INTERNATIONAL MARITIME ORGANIZATION

IMO

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SUB-COMMITTEE ON FIRE PROTECTION
45th session
Agenda item 16

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REPORT TO THE MARITIME SAFETY COMMITTEE

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LIST OF ANNEXES

1 GENERAL

1.1 The Sub-Committee held its forty-fifth session from 8 to 12 January 2001 under the chairmanship of Mr. K. Yoshida (Japan).

1.2 The session was attended by delegations from the following Member Governments:

ALGERIA
ARGENTINA
BAHAMAS
BANGLADESH
BRAZIL
CANADA
CHILE
CHINA
CUBA
CYPRUS
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA
DENMARK
EGYPT
FINLAND
FRANCE
GERMANY
GREECE
INDONESIA
ITALY
JAPAN
LEBANON
LIBERIA
LIBYAN ARAB JAMAHIRIYA
MALTA
MARSHALL ISLANDS
MEXICO
NETHERLANDS
NORWAY
PANAMA
PHILIPPINES
POLAND
PORTUGAL
REPUBLIC OF KOREA
ROMANIA
RUSSIAN FEDERATION
SINGAPORE
SPAIN
SWEDEN
TURKEY
UNITED KINGDOM
UNITED STATES
VENEZUELA

the following Associate Member of IMO:

HONG KONG, CHINA

an observer from the following intergovernmental organization:

LEAGUE OF ARAB STATES

and observers from the following non-governmental organizations:

INTERNATIONAL CHAMBER OF SHIPPING (ICS)
INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)
THE BALTIC AND INTERNATIONAL MARITIME COUNCIL (BIMCO)
INTERNATIONAL ASSOCIATION OF CLASSIFICATION SOCIETIES (IACS)
OIL COMPANIES INTERNATIONAL MARITIME FORUM (OCIMF)
INTERNATIONAL FEDERATION OF SHIPMASTERS' ASSOCIATION (IFSMA)
INTERNATIONAL ASSOCIATION OF INDEPENDENT TANKER OWNERS (INTERTANKO)
SOCIETY OF INTERNATIONAL GAS TANKER & TERMINAL OPERATORS LTD (SIGTTO)

INTERNATIONAL COUNCIL OF CRUISE LINES (ICCL)
INTERNATIONAL ASSOCIATION OF DRY CARGO SHIPOWNERS (INTERCARGO)
WORLD NUCLEAR TRANSPORT INSTITUTE (WNTI)

1.3 The Secretary-General, in welcoming participants, referred to the adoption by MSC 73 of the revised SOLAS chapter II-2 and the Fire Safety Systems (FSS) Code, considering this as an important achievement in IMO's continuous endeavours to provide the highest practicable fire safety standards for the safe operation of both passenger and cargo ships. He stressed the need for the draft Guidelines on alternative design and arrangements for fire safety to be completed before the revised SOLAS chapter II-2 enters into force.

In addressing the evacuation analysis for passenger ships and high-speed passenger craft issue, the Secretary-General expressed the hope that the guidelines being prepared would provide appropriate guidance to passenger ship owners, operators and designers for conducting a proper evacuation analysis on new passenger ships and high-speed passenger craft and, in particular, for dealing with emergencies involving large cruise ships. Recalling that the Sub-Committee had been requested by the MSC to include existing passenger ships in the context of its work on evacuation analysis, his view was that this task would give the Sub-Committee the opportunity to provide appropriate guidance to passenger ship owners and operators to identify areas of concern before a casualty occurs and to develop proactive solutions to minimize any effects the existing arrangements and procedures might have on carrying out an orderly and timely evacuation. Taking action to enhance the safety of large passenger ships would represent a most significant move on IMO's part to implement the proactive approach policy; and because it addressed such an important and sensitive issue as the safety of the thousands of passengers who travel by sea, it deserved the fullest attention and care.

Referring to the incident involving the fully laden tanker **Castor**, which, on 31 December 2000, had developed a structural problem en route from the Romanian port of Constanza to Lagos, Nigeria, fortunately without casualties, he observed that that incident had highlighted, once again, the question of "ports of refuge". Pointing out to the fact that the working group established by MSC 73 to consider post-**Erika** safety-related issues had listed the issue of "ports of refuge" among the topics selected for further consideration, he expressed the view that the time had come for the Organization to undertake, as a matter of priority, a global consideration of the problem and adopt any measures required to ensure that, in the interests of safety of life at sea and environmental protection, coastal States review their contingency arrangements so that disabled ships are provided with assistance and facilities as might be required in the circumstances.

Having thanked the flag States concerned for forwarding the reports on their investigations into the fire casualties, fortunately without fatalities, aboard the cruise ships **Celebration, Ecstasy** and **Sun Vista**, the Secretary-General urged the Sub-Committee to consider taking all positive steps which might be necessary in regard to passenger ship safety.

Ports of refuge

1.4 Addressing the Secretary-General's reference to the incident involving the tanker **Castor**, the delegation of Spain, realizing the importance of keeping the Organization and the international maritime community duly informed on situations which might seriously affect maritime safety, provided extensive information on the management of the crisis caused by the accident of the 31,068 dwt tanker in waters of the Mediterranean Sea under the responsibility of the Spanish SAR, when it suffered damage to the hull resulting in a crack of 24 metres in length running the whole of its beam from port to starboard halfway along the ship's length, following which the classification society concerned withdrew the ship's certificates. In these circumstances, the ship presented a serious risk of explosion and rupture of the hull and the authorities of Morocco and Gibraltar prohibited its entry into waters or ports under their jurisdiction, as a result of which the ship sailed towards the vicinity of the south-eastern coast of Spain accompanied by the tug **Nicolay Chiker**, with which the tanker's owner had agreed to effect the transhipment of the cargo under a commercial salvage contract.

The Spanish Maritime Authority requested the ship to keep at a distance from the Spanish coast and adopted precautionary measures, involving a visit and inspection of the ship and the stationing of a helicopter, two salvage vessels and a maritime rescue rapid intervention craft, as well as a Spanish Navy patrol boat in the area. In addition, the master of the ship was recommended to evacuate the crew and an assessment was made of the risk of bringing the ship close to the Spanish coast for unloading, either by the method of transhipment to another ship or by the method of discharging to land installations. Those possibilities were rejected as presenting a higher risk for the population, coastal properties and the environment than transhipment on the high seas.

The report issued following the inspection of the ship described the situation as one of *extreme seriousness due to the high risk of explosion*, recommending that the ship should not enter any port and should keep at a distance from the coast with a view to minimizing the consequences of a possible catastrophe. In these circumstances, units of the Spanish maritime rescue service carried out, at the request of the master, the evacuation of the 26 members of the crew, and shipowners, salvage operators and other interested parties were informed that appropriate measures should be adopted to ensure that the ship withdraws from its current position and remains at a distance of at least 30 nautical miles from the Spanish coast, in the light of the unacceptable risk posed to Spanish coastal interests.

The Spanish delegation stated that the basic policy of its Government was the safeguarding of human life at sea and the combating of pollution in waters under its SAR responsibility, in compliance with its international obligations, and that it had accordingly proceeded to the successful rescue of the whole crew of the damaged ship. It stated that its Government had also an inescapable obligation to defend the safety of its coastal population and of property and environment along the Spanish coast, which should not be put at risk as a result of a commercial operation for the salvage and recovery of the ship's cargo.

The incident of the tanker **Castor** had shown the enormous topicality and importance of improving international standards so as to provide an adequate response to the threat to human life at sea and the risk of pollution. It had also shown that this effort should be directed with a new urgency, decisiveness and firmness by IMO. Attention was also drawn to the fact that the ship had a selection factor for port State inspection of 17 and this should be seen in the light of the decision of the EU Council of Ministers of Transport of 12 December 2000 that all ships with a selection factor equivalent to, or above, 7 should be subject to inspection as from 1 January 2003. The Spanish delegation stressed the need for IMO, as a matter of urgency, to approve and facilitate the entry into force of measures designed to improve port State inspections, the responsibilities required of classification societies, the requirements for the withdrawal from service of single hull oil tankers, the installation of double hulls in oil tankers as well as the setting up of "ports of refuge" on terms acceptable to coastal States, since such measures are the best guarantee that preventive action can be taken in order to ensure the seaworthiness and safety of ships.

1.5 Following interventions by the delegations of Cyprus (providing further information on the tanker **Castor** incident), Greece, Malta, the United Kingdom, the Republic of Korea, the Bahamas, Poland (thanking the Spanish authorities for the safe evacuation of the Polish crew of the tanker) and Singapore and the ICS and INTERTANKO observers, expressing support for the Secretary-General's suggestion that the Organization should undertake, as a matter of priority, a global consideration of the issue of "ports of refuge", the Chairman stated that the discussion on the issue would be reflected in the Sub-Committee's report for any necessary follow-up action.

Adoption of the agenda

1.6 The Sub-Committee adopted the agenda (FP 45/1), which, together with a list of documents considered under each agenda item, is set out in annex 1. The Sub-Committee agreed, in general, to be guided in its work by the annotations contained in document FP 45/1/1.

2 DECISIONS OF OTHER IMO BODIES

2.1 The Sub-Committee noted the decisions of the Maritime Safety Committee (MSC) at its seventy-second and seventy-third sessions, the Marine Environment Protection Committee (MEPC) at its forty-fourth and forty-fifth sessions, the Sub-Committee on Ship Design and Equipment (DE) at its forty-third session, the Sub-Committee on Bulk Liquids and Gases (BLG) at its fifth session, the Sub-Committee on Safety of Navigation (NAV) at its forty-sixth session and the Sub-Committee on Stability and Load Lines and on Fishing Vessels Safety (SLF) at its forty-third session (documents FP 45/2, FP 45/2/1 and FP 45/2/2), and took them into account in its deliberations when dealing with relevant agenda items.

Fire safety of double hull tankers

2.2 The Sub-Committee noted that MSC 73, in considering the report of the Working Group on Oil Tanker Safety and Environmental Matters (MSC 73/WP.14), instructed the sub-committees concerned to consider it in general and, in particular, instructed the FP Sub-Committee to deal with the matters identified by the group, as contained in the annex to document FP 45/2/2.

2.3 The Sub-Committee further noted that it was instructed to advise MSC 74, as appropriate, on the outcome of its consideration of the identified issues and submit possible proposals for inclusion in the Sub-Committee's work programme, as appropriate.

2.4 In considering the above matter on the fire safety of double hull tankers, the Sub-Committee decided to discuss this issue in detail under agenda item 13 (see paragraphs 13.3 to 13.7).

Human element analysing process

2.5 The Sub-Committee noted that MSC 72 had instructed the sub-committees to apply the Interim Guidelines for the application of human element analysing process (HEAP) to the IMO rule-making process, contained in MSC/Circ.878, as a matter of priority and provide the Committee with information on any experience gained during the application of the HEAP to further improve the process. The Sub-Committee, therefore, having recalled the Committee's instruction that the sub-committees should always consider the human factor, invited Members to do so when dealing with issues under its purview and use the HEAP Guidelines as appropriate, in order that experience can be gained with their use and the process be improved through such trial applications of the HEAP.

Large passenger ships

2.6 The Sub-Committee, noting that MSC 73 had instructed it to consider the safe evacuation of existing passenger ships, decided to deal with this matter under agenda item 3 (see paragraphs 3.8 and 3.17 to 3.18).

