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PREAMBLE

1 The Guidelines for Design, Construction and Operation of Passenger Submersible Craft (hereinafter called the Guidelines) have been developed to provide international standards for passenger submersible craft. The intent of the Guidelines is to facilitate the international movement, acceptance and safe operation of such craft and to provide the highest practicable standard of safety for passengers in such craft.

2 It is recognized that passenger submersible craft designs and operational parameters may depend on the geographical area of operation, environmental conditions, intended passenger carrying capability of the craft and on the degree of surface support provided.

3 The Guidelines do not, therefore, attempt to specify which particular type of passenger submersible craft should be employed and recommend that operators examine and identify a most suitable option for the area and type of operation in which they are engaged.

4 Any existing passenger submersible craft which complies with the provisions of the Guidelines should be considered eligible for issuance of a Certificate in accordance with these Guidelines.

5 The present Guidelines do not address issues such as surface support and dive site, which may be critical to the safe operation of a passenger submersible craft. The Guidelines recognize the fact that State(s) may have specific or additional requirements in connection with the operation of passenger submersible craft in waters under their jurisdiction. In addition, a consultative process may need to be initiated between the State whose flag the craft is entitled to fly and the State(s) in whose waters the craft will be operating.

CHAPTER 1 - GENERAL

1.1 Application

1.1.1 The Guidelines for Design, Construction and Operation of Passenger Submersible Craft are applicable to submersible craft adapted to accommodate passengers and intended for underwater excursions with the pressure in the passenger compartment at or near one atmosphere.

1.1.2 Passenger submersible craft which comply with the provisions of the Guidelines should be considered eligible for issuance of a Certificate in accordance with the Guidelines.

1.1.3 Other issues such as surface support and dive site, which may be critical to safe operation, are not addressed by these Guidelines, and should be addressed to the satisfaction of the flag State Administration and the State(s) in whose waters the passenger submersible craft will be operating.

1.2 Definitions

For the purpose of these Guidelines the following definitions are adopted:

1.2.1 *Administration* is the Government of the State whose flag a passenger submersible craft is entitled to fly or in which the passenger submersible craft is registered.

1.2.2 *Autonomous craft* is a passenger submersible craft which, although requiring surface support, is not physically connected to support facilities during operation.

1.2.3 *Ballast tank* refers to a compartment/tank used to control the buoyancy of a passenger submersible craft.

1.2.4 *Exostructure* means all structure appendages, fairings and fendering outside of the pressure hull, including propeller guards.

1.2.5 *Gas container* is a pressure container for the storage and transport of gases under pressure.

1.2.6 *Life-support system* is the equipment and systems required to maintain the passenger submersible craft in a habitable condition in all anticipated operating conditions.

1.2.7 *The design depth* is the maximum depth to which the passenger submersible craft is designed to operate.

1.2.8 *Organization* is the International Maritime Organization (IMO).

1.2.9 *Payload* is the weight the passenger submersible craft is capable of carrying in addition to its permanently fitted equipment.

1.2.10 *Passenger* is every person other than the pilot and the members of the crew or other persons employed or engaged in any capacity on board a passenger submersible craft on the business of the craft.

1.2.11 *Passenger compartment* is a space intended to accommodate passengers.

1.2.12 *Passenger submersible craft* is a passenger-carrying mobile vessel, which primarily operates under water and relies on surface support, e.g. a surface ship or shore-based facilities, for monitoring and for one or more of the following:

- .1 recharging of power supply;
- .2 recharging high pressure air; and
- .3 recharging life-support.

1.2.13 *Pilot* is a person appointed to command the passenger submersible craft.

1.2.14 *Pressure container* is a pressure vessel for the storage of fluids under pressure.

1.2.15 *Recognized organization* is a classification society authorized by a flag State to perform statutory services on its behalf under certain conditions determined by the flag State*.

* Refer to the Guidelines for the authorization of organizations acting on behalf of the Administration, adopted by the Organization by resolution A.739(18), and to the Specifications on the survey and certification functions of recognized organizations acting on behalf of the Administration, adopted by the Organization by resolution A.789(19).

- 1.2.16 *Rated depth* is the maximum depth to which the passenger submersible craft is certified to operate.
- 1.2.17 *Support facility* is a surface craft or shore-based facility providing support to passenger submersible craft.
- 1.2.18 *Viewport* is a penetration in the pressure boundary including the window, flange, retaining ring and seals.
- 1.2.19 *Window* is a transparent, impermeable and pressure resistant insert in the viewport.