3 RECOMMENDATION ON EVACUATION ANALYSIS FOR PASSENGER SHIPS AND HIGH-SPEED PASSENGER CRAFT

3.1 The Sub-Committee recalled that a Correspondence Group on Evacuation Analysis for Passenger Ships and High-Speed Passenger Craft was established at the last session and instructed to:

.1 consider the appendix to the draft Guidelines for a simplified evacuation analysis of high-speed passenger craft contained in annex 1 to document FP 44/WP.2, with a view to refining the method to calculate the travel time;

.2 review the Interim Guidelines attached to MSC/Circ.909 with the aim of developing draft Guidelines for a simplified evacuation analysis of passenger ships, including ro-ro passenger ships, taking into account the considerations listed in paragraph 3.15 of document FP 44/19, document FP 44/3/1 and any other relevant issues which may be raised during the intersessional period;

.3 review and comment on the ratio of passengers to crew members available to assist the former in an emergency;

.4 based on the proposal set out in annex 2 to document FP 44/WP.2, establish proper indications as to the basic rules and assumptions, input parameters and analysis and validation of the results;

.5 develop preliminary guidelines for analysis based on a microscopic approach, endeavouring to ensure uniformity of use of the method; and

.6 examine further document FP 44/3/1 with a view to ascertaining the conclusions and recommendations directly related to the evacuation contained therein which could be attached to the draft Guidelines mentioned in paragraph 3.1.2 above as recommended operational measures.

3.2 The Sub-Committee also recalled that MSC 72 forwarded document MSC 72/12/1 (Australia), reporting on research conducted in Australia related to the evacuation of passenger ships, to the correspondence group for further consideration.

3.3 It was further recalled that MSC 73 (FP 45/2/2) instructed the Sub-Committee to include existing passengers ships within the context of the work on evacuation analysis for passenger ships.

Report of the correspondence group

3.4 In considering the comments and contributions of the Correspondence Group on Evacuation Analysis for Passenger Ships and High-Speed Passenger Craft, as contained in document FP 45/3/3, the Sub-Committee noted that the group had further developed the draft Guidelines for a simplified evacuation analysis of high-speed passenger craft and, based on the experience gained from the application of the Interim Guidelines for a simplified evacuation analysis of ro-ro passenger ships (MSC/Circ.909), identified several aspects needing modifications, additional detail and/or further elaboration to progress further the work on the Guidelines for executing an evacuation analysis for passenger ships.

3.5 With regard to the document submitted by ICCL (FP 45/3/1), the Sub-Committee, noting the outcome of an ICCL chartered industry working group which reviewed and commented on the Interim Guidelines for a simplified evacuation analysis of ro-ro passenger ships (MSC/Circ.909) with a view to their application to cruise ships, agreed that the working group should take into account the findings reported by ICCL.

3.6 The Sub-Committee considered the document submitted by Germany (FP 45/3/4) commenting on the report of the correspondence group (FP 45/3/3) and agreed that the working group should further consider the matters raised by Germany in the course of their deliberations.

Microscopic based evacuation analysis

3.7 In considering the documents submitted by Germany (FP 45/3/2) and the United States (FP 45/3), containing respective proposals for a microscopic based evacuation analysis for passenger ships, the Sub-Committee agreed that additional guidance on how to conduct such an analysis should be developed. However, the Sub-Committee was of the view that, for the time being, MSC/Circ.909 should remain as the base document for the development of the evacuation analysis guidelines.

Existing passenger ships

3.8 The Sub-Committee considered the matter referred by MSC 73 to include existing passenger ships within the context of its work on evacuation analysis. Several delegations expressed the view that an evacuation analysis of existing arrangements and procedures would be beneficial for existing passenger ships to identify areas of concern with a view to developing proactive solutions before a casualty occurs. The Sub-Committee agreed that this matter should be further considered by the working group.

Instructions to the working group

3.9 Having considered the documents submitted to the session and the comments made on the issue of evacuation analysis, the Sub-Committee established a working group and instructed it to:

.1 continue work on the evacuation analysis guidelines for new passenger ships, using as a basis MSC/Circ.909 and taking into consideration the report of the correspondence group (FP 45/3/3), the relevant documents submitted to the session and the discussion in plenary;

.2 finalize work on the draft Guidelines for the evacuation analysis of high-speed passenger craft based on annex 1 of document FP 45/3/3, taking into consideration the outcome of MSC 73 with regard to survival craft on high-speed craft, and to prepare an associated draft MSC circular for their dissemination;

.3 further progress the development of the basic guidance on the use of microscopic models taking into account documents FP 45/3 and FP 45/3/2 and any available information from ISO;

.4 further consider the matter on existing passenger ships with a view to developing a plan of action in this regard, taking into consideration the request of MSC 73 (MSC 73/21, paragraph 4.16) and comments made in plenary; and

.5 advise on whether a correspondence group is necessary and, if so, prepare a recommendation regarding the terms of reference.

Report of the working group

3.10 Having received the report of the working group (FP 45/WP.6), the Sub-Committee approved the report in general and took action as outlined in the following paragraphs, noting that the group would continue working through the week and that its Chairman would prepare part 2 of the group's report shortly after the session, containing the outcome of further consideration of the on-going issues, for submission to FP 46 and also for the benefit of the correspondence group (see also paragraph 3.19).

Guidelines for evacuation analysis of new passenger ships

3.11 The Sub-Committee noted the progress made by the working group on the development of guidelines for evacuation analysis of new passenger ships and, in particular, that:

.1 some potential application problems are related to the definition of initial density and the determination of specific flow and velocity of passengers;

.2 the clear width rather than the effective width should be used, in accordance with the suggestions of the correspondence group (FP 45/3/3, annex 3);

.3 the scenarios to be considered should also include the situation where part of the evacuation system is not available, rather than allowing for this fact through a safety factor, in which case the safety factor in question should be modified as appropriate;

.4 detailed indications will be provided as an input to the correspondence group in part 2 of the working group's report (see also paragraph 3.10); and

.5 the guidelines should include one or more worked examples suitably differentiating, as necessary, between ro-ro passenger ships and other passenger ships.

Guidelines for evacuation analysis of high-speed passenger craft

3.12 The Sub-Committee considered the draft guidelines for a simplified evacuation analysis of high-speed craft, as developed by the correspondence group (FP 45/3/3, annexes 1 and 2), taking also into consideration the outcome of MSC 73 with regard to survival craft on high-speed craft (MSC 73/21, paragraph 3.63), and agreed to the draft MSC circular on Interim Guidelines for a simplified evacuation analysis of high-speed passenger craft, as set out in annex 2, including a worked example aimed at illustrating the practical application of the Interim Guidelines to a sample craft, for submission to MSC 74 for approval.

3.13 Regarding the parameters indicating speed and flow of persons (paragraph 3.6.1 of the draft Interim Guidelines), some delegations expressed concern that the data provided in table 3.6 of the draft Interim Guidelines was derived from studies carried out for static land-based applications and that their validity might be questioned when applying them to an inherently dynamic system such as a high-speed passenger craft, where steeper and possibly narrower stairs, craft motions in a seaway and/or steep heel angles after damage, among other factors, could slow down the flow of persons relative to that estimated for a stable system. Subsequently, the Sub-Committee agreed that until more suitable data became available, the figures in table 3.6 should be used.

Basic guidance on the use of microscopic models

3.14 The Sub-Committee noted the progress made by the group on the development of basic guidance on the use of microscopic models for evacuation analysis. Although the group was not able to make any substantive progress on this issue during the time allowed, it continued considering the matter through the week and the outcome of that consideration will be detailed in part 2 of the report of the working group (see also paragraph 3.10).

3.15 In this regard, the Sub-Committee was informed that the following documentation would produce useful input to the group's further work on the subject:

.1 U.S. Federal Aviation Regulation Title 14 CFR Sec. 25.803 – Emergency evacuation; and

.2 ISO related on-going developments (ISO/TC 92),

and agreed to instruct the correspondence group to consider the above references as appropriate. The ISO observer offered his organization's full collaboration on this issue, including participation in the work of the correspondence group.

3.16 The delegation of Germany made a presentation on a Computer-based microscopic evacuation analysis. The delegation of the United Kingdom also made a presentation to the group on microscopic modeling. Both presentations were received with appreciation.

Application of evacuation analysis to existing passenger ships

3.17 The Sub-Committee noted the progress made by the group on the matter of conducting an evacuation analysis on existing passenger ships taking into consideration the relevant decisions of MSC 73 (MSC 73/21, paragraph 4.16), and generally agreed that, while the purpose of the guidelines for evacuation analysis of new passenger ships is mainly to provide suggestions for improvement in the design of the ship in question, the intention in applying similar guidelines to existing passenger ships would be to provide suggestions for improving procedures on board. Subsequently, the Sub-Committee agreed to the following plan of action to advance work on this issue:

.1 to ensure that the method(s) for carrying out evacuation analysis of passenger ships are developed and finalized;

.2 to further analyse the 5 actual emergencies reported in annex 2 to document FP 45/3/1 (ICCL) and any other available source of reliable evacuation data with a view to gaining additional information for validation of the method(s) under development;

.3 to consider the application of the guidelines for evacuation analysis to existing passenger ships, taking into account the comments reflected in this paragraph;

.4 to take into consideration any measures discussed within IMO aimed at avoiding the need for evacuation (based on the principle that "the ship is the safest lifeboat"); and

.5 to collect available information on current practices utilized by the passenger ship industry with regard to evacuation procedures.

3.18 In respect of paragraph 3.17.2 above, Member Governments were invited to acquire relevant information and provide it to IMO, as appropriate, with a view to the possible establishment of a database.

Re-establishment of the correspondence group

3.19 The Sub-Committee agreed that the correspondence group on evacuation analysis should be re-established under the co-ordination of Italy* with the following terms of reference:

.1 to continue reviewing the Interim Guidelines attached to MSC/Circ.909 with the aim of developing draft Guidelines for a simplified evacuation analysis of new passenger ships, including ro-ro passenger ships, taking into account the outcome of consideration of this matter by FP 45 and part 2 of the group's report when available;

.2 to further progress the development of the guidance on the use of microscopic models, taking into account document FP 45/3/2 and part 2 of the group's report when available;

.3 to develop guidance for validation of computerized models by the Administration;

.4 to continue considering the application of evacuation analysis to existing passenger ships according to the plan of action approved by FP 45 set out in paragraph 3.17; and

.5 to submit a report to FP 46.

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3.20 The delegation of the United Kingdom made a presentation on audible escape devices, which was received with appreciation.

4 GUIDELINES ON ALTERNATIVE DESIGN AND ARRANGEMENTS FOR FIRE SAFETY

Introduction

4.1 The Sub-Committee noted that the Committee, at its seventy-third session, had adopted the revised SOLAS chapter II-2 and FSS Code which are expected to enter into force on 1 July 2002.

4.2 The Sub-Committee recalled that, in anticipation that the revised chapter would be adopted at MSC 73, FP 44 established a Correspondence Group on Alternative Design and Arrangements for Fire Safety to further develop the draft Guidelines on alternative design and arrangements for fire safety, referred to in the revised SOLAS chapter II-2, set out in annex 2 to document FP 44/19, to ensure that the draft Guidelines would be finalized prior to the revised chapter entering into force.

Report of the correspondence group

4.3 Having considered the report of the correspondence group (FP 45/4), the Sub-Committee approved it in general and took action as outlined in the following paragraphs.

4.4 In respect of the Guidelines on alternative design and arrangements for fire safety, the Sub-Committee considered the group's decision to include a draft reporting form on the approval of alternative design and arrangements for fire safety in the draft Guidelines and agreed that the draft form needed to be further modified with a view to ensuring that it is consistent with the requirements contained in the new SOLAS regulation II-2/17.4.

4.5 In considering the group’s opinion that the minimum design fire scenarios should be provided in the Guidelines for the purposes of evaluating alternative design and arrangements, the Sub-Committee agreed that the scenarios should be further considered with a view to justifying the proposed heat release rates contained in appendix B to the draft Guidelines.

4.6 The Sub-Committee discussed the group’s view that the performance level of the alternative design and arrangements should not be required to be compared to that of the prescriptive regulations in all cases and considered that this matter needed to be further studied by the working group. However, several delegations expressed the view that any alternative design and arrangements should meet agreed performance standards.

4.7 With regard to the draft Guidelines on limitation of total amount of combustible materials per unit area in accommodation and service spaces, contained in annex 2 to document FP 44/WP.1, the Sub-Committee recalled that FP 44 had agreed to finalize the draft Guidelines at this session.

4.8 The Sub-Committee, in considering the group’s view that the draft Guidelines on limitation of total amount of combustible materials per unit area in accommodation and service spaces may be in contradiction to the aforementioned draft Guidelines on alternative design and arrangements for fire safety, agreed that the former draft Guidelines (annex 2 to document

FP 44/WP.1) should be further modified to be more closely harmonized with the alternative design process.

Instructions to the working group

4.9 Having considered the report of the correspondence group, the Sub-Committee established a working group and instructed it to:

.1 finalize the draft Guidelines on alternative design and arrangements for fire safety and associated draft MSC circular, taking into consideration the report of the correspondence group and the comments and decisions made in plenary; and

.2 consider further the draft MSC circular on Guidelines on limitation of total amount of combustible materials per unit area in accommodation and service spaces, as contained in annex 2 to document FP 44/WP.1.

Report of the working group

4.10 Upon receiving the report of the working group (FP 45/WP.4), the Sub-Committee approved the report in general and took action as outlined in the following paragraphs.

Guidelines on alternative design and arrangements for fire safety

4.11 The Sub-Committee agreed to editorial improvements to sections 6 and 7 of the draft Guidelines on alternative design and arrangements for fire safety and, on more explicit criteria regarding safety margins, noting that they should be selected considering the possibility of future changes to the fire loading and ventilation arrangements in the affected areas.

4.12 The Sub-Committee agreed that the documentation required for approval of the alternative design and arrangements would play a vital role in the future operation of any ship so equipped. It was felt that a standardized approval certificate would be more recognizable by port State inspectors. A simple reporting form was therefore also developed for Administrations to report the approval of alternative design and arrangements to IMO for circulation to the Member States. Finally, it was agreed that the SOLAS certificates of ships that have been approved with alternative design and arrangements should be endorsed with a simple statement to that effect.

4.13 The Sub-Committee noted that, while the Guidelines are considered adequate for the present, they may need to be revised in several years time after experience was gained in their application.

4.14 Having made minor modifications to various sections of the draft Guidelines to clarify the intended methodology for the engineering analysis needed to show equivalency to the prescriptive regulations, the Sub-Committee, subsequently, agreed to the draft MSC circular on Guidelines on alternative design and arrangements for fire safety, set out in annex 3, for submission to MSC 74 for approval.

Guidelines on a simplified calculation for the total amount of combustible materials per unit area in accommodation and service spaces

4.15 The Sub-Committee discussed possible revisions to the draft Guidelines on limitation of the total amount of combustible materials per unit area in accommodation and service spaces contained in annex 2 to document FP 44/WP.1. The future usefulness of the Guidelines was questioned, as the alternative design and arrangement methodology relies on a more complex scientific determination of fire growth curves and related phenomena. However, the Sub-Committee, having decided that the Guidelines could still be useful for purposes other than SOLAS regulation II-2/17, agreed to the draft MSC circular on Guidelines on a simplified calculation for the total amount of combustible materials per unit area in accommodation and service spaces, as set out in annex 4, for submission to MSC 74 for approval.

5 SMOKE CONTROL AND VENTILATION

5.1 The Sub-Committee recalled its consideration, at the last session, of the documents submitted by France (FP 44/5/1), Japan (FP 44/5/2) and the United States (FP 44/5) containing comments, proposals and test data related to smoke control and ventilation on passenger ships and that it had agreed that amendments to SOLAS were not necessary.

5.2 It was also recalled that FP 44, being of the view that voluntary smoke control guidelines would be beneficial, agreed to invite the Committee to keep this item on the agenda for two more sessions as a low priority item.

5.3 The Sub-Committee, in considering further the above documents and the issue in general, concluded that voluntary guidelines should be developed with a view toward keeping assembly stations and atriums smoke-free during a fire. Members were invited to submit proposals to FP 46 taking into consideration annex 2 to document FP 44/5.

5.4 The delegation of the United Kingdom stated that, in their opinion, the dynamics of smoke and fire development and the capabilities of any active smoke control system must be fully understood by the master and senior officers of a ship. The delegation of the United Kingdom pointed out that, to date, however, such smoke control technology is little developed and that there is very little, if any, experience of its use in real shipboard fires.

5.5 It was, therefore, the contention of the delegation of the United Kingdom that smoke control systems, that are poorly designed or misused, may represent a hazard rather than a benefit to the safety of a ship and, consequently, the Organization should be very careful in developing any standardized guidance to ensure that such guidance is not capable of misapplication, thereby making matters worse, depending on the particular fire scenario that a master and his crew may be faced with.

5.6 The delegation of Italy offered to prepare draft Guidelines on smoke control and ventilation based upon annex 2 to document FP 45/5 for consideration by FP 46.

6 UNIFIED INTERPRETATIONS OF SOLAS CHAPTER II-2 AND RELATED FIRE TEST PROCEDURES

6.1 The Sub-Committee recalled that FP 44 had agreed to retain item on "Unified interpretations of SOLAS chapter II-2 and related fire test procedures" in the Sub-Committee's work programme and the agenda for FP 45 and to establish a working group at this session with an emphasis on fire test procedures.

Unified interpretations to SOLAS chapter II-2

6.2 The Sub-Committee considered the submissions by Italy (FP 45/6/1) and the United States (FP 45/6) containing proposals for unified interpretations of SOLAS chapter II-2 and agreed that the working group should further consider these matters in the course of their deliberations on unified interpretations in general and the draft unified interpretations contained in annex 5 to document FP 44/WP.5.

Carbon monoxide detectors

6.3 With regard to a submission by the United Kingdom (FP 45/6/2) regarding the draft Guidelines on the use and fitting of carbon monoxide detectors, the Sub-Committee agreed that the working group should further consider the issues raised in the aforementioned document in the course of preparation of the draft Guidelines, contained in annex 3 to document FP 44/WP.5.

Fire test procedures

6.4 The Sub-Committee considered matters pertaining to fire test procedures, as addressed in the submissions by Italy (FP 45/6/1) and the United States (FP 44/6) and agreed that these issues should be further considered by the working group in the course of their deliberations on fire test procedures in general and the draft unified interpretations contained in annexes 1 and 2 to document FP 44/WP.5.

6.5 In conjunction with the consideration of the aforementioned documents, the Sub-Committee noted the view that surface finishes should be tested for smoke and toxicity and, agreeing in general with this view, decided to instruct the working group to also consider this matter.

Establishment of the working group

6.6 Recognizing the necessity to make progress on these issues and recalling its decision at FP 44 to establish on *ad hoc* working group on unified interpretations at this session, the Sub-Committee established the working group and, taking into account the comments and decisions made in plenary, instructed it to:

.1 further consider the draft MSC circular on the Use and fitting of carbon monoxide fire detectors in areas of high fire risk, taking into consideration documents FP 44/WP.5 (annex 3) and FP 45/6/2;

.2 consider the interpretations related to fire test procedures as contained in documents FP 44/WP.5 (annexes 1 and 2), FP 45/6 and FP 45/6/1; and

.3 consider the proposed unified interpretations to SOLAS chapter II-2 contained in documents FP 44/WP.5 (annex 5), FP 45/6 and FP 45/6/1.

Report of the working group

6.7 Having received the report of the working group (FP 45/WP.5), the Sub-Committee approved it in general and took action as outlined hereunder.

Use and installation of carbon monoxide fire detectors

6.8 The Sub-Committee noted that the group, recognizing that more information was needed to make any decision on the matter, could not finalize draft Guidelines for the use and installation of carbon monoxide detectors and invited the United Kingdom to submit further information on the alarm threshold, lifetime of chemical detectors, how to apply opacity test and testing standards to be developed, to FP 46 for consideration when the Sub-Committee intends to finalize the draft Guidelines. The Sub-Committee confirmed that these guidelines would be used for approval of carbon monoxide detectors as equivalent to detectors required by SOLAS regulation II-2/13 and did not constitute amendments to the relevant SOLAS requirements.

Unified interpretations related to fire test procedures

6.9 The Sub-Committee considered the draft unified interpretations, prepared by the group, regarding procedures in cases of test failure; paragraph 5.1.6.5 of the FTP Code; the application of approved finish materials meeting the requirements of part 5 of annex 1 to the Code; conditions of re-test in paragraph 8.3.1 of Annex to resolution A.653(16); average heat for heat sustained burning in paragraph 10 of Annex to resolution A.653(16); the duration of testing in paragraph 2.2 of part 6 of annex 1 to the Code; and the construction of aluminium alloy fire divisions in fire resistance tests in paragraph 1.6 of the Annex to resolution A.754(18); and agreed to the draft MSC circular on Unified interpretations of the International Code for the Application of Fire Test Procedures (FTP Code) and fire test procedures referred to in the Code, as set out in annex 5, for submission to MSC 74 for approval.

6.10 With regard to the proposed interpretations by Italy (FP 45/6/1) regarding deck primer tests for primary deck coverings, the Sub-Committee noted the group's opinion that it was adequately covered by paragraph 3.2.2 of part 5 of annex 1 to the FTP Code and agreed that such an interpretation was not needed.

6.11 In respect of the concern expressed by the United Kingdom as to which method (i.e. the Dräger method or other method) should be employed for gas analysis in smoke and toxicity tests, the Sub-Committee noted the group's confirmation that any method, which could produce traceable results, could be used for such tests, as provided in MSC/Circ.916.

6.12 The Sub-Committee noted the group's opinion that the FTP Code and related fire test procedures should be thoroughly reviewed in order to reflect new findings and the latest modern technology.

Unified interpretations to SOLAS chapter II-2

6.13 The Sub-Committee considered the draft interpretation prepared by the group (FP 45/WP.5, annex 2) on application of "light-weight constructions" and agreed to the draft MSC circular on Unified interpretations of vague expressions and other vague wording of SOLAS chapter II-2, set out in annex 6, for submission to MSC 74 for approval.

6.14 With regard to the draft interpretations prepared by the working group at FP 44 (FP 44/WP.5, annex 5) and the proposal by the United States (FP 45/6, annex 1) concerning mooring decks, the Sub-Committee endorsed the group's opinion that the interpretation concerning mooring decks should be left to individual Administrations.

6.15 The Sub-Committee noted that, following discussion on a proposal by Italy (FP 45/6/1) on the interpretation of "periodically unattended machinery spaces" provided in SOLAS regulation II-2/14, the group, recognizing that such spaces include not only machinery spaces of category A, but also other machinery spaces in some cases, had not agreed to the proposed interpretation.

6.16 Having considered the draft interpretation to SOLAS regulations II-2/16.7.4 and 32.1.9.3, prepared by the group (FP 45/WP.5, annex 2), concerning a fixed means using steam to extinguish a fire within a duct, the Sub-Committee decided that this matter needed further consideration and invited Members to submit their comments to FP 46 based on the draft unified interpretation contained in annex 2 to document FP 45/WP.5.

7 FIRE-RETARDANT MATERIALS FOR THE CONSTRUCTION OF LIFEBOATS

7.1 The Sub-Committee recalled that resolution 7 of the International Conference on Safety of Fishing Vessels held in Torremolinos in 1993 had invited the Maritime Safety Committee to develop an appropriate definition for fire-retardant materials for the construction of lifeboats of fishing vessels together with corresponding criteria related to the said definition as well as fire test procedures aimed at assessing compliance with the criteria for such materials.

7.2 The Sub-Committee also recalled that, at FP 41, it had agreed that the scope of discussion should not only be restricted to lifeboats for fishing vessels, but should also cover those for other ships including cargo ships and passenger ships.

7.3 The Sub-Committee further recalled that FP 44 developed draft Fire test procedures for fire-retardant plastic resins for the construction of lifeboats, as contained in annex 6 to document FP 44/WP.5.

7.4 The Sub-Committee considered the documents submitted by the United Kingdom (FP 45/7/1) and the United States (FP 45/7) commenting on the draft Fire test procedures for fire-retardant plastic resins for the construction of lifeboats and instructed the Working Group on Unified Interpretations to SOLAS chapter II-2 and Related Fire Test Procedures (see also paragraph 6.6) to finalize the draft fire test procedures, taking into consideration the comments and proposals contained in the aforementioned documents.