1.3 Exemptions

The Administration may exempt any passenger submersible craft, which embodies features of a novel kind from any of the provisions of the Guidelines, so that the research and development into such novel features is not restricted by the Guidelines. Any such submersible craft should, however, comply with safety requirements which, in the opinion of that Administration, are adequate for the operation intended and are such as to ensure its equivalent safety.

1.4 Equivalentents

Where the Guidelines require that a particular fitting, material, appliance, item or type of equipment should be fitted or carried on passenger submersible craft, or that any particular provision should be made, or any procedure or arrangement complied with, the Administration may allow alternative arrangements in that passenger submersible craft, provided that the Administration is satisfied that such alternatives are at least as effective as the requirements of the Guidelines.

1.5 Surveys

1.5.1 Each passenger submersible craft should be subject to the surveys specified below:

1.5.1.1 An initial survey before the Certificate required in section 1.6.2 is issued for the first time. This survey should include a complete and thorough examination of the passenger submersible craft, equipment, fittings, arrangements and materials and should be such as to ensure full compliance with the applicable provisions of the Guidelines.

1.5.1.2 An annual survey to ensure that the passenger submersible craft, fittings, arrangements and equipment remain in compliance with the applicable provisions of the Guidelines and are in good working order. Such survey should be endorsed on the Certificate issued under the provisions of section 1.6.2. An annual survey should include a test dive to the rated depth.

1.5.1.3 A dry-docking survey at intervals specified by the Administration, but not exceeding three years, which should be a complete and thorough examination of the passenger submersible craft, equipment, fittings, arrangements and materials and should ensure full compliance with the applicable provisions of the Guidelines. Additional dry-docking(s) may be required at the discretion of the Administration subject to accessibility of underwater components during annual surveys.

1.5.1.4 Annual surveys are to be performed within three months either way of the anniversary date of the previous dry-docking survey or the original certificate date if dry-docking surveys have not yet been performed.

1.5.1.5 Dry-docking surveys are to be completed within three months prior to the due date to avoid changing the due date. When dry-docking surveys are commenced more than three months prior to the due date, the

survey is to be completed within three months of initiation of the survey. At the operator's option, when such additional dry-docking surveys are carried out, the due date of the next dry-docking survey may be modified accordingly.

1.5.2 An inspection, either general or partial, according to the circumstances, should be made every time a defect is discovered or an accident occurs which affects the safety and certification of the passenger submersible craft. The inspection should ensure that the repairs or alterations carried out have been done effectively and are in all respects in full compliance with the applicable provisions of the Guidelines.

1.5.3 Surveys and inspections should be carried out by officers of the Administration. The Administration may, however, entrust the surveys either to surveyors nominated for the purpose or to organizations recognized by it. In every case the Administration concerned should fully guarantee the completeness and efficiency of the surveys.

1.5.4 After any survey or inspection under this section has been completed no change that affects its safety and certification should be made to the passenger submersible craft without the agreement of the Administration, or any person or organization duly authorized by it, except for the purpose of repair or maintenance. The management of passenger submersible craft operations should comply with the International Safety Management (ISM) Code*.

1.6 Certificates and documentation

1.6.1 Design and Construction Document

1.6.1.1 A Design and Construction Document should be issued by the Administration, or any person or organization duly authorized by it, after construction of the passenger submersible craft. The document should list the standards used in the design and construction of the main components, viewports, piping, electrical systems and life support. This document should be attached to the Safety Compliance Certificate.

1.6.1.2 Any exemptions granted under section 1.3 should be clearly noted on the Certificate.

1.6.2 Safety Compliance Certificate

1.6.2.1 The Administration, or any person or organization duly authorized by it, may issue a Safety Compliance Certificate after the initial survey of a passenger submersible craft. This certificate may be re-issued after a survey which complies with the requirements of paragraph 1.5.1.4. In every case the Administration should assume full responsibility for the Certificate.

1.6.2.2 The Certificate should be drawn up in the official language of the Administration, in a form corresponding to the model given in appendix 1 of the Guidelines. If the language used is not English, French or Spanish, the text should include a translation into one of these languages.

* Refer to the International Management Code for the Safe Operation of Ships and for Pollution Prevention (International Safety Management (ISM) Code), adopted by the Organization by resolution A.741(18).

1.6.2.3 The Certificate would cease to be valid if modifications which affect the safety of the craft have been made without the agreement of the Administration, except for the purpose of repair or maintenance, or if surveys and inspections as specified by the Administration under the provisions of paragraph 1.5.1 have not been carried out.

1.6.2.4 The Safety Compliance Certificate should be issued for a period not exceeding one year. An extension of the validity of the Certificate may be granted for a maximum period of three months at the discretion of the Administration.

1.7 Approvals

It is recommended that the owner of a passenger submersible craft and the Administration commence discussions at the earliest possible stages so that the Administration may evaluate the design of the craft and determine if additional or alternative requirements are necessary to achieve the required level of safety.

1.8 Port State control

The provisions of these Guidelines are without any prejudice to any rights of the port State under international law to review the Design and Construction Document and the Safety Compliance Certificate and impose its own requirements relating to the regulation, surveying and inspection of passenger submersible craft operating in the waters over which that State is entitled to exercise sovereign rights.

CHAPTER 2 - DESIGN AND CONSTRUCTION

2.1 General

2.1.1 Passenger submersible craft should be designed, constructed and maintained in compliance with the requirements of a recognized organization as defined in paragraph 1.2.15 or with applicable standards recognized by the flag State Administration, and, in both cases, the State(s) in whose waters the passenger submersible craft will be operating, which provide an equivalent level of safety.

2.1.2 The basic requirement for the passenger submersible craft design is that, as far as practicable, in the event of any single failure the craft can return to the surface without external assistance. Appropriate backup systems and equipment should be incorporated to meet this general design requirement. The craft should be able to attain positive buoyancy at any time.

2.1.3 Passenger submersible craft should operate only in waters with a sea-bed depth not greater than the craft's rated depth. The Administration, however, may consider operation in areas with a greater sea-bed depth on the basis of safety evaluations demonstrating the adequacy of provisions and/or procedures.

2.1.4 Adequate measures should be taken to prevent passengers from interfering with the operation of passenger submersible craft.

2.1.5 The passenger submersible craft should be designed for and be capable of operating in the environmental conditions and temperature ranges envisaged both whilst on the surface and under water.

2.1.6 The arrangement of occupied spaces should provide for easy evacuation.

2.2 Pressure boundary

2.2.1 Pressure hull structural requirements

All materials used in the pressure hull, all welding materials and procedures, the design criteria, permissible stresses and all test procedures should comply with the requirements of a recognized organization to the satisfaction of the Administration.

2.2.2 Hatches

2.2.2.1 The number and location of access hatches should be subject to special consideration of the Administration, bearing in mind the length of the passenger submersible craft, the length of the pressure hull, the number of passengers, the conditions of operation and rescue facilities.

2.2.2.2 The following should be taken into account when determining the number, size and location of access hatches:

- .1 access hatches have an essentially important function when passengers and crew must be evacuated in an emergency situation;
- .2 hatches should be arranged with consideration given to all relevant risks such as fire, smoke, hydrostatic stability of the craft after passenger movement, possible down flooding due to adverse sea state, etc.; and
- .3 the number of hatches should not be unnecessarily increased beyond the safe minimum.

2.2.2.3 Two means, one of which should be visual, should be available to ensure that hatches are closed and secured prior to diving.

2.2.2.4 Means should be available to ensure that hatches are clear of water before opening, and that pressures on either side of the hatch are equalized. Hatches should be outward opening.

2.2.2.5 The means for opening and closing of hatches should permit operation by a single person in all anticipated conditions.

2.2.2.6 Provisions should be made for opening/closing hatches from both sides.

2.2.2.7 Hatches should have means for securing them in the open and closed position.

2.2.3 Viewports

2.2.3.1 Viewports should be of acrylic material and in accordance with the requirements of a recognized organization to the satisfaction of the Administration. Viewports may be of other material, as appropriate, provided viewports of such material are at least as effective and in accordance with the requirements of a recognized organization to the satisfaction of the Administration.

2.2.4 Pressure containers

2.2.4.1 The material of pressure containers should comply with the standards of a recognized organization to the satisfaction of the Administration.

2.2.4.2 Gas containers should have reliable protection against mechanical damage. They should be securely stowed. The volume of a single internal source should be limited in such a way that complete release of its contents will not increase the pressure beyond the safe limit for the craft and its occupants.

2.2.4.3 Cylinders and pressure vessels mounted externally which may be depleted while at depth should be designed to withstand external pressures equal to the design depth of the passenger submersible craft.

2.3 External structure

2.3.1 Exostructure

2.3.1.1 The craft should be provided with an exostructure to prevent damage to the pressure hull and other vital components such as ballast systems. Externally mounted equipment such as thrusters, manipulators, etc. should be designed to minimize risk of entanglement or fouling.