Report of the Working Group

7.5 Having considered the report of the Working Group on Unified Interpretations to SOLAS Chapter II-2 and Related Fire Test Procedures (FP 45/WP.5) with regard to the work related to this agenda item, the Sub-Committee agreed to the draft MSC circular on Guidelines on fire test procedures for acceptance of fire-retardant materials for the construction of lifeboats, as set out in annex 7, for submission to MSC 74 for approval.

8 FIRE-FIGHTING SYSTEMS IN MACHINERY AND OTHER SPACES

Fixed gas fire-extinguishing systems

8.1 The Sub-Committee considered the documents submitted by Italy (FP 45/8/2 and FP 45/8/3) on proposed modifications to MSC/Circ.848 on Revised Guidelines for the approval of equivalent fixed gas fire-extinguishing systems, as referred to in SOLAS 74, for machinery spaces and cargo pump-rooms. The Sub-Committee agreed that this proposal constituted a new work programme item and, therefore, in accordance with the Guidelines on the organization and method of work (MSC/Circ.931, as amended), the proposal should first be considered by the Committee. Recognizing the concern raised by Italy, and supported by other delegations, regarding the difficulties associated with implementing the new European Community regulations on the decommissioning of all existing halon fire-extinguishing systems, the Sub-Committee invited Italy to submit their proposals to the MSC in accordance with the provisions of MSC/Circ.931, as amended.

8.2 The delegation of the United Kingdom informed the Sub-Committee that a new fire-fighting compound had been developed that exhibits sustainable characteristics the likes of which have yet to be apparent in any halocarbon clean extinguishing agent products commercially available today. It was noted that the new compound has performed well in fire tests, is compatible with materials of construction and has a favourable acute toxicity profile.

Water mist fire protection systems

8.3 The Sub-Committee noted with interest the information provided in the document submitted by the United States (FP 45/INF.4) summarizing the results of a full-scale fire test programme to evaluate the performance of water mist fire-extinguishing systems in very large machinery spaces and thanked the United States for providing this information.

Aerosol fire-extinguishing systems

8.4 The Sub-Committee recalled that, at FP 44, it had considered the preliminary text of the draft Guidelines on fixed aerosol fire-extinguishing systems, as contained in annex 2 of document FP 44/WP.6, and agreed to invite the Committee to extend the target completion date of this item to 2001.

8.5 The Sub-Committee also recalled that FP 44 had established a correspondence group, under the co-ordination of Sweden, to further progress the work on the draft guidelines and instructed it to:

.1 prepare, on the basis of documents FP 43/8 and FP 44/9 and any other relevant information collected, taking into account the proposed format of a new MSC circular (paragraph 8 of document FP 45/WP.6) and the preliminary text contained in annex 2 to document FP 44/WP.6, draft Guidelines for the approval of equivalent fixed gas fire-extinguishing systems and equivalent fixed aerosol fire-extinguishing systems, as referred to in SOLAS 74, for machinery spaces and cargo pump-rooms; and

.2 submit a report to FP 45.

Report of the correspondence group

8.6 Having considered the report of the correspondence group (FP 45/8) and the document submitted by the United States (FP 45/8/1) on toxicity criteria for aerosol fire-extinguishing systems, the Sub-Committee agreed to the following:

.1 acceptance criteria should be established based on the proposal by the United States (FP 45/8/1);

.2 a re-ignition test should be included in the guidelines;

.3 a safety factor should be developed;

.4 the maximum volume for the system should be limited to the maximum volume tested;

.5 the system should not be used in cargo pump-rooms;

.6 a recommendation on arrangements for hot work conducted in vicinity of the systems should be developed;

.7 standards for cables used for fire detection systems should also be used for these systems;

.8 a standard for extinguishing media life-time should be included in the aforementioned guidelines; and

.9 the scope of the guidelines should not be limited to a single type of aerosol fire-extinguishing systems.

Establishment of the drafting group

8.7 Recognizing that a good deal of work still needed to be undertaken on this matter, the Sub-Committee established a drafting group and instructed it to finalize the draft Guidelines on aerosol fire-extinguishing systems, contained in annex 2 of document FP 44/WP.6, taking into account documents FP 45/8 and FP 45/8/1 and the comments and decisions made in plenary (see paragraph 8.6 above).

Report of the drafting group

8.8 Having received the report of the drafting group (FP 45/WP.7 and Corr.1), the Sub-Committee approved it in general and took action as indicated hereunder.

8.9 The Sub-Committee endorsed the proposals by the group regarding human health issues, particle size, safety factor and scaling, which have been appropriately incorporated into the draft Guidelines for the approval of fixed aerosol fire-extinguishing systems equivalent to fixed gas fire-extinguishing systems as referred to in SOLAS 74, for machinery spaces.

8.10 With regard to the cargo pump-room issue, the Sub-Committee, having decided not to include cargo pump-rooms in the scope of the Guidelines, agreed that the application of the Guidelines could be extended, in the future, to the cargo pump-rooms when appropriate classifications of the components are available.

8.11 In respect of unwanted activation/agent concentration, the Sub-Committee agreed with the opinion of the group that aerosol fire-extinguishing systems did not require additional precautions to be taken, as compared to the precautions commonly used for other systems.

8.12 With regard to the lifetime of components issue, the Sub-Committee, having taken into account the limited field of experience with this technology, agreed that such determinations should be made by the Administrations based on data provided by individual manufacturers.

8.13 The Sub-Committee, having noted that the SOLAS regulations referred to in the draft Guidelines are those contained in the 1974 SOLAS Convention, as amended, agreed that footnotes should be incorporated into the Guidelines stating the corresponding regulation numbers contained in the revised SOLAS chapter II-2 adopted by resolution MSC.99(73). The Secretariat was instructed to add the aforementioned footnotes as appropriate.

8.14 Subsequently, the Sub-Committee agreed to the draft MSC circular on Guidelines for the approval of fixed aerosol fire-extinguishing systems equivalent to fixed gas fire-extinguishing systems, as referred to in SOLAS 74, for machinery spaces, as set out in annex 8, for submission to MSC 74 for approval.

9 DEVELOPMENT OF GUIDELINES FOR SHIPS OPERATING IN ICE-COVERED WATERS

9.1 The Sub-Committee recalled that MSC 71 had agreed to a new framework as a basis for the continued work on the draft Guidelines for ships operating in ice-covered waters and that Members had been invited to submit comments to FP 45 taking into account the outcome of DE 43.

9.2 The Sub-Committee was informed by the Secretariat (FP 45/2, paragraph 2.5) that DE 43 further considered the draft guidelines taking into consideration the new framework approved by MSC 71 and, having discussed the report of its working group (DE 43/WP.10), had agreed to refer to DE 44 (scheduled to take place in March 2001) the report together with the status report of the draft Guidelines (part 2 of the report of the working group to be submitted to DE 44), for further consideration.

9.3 In view of the above developments, the Sub-Committee decided that no action need be taken at this stage and that the matter should be further considered at FP 46, following DE 44, when guidance on the matter to other sub-committees would have been made available. Members were invited to submit comments and proposals to FP 46 taking into account the outcome of DE 44.

10 ANALYSIS OF FIRE CASUALTY RECORDS

Overheating of belt rollers

10.1 The Sub-Committee recalled that FP 44 had considered the findings and recommendations of the FSI Working Group on Casualty Statistics and Investigations on matters related to fires caused by the overheating of belt rollers in a number of self-unloading bulk carriers.

10.2 The Sub-Committee also recalled the information provided by the Secretariat (FP 44/13) to FP 44 noting that eight similar casualties had occurred since 1975 and that FP 44, taking into account that more information would be useful in considering this matter in further detail, had invited Members to submit comments, proposals and similar casualty information to FP 45.

10.3 Having noted the information by the delegation of Canada that it was conducting research on the overheating of belt rollers on self-unloading bulk carriers and intended to submit the outcome of this research when the results become available, the Sub-Committee agreed to inform FSI 9 that, until such information becomes available to consider this issue in further detail, no action will be taken on this matter.

Fire on board the containership "Ever Decent"

10.4 The Sub-Committee recalled that FP 44 had considered a joint submission by Panama and the United Kingdom (FP 44/13/1), highlighting the concerns about fire-fighting on board containerships in light of the recent fire on the **Ever Decent** and that it had urged Administrations to submit similar casualty information on the fire safety of cargo areas on board containerships so that this issue can be considered in a holistic manner. Members were invited to submit comments and proposals to this session of the Sub-Committee.

10.5 The Sub-Committee noted that the Bahamas had submitted their investigation report on the collision between the **Norwegian Dream** and the **Ever Decent** to IMO and that this information had been forwarded to the FSI Correspondence Group on Casualty Analysis for consideration. The Sub-Committee also noted that the aforementioned report did not cover the fire on board the **Ever Decent** and that the Panamanian report was awaited.

Outcome of FSI 8

10.6 The Sub-Committee recalled that, at FP 44, it had considered the outcome of FSI 8 on matters relevant to the Sub-Committee and, in particular, that FSI 8, in considering the findings and recommendations of the Correspondence Group on Casualty Analysis, as recommended by the Working Group on Casualty Statistics and Investigations, had agreed to:

.1 refer, to this Sub-Committee, document FSI 8/11/1 (Australia) on investigations into shipboard fires conducted by Australia, noting that copies of the referenced investigation reports can be made available by the Secretariat, if desired; and

.2 requested the Sub-Committee to consider the analysis and recommendations on fires and explosions contained in the annex to document FSI 8/WP.4 with a view toward whether further guidance on hot work is needed, taking into consideration resolution A.864(20) on Recommendations for entering enclosed spaces aboard ships and MSC/Circ.807 on Guidelines on riding repairs.

10.7 In considering document FSI 8/11/1 by Australia, the Sub-Committee was of the view that more time would be necessary to analyze the reports provided by Australia and took relevant action as indicated in paragraph 10.11. The Sub-Committee noted that copies of the reports referred to in document FSI 8/11/1 have been made available to the Secretariat for use by the Sub-Committee as appropriate.

10.8 On matters related to hot work safety, the Sub-Committee recalled that FP 44 had noted the outcome of FSI 8 and, in particular its recommendation that the Sub-Committee:

.1 set up a working group on hot work to study the available statistics;

.2 decide what mandatory or recommendatory measures need to be taken to prevent future occurrences; and

.3 make appropriate recommendations to the Maritime Safety Committee,

and, due to the close proximity between FSI 8 and FP 44 meetings, invited Members to submit their comments on the subject to this session of the Sub-Committee.

10.9 In discussing the matter, the Sub-Committee noted that the annex to document FSI 8/WP.4 showed that three people died and four people received serious injuries in three different accidents resulting from hot work or equipment intended to be used on board ships for hot work.

10.10 Therefore, the Sub-Committee, being concerned with the number of hot work casualties and the severity of such casualties, as reported by the FSI Casualty Analysis Working Group, requested the Secretariat to review the reports on accidents involving hot work that have been submitted to the Organization and to provide FP 46 with the following information:

.1 whether the ships involved were in or out of service;

.2 if in service, whether they were at sea or alongside;

.3 whether the officers and crew were shoreside or on board;

.4 determine, if possible, whether resolution A.864(20) and MSC/Circ.807 were available for use;

.5 identify the onboard location where the accident occurred;

.6 determine, if possible, whether areas where hot work was being carried out were in use;

.7 identify what type of hot work was underway (e.g. burning, welding, cutting, etc.);

.8 determine, if possible, qualifications and training of people involved;

.9 determine whether the fire occurred "remote" from the place of hot work; and

.10 report on whether company or industry procedures were in place and whether such procedures were in excess or less than that stated in resolution A.864(20) and MSC/Circ.807.

10.11 In further considering the issue of analysis of fire casualty records, in general, the Sub-Committee agreed that a precise analysis on fire casualties should be conducted by the Sub-Committee, and for this purpose, a working group should be established at the next session to analyse the casualties referred to it by FSI 8 with a particular emphasis on casualties related to hot work.