2.3.1.2 All parts of the exostructure which are designed for free flooding should be provided with openings in such a way that void spaces are fully flooded and vented.

2.3.2 Access areas

2.3.2.1 Adequate means, such as guardrails and anti-slip surfaces, should be provided to protect passengers and crew, taking into account all operational conditions likely to be encountered.

2.3.2.2 Safe means of boarding passengers should be provided, taking into account the relative heights of the passenger submersible craft and the boarding area, wave effects, protection of the craft appurtenances and the hull of the transfer vessel, where applicable.

2.4 Systems

Systems should be designed, installed and tested in accordance with the requirements of a recognized organization to the satisfaction of the Administration.

2.4.1 Penetrations

2.4.1.1 Piping

Any piping system penetrating the pressure hull should be equipped with a manual shut-off valve mounted directly on the inner side of the hull. Where this is not practicable, short and strong stub pieces capable of withstanding anticipated mechanical and pressure loads may be fitted between the valve and hull.

2.4.1.2 Electrical penetrations through pressure boundaries

2.4.1.2.1 Penetrating devices conveying electricity through pressure boundaries should be designed, manufactured and tested to standards acceptable to the Administration. The penetrating devices should be capable of maintaining the watertight integrity of the hull if the cable is cut.

2.4.1.2.2 Electrical conductors within the penetrating device should be of solid material.

2.4.1.2.3 The positive and negative conductors from a power source are not to pass through the same penetrating device unless:

- .1 it can be shown that there is little risk of short circuiting or 'tracking' between conductors; and
- .2 the voltages and currents are of such an order that, in the event of failure in any way of the conductor insulation, the integrity of the penetrating device's water block is maintained.

2.4.1.2.4 Electrical penetrating devices should not have any pipes or other system passing through them. This would not preclude having different types of penetrating devices passing through a common plate.

2.4.2 Mechanical systems

2.4.2.1 Piping

2.4.2.1.1 Systems, fittings and equipment subject to internal or external pressures or a combination of both should be suitable for this purpose. All piping which may be exposed to the sea pressure should be able to withstand the design depth of the hull.

2.4.2.1.2 Means should be provided for valves or cocks to indicate open and closed positions. When such an arrangement is not practicable an equivalent method/procedure may be accepted.

2.4.2.1.3 Piping passing through spaces inaccessible for maintenance should consist of continuous length pipe.

2.4.2.1.4 Piping which may be susceptible to mechanical damage should be adequately protected.

2.4.2.1.5 For piping systems penetrating the occupied pressure hull and open to the sea pressure a non-return valve or shut-off valve should be provided in addition to that provided in accordance with paragraph 2.4.1.1.

2.4.2.1.6 Taper cocks should not be used.

2.4.2.2 Hydraulic systems

To protect the hydraulic system from over pressurization, a closed circuit safety valve should be fitted to the pressure line. The liquid discharged through safety valves should be returned into the system.

2.4.3 Electrical systems

All power sources and electrical equipment should be designed for the environment in which they will operate to minimize the risk of fire, explosion, electrical shock and emission of toxic gases to personnel and passengers, and galvanic action of the passenger submersible craft.

2.4.3.1 Power

2.4.3.1.1 Each passenger submersible craft should have a separate main and an onboard emergency source of electrical power.

2.4.3.1.2 If the main source of electrical power is from an external support facility, the capacity of that source is to be adequate for its intended usage.

2.4.3.1.3 The main source of electrical power should have a reserve capacity beyond the normal mission time to supply, where and as appropriate, the following systems for a period of time consistent with the emergency rescue plan but in no case less than 24 h:

- .1 emergency lighting;
- .2 communication equipment;
- .3 life-support systems;
- .4 environmental monitoring equipment;
- .5 essential control systems; and
- .6 other equipment necessary to sustain life.

2.4.3.1.4 The onboard emergency source of electrical power should have the capacity to supply the systems listed in paragraph 2.4.3.1.3 (.1), .2), .4), .5) and .6) plus the emergency life support system, if electrically supplied, for 1.5 times the time required for emergency ascent or 1 h, whichever is greater, unless approved otherwise by the Administration on the basis of special operating conditions.

2.4.3.1.5 Passenger submersible craft should be fitted with emergency lighting which is switched on automatically in the event of failure of the main power supply.

2.4.3.1.6 The emergency source of electrical power should be located so as to ensure its functioning in the event of fire or other casualty causing failure to the main electrical power source.

2.4.3.2 Electrical arrangements

2.4.3.2.1 Power cables should be provided with short circuit and overload protection. The device fitted to power cables passing through a pressure boundary should have response characteristics which will ensure watertight integrity of the electrical penetrators. Protection devices located in the battery compartment should not, under any circumstances, provide an ignition source for the hydrogen gas.

2.4.3.2.2 Adequate precautions should be taken to eliminate all potential sources of ignition within battery compartments. The use of a rigid interconnecting links between batteries should be avoided.

2.4.3.2.3 Electrical equipment should be suitable and safe for its intended use. Consideration should be given to pressure and pressure cycling, humidity, moisture, temperature, oxygen concentration, cable combustibility and water absorption characteristics.

2.4.3.2.4 Arrangements and procedures should be in place to avoid the potential hazards arising from hydrogen accumulation. Hydrogen gas concentrations within the pressure boundary should be monitored and maintained at a level below the lower explosive limit in order to allow the craft time to take corrective action.

2.4.4 Life support

2.4.4.1 The passenger submersible craft should be provided with systems and equipment necessary to ensure adequate life support during normal and emergency conditions.

2.4.4.2 A separate main and an on-board emergency life-support system should be provided for maintaining the oxygen content of the breathing gas between 18% and 23% percent by volume and the concentration of CO₂ below 0.5% by volume under normal conditions and 1% percent under emergency conditions.

2.4.4.3 The capacity of the main life-support system should be sufficient for the design mission time plus a period of time consistent with the emergency rescue plan, but in no case less than 24 h. The capacity of the on board emergency life support system is to be sufficient for 150% of the time normally required to reach the surface or 1 h, whichever is greater. The Administration may consider a reduced duration for the emergency system based on special operating conditions.

2.4.4.4 For the purpose of calculating the required capacities of main and emergency life-support systems, the consumption of oxygen should be assumed to be 28.3 litres per hour per person and a CO₂ production rate of 0.0523 kg per hour per person.

2.4.4.5 Where oxygen containers are located inside the pressure hull, the volume of a single container should be limited such that the complete release of its contents will not increase the pressure by more than 1 atmosphere nor raise the oxygen level above 25% by volume. The allowable pressure increase may be further limited by design and safety considerations.

2.4.4.6 When the pressure containers for oxygen are stored outside the pressure hull, they are to be arranged in at least two banks with separate penetrations entering the craft. The pressure containers are to be designed for an external pressure differential not less than the rated pressure of the passenger submersible craft.

2.4.4.7 In view of the hazards associated with oxygen systems, special consideration should be given to the selection of materials, equipment, installation, cleaning and testing procedures. Ball valves should not be used in oxygen systems.

2.4.4.8 The pilot or a crew member should be able to monitor O₂ and CO₂ concentrations, humidity, temperature and pressure of occupied spaces.

2.4.4.9 Means should be provided and/or operational procedures implemented to notify of a malfunction of the life-support systems.

2.4.4.10 Consideration should be given to the possible need for thermal protection, sanitary facilities, food and water, consistent with the mission time and the emergency rescue plan.

2.4.5 Fire protection

2.4.5.1 The general construction of the passenger submersible craft should be such as to minimize hazards of smoke and fire. All materials and equipment within the craft should be non-combustible within the range of O₂ levels envisaged. Toxicity of burning materials and low flame-spread characteristics should be taken into account.

2.4.5.2 Passenger submersible craft may be fitted with fire/smoke detectors to alert the crew as may be required by the Administration. Consideration should be given to the size of the passenger submersible craft, usage of unoccupied spaces and the ability of occupants to detect fire/smoke in advance of an on-board detector.

2.4.5.3 Passenger submersible craft should be fitted with a suitable means of fire extinguishing. This may consist of a permanently installed system and/or portable extinguishers. The design of the system and selection

of the extinguishing medium should consider type and location of fire anticipated, hazards to human health and the effects of increased pressure. Carbon dioxide and seawater are generally considered to be unsuitable.

2.4.6 Navigation

2.4.6.1 Passenger submersible craft, when engaged in surface navigation, should be provided with means and/or procedures to enable the craft to be navigated safely. Autonomous craft should be provided with such visibility on the surface as will enable the craft to be navigated safely.

2.4.6.2 Provisions are to be made for the pilot to assess the situation in the area in which the craft is intended to surface.