10.12 Notwithstanding the above decision to establish a Working Group, the Sub-Committee was of the view that a long-term solution is necessary to deal with future recommendations made by the FSI Sub-Committee. In this regard, the Sub-Committee agreed with the view expressed by several delegations that such recommendations are usually not accompanied by the information and casualty data necessary to facilitate consideration of the issues referred to it by the FSI Sub-Committee (see paragraph 10.10 above).

10.13 The Secretariat was instructed to inform the FSI Sub-Committee of the outcome of consideration of the above matters, as appropriate.

11 ROLE OF THE HUMAN ELEMENT: REVISION OF RESOLUTION A.654(16) ON GRAPHICAL SYMBOLS FOR FIRE CONTROL PLANS

11.1 The Sub-Committee recalled that FP 41 requested ISO to develop an International Standard on safety plans for fire protection, life-saving appliances and arrangements and means of escape. It was agreed that the standard should be developed by ISO in close co-operation with IMO and, once the final product is completed by ISO, it should also be adopted by IMO as an Assembly resolution, so that the plans and symbols may also be published by IMO or referred to in the revised SOLAS chapter II-2 or the FSS Code, as appropriate.

11.2 The Sub-Committee also recalled that FP 41 had prepared terms of reference for the work requested of ISO/TC 8, as contained in annex 11 to document FP 41/22, and, noting the progress by ISO on the development of the draft guidelines at the last session, had decided to keep this item on the agenda for FP 45.

11.3 The Sub-Committee considered the documents submitted by ISO (FP 45/11 and FP 45/INF.3) and noted the further information by the observer from ISO that the standard ISO 17631 – *Shipboard plans for fire protection, life-saving appliances and means of escape*, would be published well in advance of FP 46, so that Members would be able to purchase the aforementioned standard from ISO and review it prior to the next session. The ISO observer also informed the Sub-Committee that all the comments presented at the previous sessions of the Sub-Committee have been considered during the development of the standard.

11.4 In considering how to incorporate ISO 17631, once finalized, within the IMO regulatory framework, the Sub-Committee agreed that an in-depth review of the ISO standard, and those IMO standards specified in the aforementioned terms of reference to ISO/TC 8, would be necessary to determine how to proceed on this matter while being mindful to avoid a duplication of work.

11.5 The Sub-Committee agreed, therefore, to keep this item on the agenda for FP 46 and invited the Committee to extend the target completion date of the item to 2003.

11.6 The Sub-Committee, noting that the aforementioned ISO standard also includes the symbols used for life-saving appliances, invited the DE Sub-Committee to note this fact. The Secretariat was instructed to inform the DE Sub-Committee accordingly.

12 REVISION OF RESOLUTION A.602(15)

12.1 The Sub-Committee recalled that, at FP 44, it had considered a document submitted by the Russian Federation (FP 44/6/1) on the revision of resolution A.602(15) - Revised Guidelines for marine portable fire extinguishers and agreed to place this matter on the work programme with a target completion date of 2002.

12.2 The Sub-Committee considered the document submitted by the United Kingdom (FP 45/12) containing proposed modifications to the aforementioned resolution and requested the

Secretariat to prepare a draft which incorporates the proposed modifications into resolution A.602(15) so that they could be reviewed by the Sub-Committee within the context of the existing Revised Guidelines.

12.3 Having considered the document prepared by the Chairman and the Secretariat (FP 45/WP.2) providing a draft Assembly resolution on Improved guidelines for marine portable fire-extinguishers, the Sub-Committee agreed that more time was necessary to consider the proposed revisions and invited Members to submit comments and proposals on the draft Assembly resolution (FP 45/WP.2, annex) to FP 46.

13 WORK PROGRAMME AND AGENDA FOR FP 46

Application of the Guidelines on the organization and method of work

13.1 The Sub-Committee noted the outcome of MSC 73 regarding matters related to the application of the Guidelines on the organization and method of work (MSC/Circ.931, as amended), as addressed in paragraphs 17.3, 17.5 and 17.8 of document MSC 73/21, and, in particular, that the Committee had:

.1 re-affirmed its commitment to strict adherence to the Guidelines and that its subsidiary bodies should do the same; and

.2 in line with the provisions of paragraph 7 of the Guidelines, agreed that, at an appropriate time, a meeting should be convened of the Chairmen of the Committees and Sub-Committees to examine any matters pertinent to the effective conduct of business of the Committees and their subsidiary bodies.

New work programme item proposal

13.2 The Sub-Committee noted the document submitted by the United States (FP 44/INF.5) informing the Sub-Committee that it intended to submit a paper to MSC 74 proposing an inclusion, in the Sub-Committee's work programme, of a new item on "Performance testing and approval standards for fire safety", and thanked the United States for this information.

Fire safety of double hull tankers

13.3 The Sub-Committee recalled that it had agreed to further discuss matters related to the fire safety of double hull tankers under this agenda item (see paragraph 2.4). In particular, consideration was given to the proposal by the Netherlands (FP 45/WP.1), as amplified by the United Kingdom, to:

.1 develop an inventory of fire and explosion risks associated with single and double hull tankers;

.2 determine if such risks have been properly recognized and acknowledged;

.3 determine if measures to reduce or eliminate these risks are available;

.4 determine if such measures have been implemented and if any corrective actions are warranted;

.5 analyse, without delaying the previous actions, any reported fire and explosion incidents involving double hull tankers and to consider the lessons to be learned from these incidents; and

.6 promote reporting of such incidents.

13.4 The Sub-Committee had a general discussion on the proposal by the Netherlands and agreed, in principle, that it was a positive step forward and would be an important part of any proposal on the fire safety of double hull tankers. However, the Sub-Committee was of the view that the various subitems of the proposal still needed to be further clarified.

13.5 The Sub-Committee also had a general discussion on the issues assigned to it by MSC 73, and some delegations expressed the view that the issues assigned by the Committee needed to be closely examined with a view to justifying any proposals.

13.6 In concluding its discussion on the topic, the Sub-Committee agreed that no further action should be taken on any of the above matters unless relevant proposals are submitted by Governments and international organizations concerned to the Committee, presumably at its seventy-fifth session, in accordance with the Guidelines on the organization and method of work (MSC/Circ.931, as amended), and the Committee decides to include any of them in the Sub-Committee's work programme.

Statement by the delegation of the United Kingdom

13.7 The delegation of the United Kingdom stated that, in its opinion, any submission to the Committee by Governments and international organizations to include an item on the Sub-Committee's work programme relating to the fire safety of double hull tankers, should take note of paragraphs 13.3.1 and 13.3.6 above, if they are endorsed by the Committee.

Work programme and agenda for FP 46

13.8 Taking into account the progress made during the session and the provisions of the agenda management procedure, the Sub-Committee reviewed its work programme and agenda for its next session (FP 45/WP.3) and prepared a revised work programme and provisional agenda for FP 46. While doing so, the Sub-Committee agreed to invite the Committee to:

.1 delete the following work programme items as work on them has been completed:

.1 item H.1 - Guidelines on alternative design and arrangements for fire safety,

.2 item H.3 - Fire-fighting systems in machinery and other spaces; and

.3 item L.2 - Fire retardant materials for the construction of lifeboats;

.2 extend the target completion dates of the following work programme items:

.1 item L.1 - Role of the human element: revision of resolution A.654(16) on Graphical symbols for fire control plans, to 2003 with the revised title "Revision of resolution A.654(16)"; and

.2 item L.3 - Development of guidelines for ships operating in ice-covered waters, to 2003; and

.3 renumber the work programme items accordingly.

13.9 The Committee was invited to approve the proposed revised work programme of the Sub-Committee and provisional agenda for FP 46, as set out in annex 9.

Arrangements for the next session

13.10 The Sub-Committee tentatively agreed to establish, at FP 46, working groups on the following items:

.1 evacuation analysis for new and existing passenger ships;

.2 unified interpretations to SOLAS chapter II-2 and related fire test procedures; and

.3 analysis of fire casualty records,

and a drafting group on smoke control and ventilation.

13.11 The Sub-Committee recalled that, following consideration of agenda item 3, it had agreed to establish a correspondence group on evacuation analysis for new and existing passenger ships.

13.12 The Sub-Committee was advised that, subject to the decisions of the Assembly at its forthcoming twenty-second session, the Sub-Committee's forty-sixth session, has been tentatively scheduled to be held from 4 to 8 February 2002.

14 ELECTION OF CHAIRMAN AND VICE-CHAIRMAN FOR 2002

14.1 The Sub-Committee, in accordance with the Rules of Procedure of the Maritime Safety Committee, unanimously re-elected Mr. K. Yoshida (Japan), as Chairman and Mr. J. C. Cubisino (Argentina), as Vice-Chairman for 2002.

15 ANY OTHER BUSINESS

Recommendation for the installation of partially weathertight hatch covers

15.1 The Sub-Committee recalled that SLF 42, in considering the draft Recommendation for the installation of partially weathertight hatch covers on board containerships, contained in the annex to document MSC 67/19/9 (France), requested the Sub-Committee to consider the recommendation's section dealing with the capacity of fixed gas fire-extinguishing systems and provide comments to SLF 43, as appropriate.

15.2 The Sub-Committee also recalled that, at FP 44, concern was expressed that a fixed gas fire-extinguishing system may not be effective in a cargo hold which could not be properly isolated from the outside atmosphere and that Members were invited to submit comments to FP 45.

15.3 In this context, the Sub-Committee noted the outcome of SLF 43 on matters pertaining to the Recommendation for the installation of partially weathertight hatch covers on board containerships.

15.4 The observer from IACS informed the Sub-Committee that IACS had developed a Unified Interpretation on non-weathertight hatch covers above the superstructure deck (SLF 42/INF.7) which, *inter alia*, recommends a ten percent increase in the quantity of the fire-extinguishing gas to compensate for the possible loss of such media through hatch cover openings; and that the development of the fire safety provisions of this unified interpretation was based on fire testing.

15.5 The Sub-Committee noted that the aforementioned IACS Unified Interpretation is available and could be used in the meantime by the maritime industry as guidance for existing containerships until work on this matter was completed by IMO.

15.6 Having agreed to complete the fire safety aspects of the draft Recommendation at FP 46, the Sub-Committee invited IACS and other interested parties to provide testing data, if available, for use by the Sub-Committee as appropriate.

15.7 The Secretariat was instructed to inform SLF 44 accordingly.

Test laboratories recognized by the Administration

15.8 The Sub-Committee noted the information provided by Germany (FP 45/INF.2) regarding test laboratories recognized by the Administration and instructed the Secretariat to add the information to the next revision of the relevant circular.

15.9 The Secretariat informed the Sub-Committee that the latest annual FP Circular on test laboratories recognized by the Administrations had been published as FP/Circ.20.

Halon banking and reception facilities

15.10 The Secretariat informed the Sub-Committee that the latest annual FP Circular on halon banking and reception facilities had been published as FP/Circ.21.

New publication on fire safety and training

15.11 The delegation of Sweden informed the Sub-Committee that a new book entitled “Fire protection and fire drills on board ships” has been produced by the Swedish Maritime Fire Protection Committee. It was pointed out that the new book is intended for use by crews on board ships and, in particular, for officers responsible for shipboard fire safety. The book may also be used by surveyors of authorities, shipping and insurance companies, maritime training schools and academies as well as others in the field of maritime safety.

15.12 The delegation of Sweden also informed the Sub-Committee that the fire safety information contained in the book is based upon the requirements contained in the 1997 Consolidated Edition of the 1974 SOLAS Convention, as amended, and the revised STCW Convention requirements relating to fire protection and fire-fighting operations onboard different types of ships. The book also provides a number of examples of how to arrange practical exercises and theoretical training for shipboard crews. A copy of the book was provided to each delegation at the meeting.