2.4.6.3 Means are to be provided to render the passenger submersible craft, while on the surface, readily visible to other vessels.

2.4.6.4 Passenger submersible craft should be provided with navigational equipment to enable safe operations under all design conditions. Equipment may include, but not be limited to, directional indicator, depth indicator, depth sounder, clock, trim and heel indicator, underwater location device, speed and distance device and Sonar. Navigational equipment should be located in the pilot's work area.

2.4.6.5 Passenger submersible craft equipped with propulsion systems should be provided with adequate controls and indicators to enable safe operation under all design conditions.

2.4.6.6 Where a releasable location system is used, the release arrangement may be manual or hand-hydraulic. It should not depend on electrical power for its operation and should be able to operate at all anticipated angles of heel and trim. The size of the float and length of line should be such that expected currents acting on the line do not prevent the float from coming to the surface.

2.4.6.7 Passenger submersible craft should have two independent instruments for registration of its depth. At least one of these instruments is to be a pressure gauge capable of functioning also in an emergency situation. If both are pressure gauges, they should not have a common inlet. Passenger submersible craft operating in areas where the sea-bed depth is greater than the rated depth should have a depth alarm set at no greater than the rated depth of the craft.

2.4.7 Communications

2.4.7.1 Passenger submersible craft should be provided with such equipment as is necessary for the craft to communicate with the support facility when on the surface and when submerged.

2.4.7.2 Surface communications

Passenger submersible craft should be equipped with at least one two-channel transmitter/receiver, one of the channels of which must operate on safety channel 16-VHF, while the other is used as a "working channel" for communication between the passenger submersible craft and its support facility.

2.4.7.3 Underwater communications

Passenger submersible craft should be equipped with at least one single channel side-band underwater telephone system. Such system should as a minimum requirement enable communication to be maintained with the support facility when it is at a distance equivalent to twice the nominal depth of passenger submersible craft.

2.4.7.4 Provisions should be made for easy and reliable communication between the crew members and to passengers.

2.4.7.5 Where passenger submersible craft have more than one compartment, intercommunication should be provided.

2.4.7.6 Passenger submersible craft should be fitted with a radar transponder if they are not clearly visible on a radar screen.

2.4.7.7 Passenger submersible craft should be fitted with an emergency acoustic pinger compatible with surface support facilities or with sonar reflector. Buoys may be additionally provided. These means should remain operational in the event of loss of main power.

2.4.8 Control and instrumentation

2.4.8.1 The arrangements for blowing ballast tanks should be such that damage to the tanks due to overpressurization is not possible.

2.4.8.2 Adequate indications should be available to the pilot to enable effective monitoring of conditions affecting the safety of the passenger submersible craft and its occupants. The equipment provided should be consistent with the design operating and emergency conditions and procedures. Indications should be provided for at least the following:

- .1 water leakage into the main pressure hull, battery pods and other compartments as may be deemed necessary;
- .2 indications of available power (fuel, electrical, etc.);
- .3 amount of ballast water;
- .4 ground/earth fault monitoring; and
- .5 voltage of, and current from, each electrical source of power.

2.5 Life-saving appliances

2.5.1 Lifejackets should be provided for, and accessible to, each person on the passenger submersible craft. Inflatable type lifejackets should be considered to facilitate disembarkation.

2.5.2 Lifebuoys or equivalent should be available during embarkation and disembarkation of passengers or whenever personnel are on deck.

2.5.3 Passenger submersible craft should be provided with a first aid kit.

2.6 Buoyancy, stability and emergency ascent

2.6.1 Passenger submersible craft should be able to ascend/descend in a safe and controlled manner throughout the craft's rated depth of operations to the satisfaction of the Administration.

2.6.2 Passenger submersible craft should be able to maintain an acceptable stability and trim during ascent, descent, while submerged and on the surface.