Expression of appreciation

15.13 The Sub-Committee, being informed of the retirement of Mr. D. Kaps (Germany) who served as the Chairman of the Sub-Committee's Working Group on Unified Interpretations to SOLAS 74, expressed its sincere appreciation for his valuable contributions to its work and wished him a long and healthy retirement.

16 ACTION REQUESTED OF THE COMMITTEE

16.1 The Maritime Safety Committee is invited to approve this report in general and, in particular, to:

.1 approve the draft MSC circular on Interim Guidelines for a simplified evacuation analysis of high-speed passenger craft (paragraph 3.12 and annex 2);

.2 note the progress made by the Sub-Committee on matters related to the development of evacuation analysis guidelines for existing passengers ships (paragraphs 3.17, 3.18 and 3.19.4);

.3 approve the draft MSC circular on Guidelines on alternative design and arrangements for fire safety, referred to in the revised SOLAS chapter II-2 (paragraph 4.14 and annex 3);

.4 approve the draft MSC circular on Guidelines on a simplified calculation for the total amount of combustible materials per unit area in accommodation and service spaces (paragraph 4.15 and annex 4);

.5 approve the draft MSC circular on Unified interpretations of the International Code for Application of Fire Test Procedures (FTP Code) and fire test procedures referred to in the Code (paragraph 6.9 and annex 5);

.6 approve the draft MSC circular on Unified interpretations of vague expressions and other vague wording of SOLAS chapter II-2 (paragraph 6.13 and annex 6);

.7 approve the draft MSC circular on Guidelines on fire test procedures for acceptance of fire-retardant materials for the construction of lifeboats (paragraph 7.5 and annex 7);

.8 approve the draft MSC circular on Guidelines for the approval of fixed aerosol fire-extinguishing systems equivalent to fixed gas fire-extinguishing systems, as referred to in SOLAS 74, for machinery spaces (paragraph 8.14 and annex 8);

.9 note the outcome of the Sub-Committee's consideration of the post-**Erika** safety-related issues, in particular the one on the fire safety of double hull tankers (paragraphs 2.2 to 2.4 and 13.3 to 13.7); and

.10 approve the proposed revised work programme of the Sub-Committee and the provisional agenda for FP 46 (paragraphs 13.8 to 13.12 and annex 9).

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ANNEX 1

AGENDA FOR THE FORTY-FIFTH SESSION AND LIST OF DOCUMENTS

1 Adoption of the agenda

FP 45/1	Secretariat	Provisional agenda
FP 45/1/1	Secretariat	Annotations to the provisional agenda

2 Decisions of other IMO bodies

FP 45/2	Secretariat	Outcome of other IMO bodies
FP 45/2/1	Secretariat	Outcome of NAV 46, SLF 43 and MEPC 45
FP 45/2/2	Secretariat	Outcome of MSC 73

3 Recommendation on evacuation analysis for passenger ships and high-speed passenger craft

FP 45/3	United States	Recommended guidance for computer-aided evacuation analysis tools
FP 45/3/1	ICCL	Passenger vessel evacuation analysis
FP 45/3/2	Germany	Draft Guidelines for a microscopic evacuation analysis for ro-ro passenger ships and high-speed passenger craft
FP 45/3/3	Italy	Report of the correspondence group
FP 45/3/4	Germany	Comments on document FP 45/3/3
MSC 72/12/1	Australia	Evacuation analysis for ro-ro passenger ships
FP 45/WP.6	Working Group	Report of the working group

4 Guidelines on alternative design and arrangements for fire safety

FP 45/4	United States	Report of the correspondence group
FP 45/WP.4		Report of the working group

5 Smoke control and ventilation

FP 44/5	United States	Alternate proposal for the application of smoke control systems for passenger ships
FP 44/5/1	France	Smoke control and ventilation
FP 44/5/2	Japan	Comments and proposals on smoke control and ventilation systems

6 Unified interpretations of SOLAS chapter II-2 and related fire test procedures

FP 45/6	United States	Mooring decks and interpretations of the FTP Code
FP 45/6/1	Italy	Fire detection and fire alarm in A/C rooms, galley exhaust ducts, primary deck coverings, fire test of fittings on aluminum alloy fire divisions
FP 45/6/2	United Kingdom	Combined carbon monoxide and rate of temperature rise fire detectors
FP 44/WP.1, annex 2		Report of the intersessional working group
FP 44/WP.5		Report of the working group
FP 45/WP.5	Working Group	Report of the working group

7 Fire-retardant materials for the construction of lifeboats

FP 45/7	United States	Test for fire-retardant materials for the construction of lifeboats
FP 45/7/1	United Kingdom	Test for fire-retardant plastic resins for the construction of lifeboats
FP 44/WP.5, annex 6		Report of the working group

8 Fire-fighting systems in machinery and other spaces

FP 45/8	Sweden	Report of the correspondence group
FP 45/8/1	United States	Toxicity criteria for aerosol fire-extinguishing systems
FP 45/8/2	Italy	Facilitating the replacement of halon fire-extinguishing systems on existing ships
FP 45/8/3	Italy	Comments on document FP 45/8/2
FP 45/INF.4	United States	Water mist protection requirements for very large machinery spaces
FP 44/WP.6, annex 2		Report of the drafting group
FP 45/WP.7 and Corr.1	Working Group	Report of the working group

9 Development of guidelines for ships operating in ice-covered waters

No document

10 Analysis of fire casualty records

FP 44/13	Secretariat	Overheating of belt rollers on self-unloading bulk carriers
FP 44/13/1	United Kingdom	Fire onboard container ship **Ever Decent**
FSI 8/11/1	Australia	Fires on board ships
FSI 8/WP.4		Report of the working group

11 Role of the human element: revision of resolution A.654(16) on Graphical symbols for fire control plans

FP 45/11	ISO	Update on ISO activities in support of the FP Sub-Committee
FP 45/INF.3	ISO	Standard for shipboard safety plans

12 Revision of resolution A.602(15)

FP 45/12	United Kingdom	Proposed amendments to resolution A.602(15)
FP 44/6/1	Russian Federation	Revision of resolution A.602(15)
FP 45/WP.2	Chairman	Proposed revisions to the revised guidelines for marine portable fire extinguishers

13 Work programme and agenda for FP 46

FP 45/INF.5	United States	Performance testing and approval standards for fire safety systems
FP 45/WP.1	Chairman	Oil tanker safety and environmental matters
FP 45/WP.3	Chairman	Work programme and agenda for FP 46

14 Election of Chairman and Vice-Chairman for 2002

No document

15 Any other business

FP 45/INF.2	Germany	Test laboratories recognised by the Administration
MSC 67/19/9	France	Recommendation for the installation of partially weathertight hatch covers

16 Report to the Maritime Safety Committee

FP 45/WP.8	Draft report to the Maritime Safety Committee
FP 45/16	Report to the Maritime Safety Committee
FP 45/INF.1	List of participants

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ANNEX 2

DRAFT MSC CIRCULAR

INTERIM GUIDELINES FOR A SIMPLIFIED EVACUATION ANALYSIS OF HIGH-SPEED PASSENGER CRAFT

1 The Maritime Safety Committee, at its seventy-third session (27 November to 6 December 2000), adopted the International Code of Safety for High-Speed Craft, 2000 (2000 HSC Code) by resolution MSC.97(73), which is expected to enter into force on 1 July 2002. This Code requires in section 4.8.2 that "an evacuation procedure, including an evacuation analysis carried out taking into account the guidelines developed by the Organization shall be developed for the information of the Administration in connection with the approval of fire insulation plans and for assisting the owners and builders in planning the evacuation demonstration required in 4.8.3" of the Code.

2 The Maritime Safety Committee, at its [seventy-fourth session (30 May to 8 June 2001)], noting that computerized simulation systems are still under development, decided that a simplified evacuation analysis method was needed in the interim and, having considered a proposal by the forty-fifth session of the Sub-Committee on Fire Protection, approved the Interim Guidelines for a simplified evacuation analysis of high-speed passenger craft, together with the worked example appended thereto, as set out in the annex to the present circular.

3 Member Governments are invited to apply the annexed Interim Guidelines when implementing the requirements of section 4.8.2 of the 2000 HSC Code and submit to the Sub-Committee on Fire Protection information on experience gained in the implementation of the Interim Guidelines and on any progress made in the development of computerized simulation systems.

4 Member Governments are also invited to bring the annexed Interim Guidelines to the attention of craft designers, craft owners and other parties involved in the design, construction and operation of high-speed passenger craft.

ANNEX

INTERIM GUIDELINES FOR A SIMPLIFIED EVACUATION ANALYSIS OF HIGH-SPEED PASSENGER CRAFT

1 General

1.1 In addition to the relevant requirements for means of escape, escape routes in high-speed passenger craft are required to be evaluated by an evacuation analysis early in the design process, under the International Code of Safety for High-Speed Craft, 2000 (2000 HSC Code**),** section 4.8.2.

1.2 The purpose of the Interim Guidelines is to provide guidance on how to execute a simplified (hydraulic) evacuation analysis and use its results to plan the evacuation demonstration required in section 4.8.5 of the 2000 HSC Code.

2 Definitions

2.1 *Ideal deployment time* (t_M) is the time needed for the preparation and launching of the marine evacuation system (MES) and the first survival craft in calm water.

2.2 *Ideal travel time* (t_I) is the time needed for the slowest group of people to reach the embarkation point in calm water. Unless otherwise stated in the evacuation procedure, the number of people of the slowest group should be assumed equal to the capacity of the largest survival craft onboard. For the purpose of these Interim Guidelines, t_I is assumed to run concurrently with t_M.

2.3 *Ideal embarkation time* (t_E) is the time needed for all passengers and crew to board the survival craft in calm water.

2.4 *Structural fire protection time (SFP)* is the protection time for areas of major fire risk as defined in section 4.8.1 of the 2000 HSC Code.

2.5 *Slowest group of people* is the group of evacuating persons for which the highest travel time is obtained from calculations according to paragraph 3.6.3.3.

3 Method of evaluation

The steps in the evacuation analysis are:

3.1 Description of the system

.1 Identification of assembly stations.

.2 Identification of embarkation stations, MES and survival craft.

.3 Description of the evacuation procedure including the role of the crew.

.4 Identification of groups and their escape route.

3.2 Assumptions

This method for estimating evacuation time is basic in nature and, therefore, common evacuation analysis assumptions should be made as follows:

.1 passengers and crew should carry out the evacuation in a sequence of groups according to the evacuation procedure;

.2 passengers and crew will evacuate via the primary escape route;

.3 walking speed depends on the type of escape facility, assuming that the flow is only in the direction of the escape route, and that there is no overtaking;

.4 passengers' disabilities or medical conditions that will severely hamper their ability to keep up with the flow are neglected (see paragraph 3.2.8.1 below);

.5 passenger load is assumed to be 100% (full load);

.6 full availability of escape arrangements is considered;

.7 people can move unhindered;

.8 the allowable evacuation time as per section 4.8.1 of the 2000 HSC Code is given by $\frac{SFP - 7}{3}$ (min), where:

.8.1 division by 3 accounts for the safety factor, which includes passengers' ages and disabilities, restricted visibility due to smoke, effects of waves and craft motions on deployment, travel and embarkation time and of violations to the evacuation procedure;

.8.2 subtraction of 7 min accounts for initial detection and extinguishing action (section 4.8.1 of the 2000 HSC Code); and

.8.3 for category B craft, the passenger awareness time, the time needed for passengers to reach assembly stations and the time needed for manning emergency stations is included in the 7 min time (see section 4.8 of the 2000 HSC Code);

.9 as the evacuation procedure is designed to carry out evacuation under controlled conditions (section 4.8.1 of the 2000 HSC code), no counter flow takes place; and

.10 when using table 3.6 it is assumed that at the beginning of the evacuation, passengers are located at a distance not greater than two decks from the embarkation station.

3.3 Scenarios to be considered

3.3.1 For the purpose of calculating the evacuation time in category A craft, passengers should be assumed to be distributed in a normal voyage configuration (section 4.8.4.1 of the 2000 HSC Code).

3.3.2 For the purpose of calculating the evacuation time in category B craft, passengers and the crew should be assumed to be distributed among assembly stations and be ready for embarkation (section 4.8.4.2 of the 2000 HSC Code).

3.4 Performance standards

3.4.1 The following two performance standards should be complied with:

Calculated overall evacuation time:

$$t_M + t_E \leq \frac{SFP - 7}{3} \qquad (3.4.1)$$

$$t_I + t_E \leq \frac{SFP - 7}{3} \qquad (3.4.2)$$

3.4.2 Both performance standards are derived from section 4.8.1 of the 2000 HSC Code.

3.5 Calculation of t_E and t_M

3.5.1 The values t_E and t_M should be calculated separately based on:

.1 the results of full scale trials on similar craft and evacuation systems; or

.2 data provided by the manufacturers; however, in this case, the method of calculation should be documented.

3.5.2 Safety factors on t_E and t_M are accounted for by dividing by 3 in performance standards formulae (3.4.1) and (3.4.2).

3.6 Calculation of t_I

3.6.1 Parameters to be considered:

.1 clear width, W_c , is:

.1 measured off the handrail(s) for corridors and stairways;

.2 the actual passage width of a door in its fully open position;

.3 the space between the fixed seats for aisles in public spaces; and

.4 the space between the most intruding portions of the seats (when unoccupied) in a row of seats in public spaces;

.2 speed of persons, S (m/s) is the speed of evacuees along the escape route (table 3.6 provides the values of S which should be used for the analysis);

.3 specific flow of persons, F_s (p/ms), is the number of evacuating persons past a point in the escape route per unit time per unit of clear width W_c (table 3.6 provides the values of F_s which should be used for the analysis)

Table 3.6*

Type of Facility	Speed of persons S (m/s)	Specific Flow Fs (p/(ms))
Stairs (down)	0.55	1.1
Stairs (up)	0.44	0.88
Corridors, doorways	0.67	1.3

.4 calculated flow of persons, F_c (p/s), is the predicted number of persons passing a particular point in an escape route per unit time. It is obtained from:

$$F_c = F_s \cdot W_c \qquad (3.6.1.4)$$

.5 flow time, t_F (s), is the total time needed for a group of N persons to move past a point in the egress system. It is calculated as:

$$t_F = N / F_c \qquad (3.6.1.5)$$

.6 walking time, t_w (s), is the total time needed for a person to cover the distance between the assembly station and the embarkation station.

3.6.2 Transitions

3.6.2.1 Transitions are those points in the egress system where the type of a route changes (e.g. from a corridor to a stairway) where routes merge or branch out.

3.6.3 Procedure for calculation of t_I is as follows:

.1 Groups of people:

For the purposes of evacuation, the total number of persons on board is broken down into one or more groups of people. It should be assumed that all persons in a group carry out the evacuation at the same time, along the same route and towards the same embarkation station. The number of persons in each group, the number of groups and the embarkation station assigned to each group should be in accordance with the evacuation procedure.

* Data derived from land-based stairs, corridors and doors in civil buildings, and are extracted from the publication "SFPE Fire Protection Engineering Handbook, 2nd edition NFPA 1995".

.2 Schematic representation:

The escape routes from assembly stations to embarkation stations are represented as a hydraulic network, where the pipes are the corridors and stairways, the valves are the doors and restrictions in general.

.3 For each foreseen group of people:

.1 The walking time, t_w, is calculated by using the speed of persons specified in table 3.6 and the distance between the pertinent assembly and embarkation stations.

.2 The flow time, t_F, of each portion of the escape route is calculated using the specific flow F_s from table 3.6 and the appropriate clear width of that portion of escape route. The total flow time is the largest value obtained.

.3 The travel time is obtained as the sum of the walking time and the total flow time.

3.6.4 Ideal travel time t_I is as follows:

Calculations as per paragraph 3.6.3.3 are repeated for each foreseen group of people. The highest resulting travel time is then taken as the ideal travel time for use in performance standard in paragraph 3.4.

4 Corrective actions

If the performance standards under paragraph 3.4 are not fulfilled, corrective actions should be considered at the design stage by either modifying one or more components in the evacuation system (e.g., escape routes, life-saving appliances, passengers load, etc.) or by modifying the evacuation procedure.

5 Documentation

The documentation of the analysis should report the following items:

.1 the basic assumptions for the analysis;

.2 a schematic representation of the layout of the craft;

.3 position and role of the crew during the evacuation, according to the evacuation procedure;

.4 the method for the analysis, if different from these Interim Guidelines;

.5 details of the calculation; and

.6 the resulting overall evacuation time.

APPENDIX

EXAMPLE OF APPLICATION

1 General

The example provides an illustration on the application of the Interim Guidelines. Therefore it should not be viewed as a comprehensive and complete analysis nor as an indication of the data to be used. More specifically, the embarkation time and the deployment time used in paragraph 4 below are purely illustrative.

2 Craft characteristics

The high-speed craft considered is a Category B craft with a total capacity of 800 persons (784 passengers and 16 crew members). As shown in figure 1, when the order to abandon the craft is given, passengers are distributed in the public spaces on two decks (210 on the upper deck and 574 on the lower deck), the lower deck is equipped with 4 MES. The structural fire protection time (SPF) is 60 min.

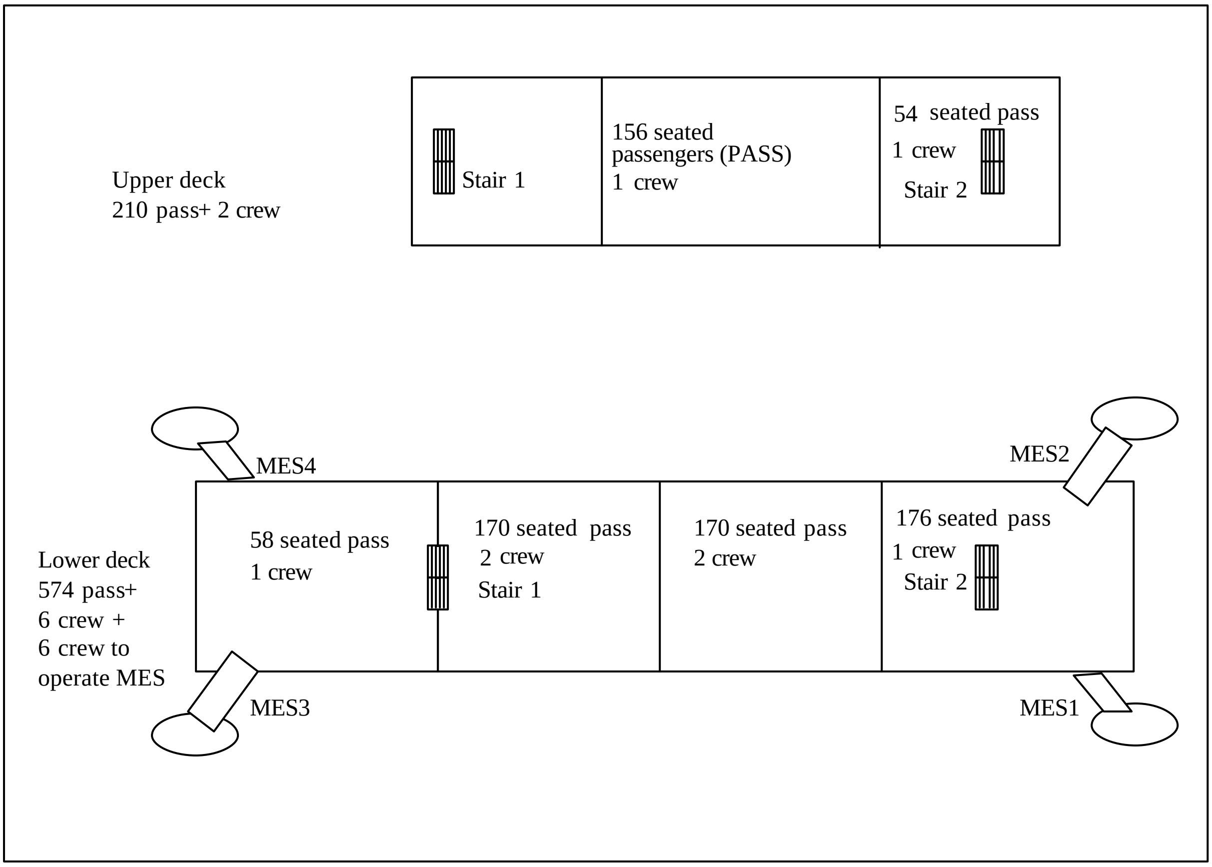

Figure 1 – Sketch of the considered high-speed craft

3 Description of the system

.1 Identification of assembly stations

Assembly stations coincide with the public spaces where passengers are located (seated). Passengers are wearing life jackets.

.2 Identification of embarkation stations, MES and liferafts

.1 Embarkation stations (4, one for each MES) are located at the lower deck.

.2 Each MES consists of an inflatable slide with an attached platform.

.3 Liferafts (8), 135 persons capacity each, are stowed in racks on the lower decks, in the proximity of the MES. The aggregate capacity of liferafts is therefore 1080 persons, or of 810 persons if one embarkation station is not available in accordance with the 2000 HSC Code.

.4 Two rescue boats are available for marshalling the liferafts.

.3 Description of the evacuation procedure

.1 When the order to abandon the craft is given, crew members start operating the MES (total 6 crew members), the rescue boats (1 crew member per boat) and to direct the passengers (as shown in figure 1: two crew members on the upper deck and 6 crew members on the lower deck).

.2 PHASE 1: For each MES, the slide is inflated and the first liferaft launched, inflated and connected to the slide's platform. In the mean time the first 4 groups of persons (each composed of 99 passengers + 1 crew member) move to the embarkation stations.

.3 PHASE 2: Once the first liferaft is ready for boarding, the first group for each MES descends to the liferaft using the slide and platform. When boarding is completed, the liferaft is detached from the platform and the second liferaft is launched, inflated and connected to the platform.
In the mean time the second 4 groups of persons (each composed of 97 passengers + 1 crew members) move to the embarkation stations.

.4 PHASE 3: Once the second liferaft is ready for boarding, the second group for each MES descents to the liferaft through the slide and platform. Finally, the 6 crew members operating the MES board. When boarding is completed, the liferaft is detached from the slide. The evacuation is now completed.

.4 Identification of groups and their escape routes

In total 8 groups, each composed of 100 persons, are considered. Their (primary) escape routes are shown in figure 2 for the first 4 groups and in figure 3 for the second 4 groups.