- 2.6.3 Passenger submersible craft should be capable of remaining on the surface with the hatches open during all normal design environmental and operating conditions without downflooding.
- 2.6.4 Two independent means, one of which is to be operated with no electric power, should be provided to bring the unit to the surface in a stable and upright condition.
- 2.6.5 In addition to the means provided in accordance with paragraph 2.6.4, passenger submersible craft should be provided for emergency surfacing with means to jettison sufficient mass so that if the largest single floodable volume, other than personnel compartments, is flooded, the ascent rate will be equal to the normal ascent rate. The jettisoned mass may consist of a drop weight, appendages subject to entanglement or a combination of both. Alternatively, the passenger compartment may be provided with a means of separating it from all other parts of the system, including appendages, provided the personnel compartment is positively buoyant when released.
- 2.6.6 The possibility of entanglement should be considered in the design of the passenger submersible craft. Design features, operational and emergency procedures and/or means of jettisoning may be necessary.
- 2.6.7 In accordance with the emergency procedures, it may be necessary to provide means to jettison lifting cables and umbilicals.
- 2.6.8 Jettisoning systems, where provided, should require at least two positive manual actions and should be independent of electric power.
- 2.6.9 Passenger submersible craft should have adequate stability under any possible combination of dropped jettisoned masses to provide for the safe recovery of passengers in accordance with the emergency response plan.
- 2.6.10 Passenger submersible craft should be provided with means of externally bringing the craft to the surface.

CHAPTER 3 - PASSENGER SUBMERSIBLE CRAFT OPERATION

3.1 General

3.1.1 Apart from safety issues associated with system design and operation, there is also a variety of issues dealing with the qualification of personnel, the management of passengers and contingency planning for dealing with emergencies.

3.1.2 The selection of unreliable or unqualified personnel, inadequate training or inadequate licensing procedures could adversely affect the safe operation of the passenger submersible craft. The safety of passengers and crew as well as the protection of property involved in tourist submersible craft operations requires careful attention to personnel selection, training programme and licensing procedures.

3.2 Chain of command

A chain of command should be well defined for each operation such that each person involved knows who is in charge, their individual responsibilities and those of crew members and other personnel external to the passenger submersible craft and contacts in the event of an emergency. The chain of command should be well documented and readily available for inspection.

3.3 Operation preparation and planning

3.3.1 An operating manual, describing normal and emergency operational procedures, should be prepared and be available on board and to others as deemed necessary. This manual should include the following, as applicable:

- .1 operation check-off lists, including pre and post dive check-off lists;
- .2 emergency procedures for situations such as power failure, break in umbilical cord, deballasting/jettisoning, loss of communications, life support system malfunction, fire, entanglement, high hydrogen level, high oxygen level, internal and external oxygen leaks, stranded on bottom, minor flooding and specific emergency conditions characteristics of special types of systems;
- .3 operational mission/ time and depth capabilities;
- .4 sea state capabilities;
- .5 geographical dive site limitations;
- .6 launch and recovery operation procedures;
- .7 liaison with support vessels;
- .8 special restrictions based on uniqueness of design and operating conditions; and
- .9 manning levels.

3.3.2 A written emergency response plan for each operating passenger submersible craft should be prepared and be available on board and to others as deemed necessary.

3.3.3 Emergency drills should be performed on a regular basis. These drills should clearly demonstrate the effectiveness of the procedures.

3.3.4 A maintenance manual containing procedures for periodic inspections and preventative maintenance techniques should be readily available for inspection. The manual is to include the expected service life of the pressure hull and of other vital components/equipment (e.g. viewports, batteries, etc.) along with particular instructions for the maintenance of items requiring special attention. The manual, together with operational and maintenance records should be readily available at the operation site.

3.3.5 Procedures for normal and emergency operations and essential drawings should be carried on board the unit.

3.4 Passenger submersible craft pilot

The pilot should be certificated for the passenger submersible craft he is to operate. The certificate should be obtained by successful completion of a training course, completion of a given number of dives while at the controls of the passenger submersible craft and passing of a test.

3.5 Training

3.5.1 The operator is responsible for ensuring that personnel (including the pilot, crew and maintenance staff) are at all times adequately trained. Such training should include theoretical, practical and operational aspects of passenger submersible craft and procedures to be adopted in emergency situations. The training should, where applicable, include the following subjects as deemed necessary to suit the particular type of craft.

3.5.1.1 Life support

The properties and effects of carbon dioxide, high and low levels of oxygen, carbon monoxide and other gases which could be present in the craft, gas concentrations, oxygen systems, colour coding of gas bottles, methods of carbon dioxide removal and effects of humidity and shelf life on the efficiency of the CO₂ absorbent.

3.5.1.2 Buoyancy and stability

Buoyancy, payload, basic stability and factors affecting stability in both normal and emergency situations.

3.5.1.3 Navigation

The use of surface and sub-surface navigational equipment, effects of currents and tides, seamanship and Collision Regulations.

3.5.1.4 Communications

Surface and sub-surface communication systems, effects of thermal layering on sub-surface communications and the use of standard communication vocabulary.

3.5.1.5 Power sources and electrical arrangements

Batteries and battery charging, explosive hazards and ignition sources, particularly in battery compartments, circuit protection devices, emergency power sources, ground/earth fault detection, fault currents from batteries and pressure compensating arrangements for batteries exposed to sea pressure.

3.5.1.6 Emergency planning

Fires and their causes, fire extinguishing systems and their environmental effects, flooding, entanglement, available life support, toxic hazards, loss of communication, loss of power, physical and physiological effects on passengers and crew subject to prolonged periods underwater when subject to sensory, perceptive or thermal deprivation, control of passengers and means to avoid panic, claustrophobia and hypothermia.

3.5.1.7 Personnel responsibilities

Allocation of duties, chain of command in normal and emergency situations, familiarization with local, national and international requirements.

3.5.1.8 Practical and operational training

The operational training of crew members should be under direct supervision of an experienced pilot and culminate in practical and operational tests including simulated emergency situations.

3.6 Certificate of Competence

Each pilot should be trained, as determined by the operator, in all aspects necessary to safely operate the passenger submersible craft under normal and emergency situations. After having passed the full examination to the satisfaction of the operator, each pilot should be awarded a Certificate of Competence according to the model given in appendix 2.

3.7 Reporting

Information on incidents threatening injury, casualties, damage to the craft or equipment failure should be collected and analyzed by the operator. Measures should be taken to prevent recurrence. Incidents affecting the safety of passengers and/or the passenger submersible craft should be reported to the Administration.

APPENDIX 1

**MODEL FORM OF SAFETY COMPLIANCE CERTIFICATE
FOR PASSENGER SUBMERSIBLE CRAFT**

SAFETY COMPLIANCE CERTIFICATE

(Official seal)

(Country)

Issued under the provisions of the

**GUIDELINES FOR THE DESIGN, CONSTRUCTION AND OPERATION OF PASSENGER
SUBMERSIBLE CRAFT (MSC/Circ.981)**

Name of the passenger submersible craft

Owner

Official number of the passenger submersible craft

Total duration of life-support in excess of
normal mission time

Port of registry

Payload

Normal lightweight displacement

Minimum number of crew

Rated depth

Number of lifejackets

Design depth

Maximum number of passengers

Limiting operational conditions _____

Limiting environmental conditions

Date on which the passenger submersible craft was certified for the first time _____

Date of the last dry-docking survey _____

The (Name) Government certifies

I, the undersigned _____ (Name) certify

- 1 That the above-mentioned passenger submersible craft has been duly surveyed in accordance with the provisions of the Guidelines referred to above.
- 2 That the survey showed that the systems, components and equipment and the conditions thereof are in all respects satisfactory and that the system complies with the relevant provisions.

This certificate is valid until _____ day of _____ 20...

Issued at _____ 20...
(Place of issue of certificate)

The undersigned declares that he is authorized by the said Government to issue this Certificate.

(Signature of official issuing the Certificate
and/or seal of issuing authority)

(Seal or stamp of issuing authority,
as appropriate)

Surveys

This is to certify that, at a survey required by section 1.5 of the Guidelines, this passenger submersible craft was found to comply with the relevant provisions of the Guidelines.

Annual survey

Place _____ Date _____

(Signature and official seal of issuing authority)

Dry-docking survey

Place _____ Date _____

(Signature and official seal of issuing authority)

Endorsement for the extension of the Certificate

The passenger submersible fully complies with the relevant provisions of the Guidelines and this Certificate shall, in accordance with paragraph 1.6.2.4, of the Guidelines, be accepted as valid until _____

Signed _____
(Signature of authorized official)

Place _____ Date _____

(Seal or stamp of the Administration, as appropriate)

APPENDIX 2

**MODEL FORM OF PASSENGER SUBMERSIBLE CRAFT
PILOT CERTIFICATE OF COMPETENCE**

CERTIFICATE OF COMPETENCE

Issued under the provisions of chapter 3 of the Guidelines for the Design, Construction and Operation of Passenger Submersible Craft (MSC/Circ. 981).

**Certificate of Competence
Passenger submersible craft pilot**

This is to certify that _____ (name)
has successfully completed a course of theoretical and practical training as specified in the Guidelines for the Design, Construction and Operation of Passenger Submersible Craft (MSC/Circ.981) and, having passed all the practical and theoretical examinations, is awarded this Certificate of Competence, enabling the above-named person to act as pilot in charge of the following type(s) of passenger submersible craft:

NAME _____
Operator's representative

COMPANY _____

Date _____