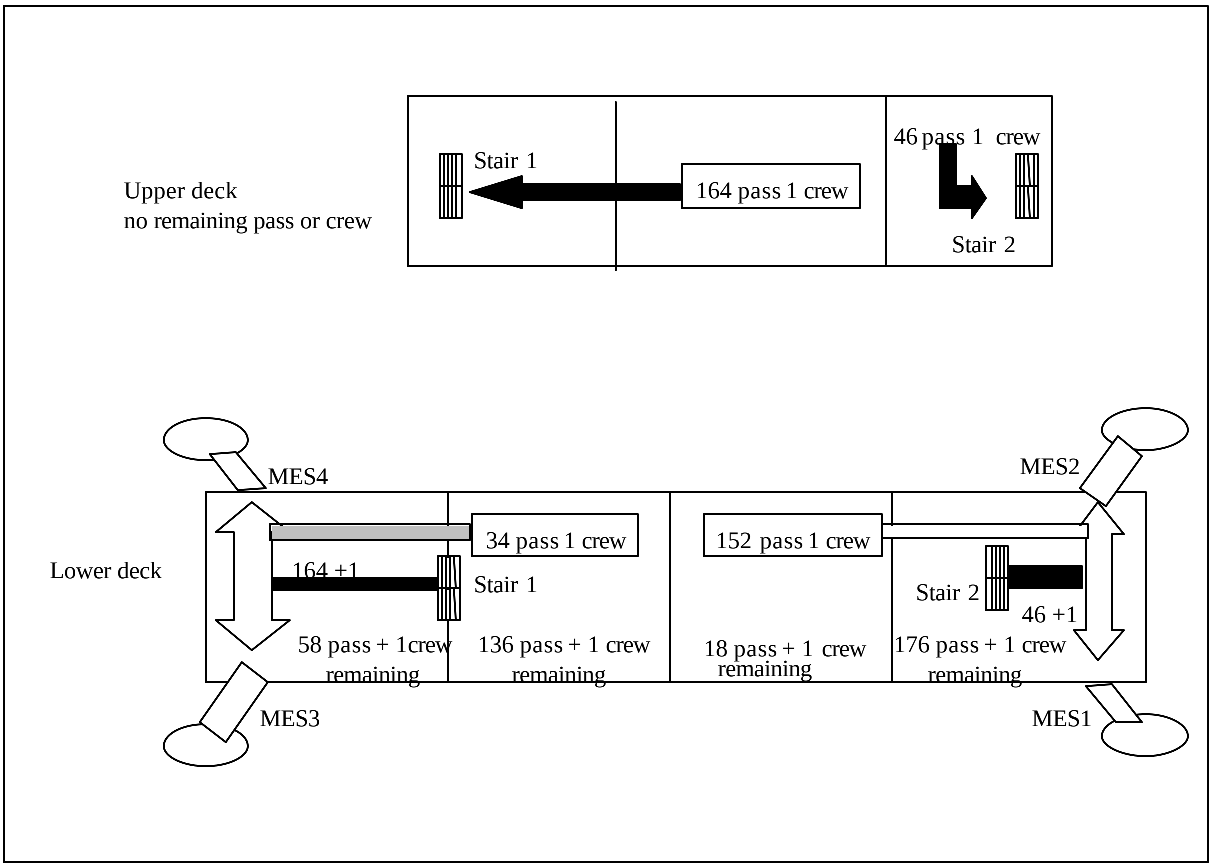

Figure 2 – First 4 groups of persons (each 100 people)

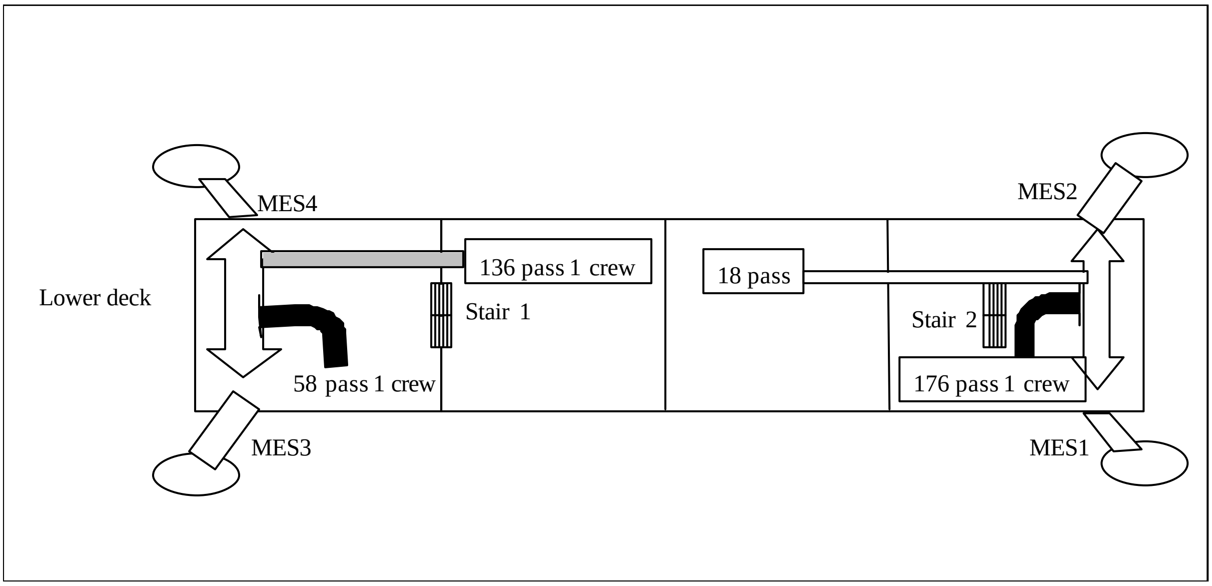

Figure 3 – Second 4 groups of persons (each 100 people)

4 Calculation of t_E and of t_M

.1 Embarkation time t_E

According to the evacuation procedure, each MES is used by 200 persons, if all four MES are available. Based on full scale trials on craft having similar arrangements and using the same MES and same number of crew, the total time needed to deploy, inflate and mooring the liferaft and to embark 100 persons is 330 s (5 min and 30 s). Accordingly, the total embarkation time is 660 s (11 min).

.2 Deployment time t_M

Based on full scale trials on craft having similar arrangements and using the same MES, the total time needed to deploy and inflate an MES is 150 s (2 min and 30 s).

5 Calculation of t_I

.1 For the purposes of this example, it is assumed that calculations have been carried out for all the 8 groups of people into which the evacuation is organized, according to the evacuation procedure described in paragraph 3.3 above. It is further assumed that the highest travel time is obtained for the first two groups i.e. the two groups of people moving from the afterward passenger area in the upper deck down to MES 3 and 4 respectively on the lower deck.

.2 The schematization of the escape route is shown in figure 4. As it may be seen, the elements composing the escape path are 2 doors, 2 corridors and 1 stairway.

.3 The characteristics of the escape path's elements are as follows:

Table 5.3

Element	L (m)	W_c (m)	F_s	S (m/s)	F_c (p/s)	N people
Door 1	N.A.	1.4	1.3	N.A.	1.82	165
Corridor 1	14	4.2	1.3	0.67	5.46	165
Stairway 1	4.7	3.5	1.1	0.55	3.85	165
Corridor 2	14	3.0	1.3	0.67	3.90	200
Door2	N.A.	1.4	1.1	N.A.	1.54	100

The values of specific flow (F_s) and speed (S) are taken from table 3.6 of the guidelines; the value of calculated flow (F_c) is obtained by $F_c = F_s W_c$ (see paragraph 3.6.1.4 of the guidelines).

.4 The resulting walking time (t_w) and flow time (t_F), calculated according to paragraphs 3.6.1.5 and 3.6.1.6 of the guidelines are as follows:

Table 5.4

Element	L (m)	W_c (m)	N people	t_W (s)	t_F (s)
Door 1	N.A.	1.4	165	N.A.	91
Corridor 1	14	4.2	165	21	30
Stairway 1	4.7	3.5	165	9	43
Corridor 2	14	3.0	200	21	51
Door2	N.A.	1.4	100	N.A.	65

The resulting total walking time is the sum of the walking time of each element in the escape path and totals 51 s. The flow time is the highest among all the elements in the escape path and corresponds to 91 s.

Accordingly, the ideal travel time is where, t_I = 142 s.

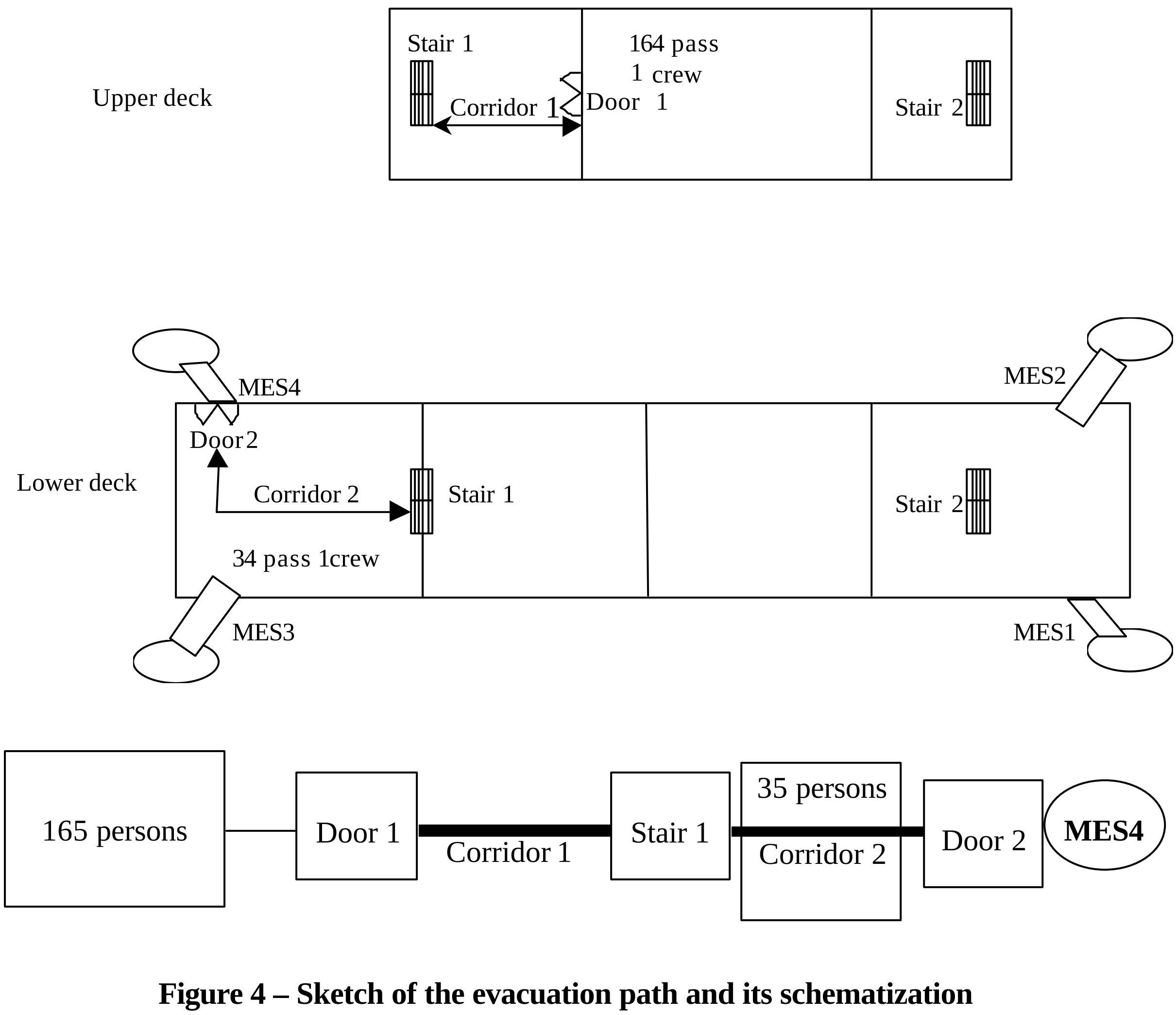

Figure 4 – Sketch of the evacuation path and its schematization

6 Performance standard

The calculated overall evacuation time:

$$t_M + t_E = 150 + 660 \leq \frac{SFP - 7}{3} \text{ min} = 1059 \text{ s}$$

$$t_I + t_E = 142 + 660 \leq \frac{SFP - 7}{3} \text{ min} = 1059 \text{ s}$$

The requirements are fulfilled.

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ANNEX 3

DRAFT MSC CIRCULAR

GUIDELINES ON ALTERNATIVE DESIGN AND ARRANGEMENTS FOR FIRE SAFETY

1 The Maritime Safety Committee, at its [seventy-fourth session (30 May to 8 June 2001)], approved Guidelines on alternative design and arrangements for fire safety, as set out in the annex, developed to provide further guidance on SOLAS regulation II-2/17, which was adopted by resolution MSC.99(73) as part of the revised SOLAS chapter II-2 and is expected to enter into force on 1 July 2002.

2 The Guidelines serve to outline the methodology for the engineering analysis required by SOLAS regulation II-2/17 on Alternative design and arrangements, applying to a specific fire safety system, design or arrangements for which the approval of an alternative design deviating from the prescriptive requirements of SOLAS chapter II-2 is sought.

3 Member Governments are invited to bring the annexed Guidelines to the attention of ship owners, ship builders and designers for the facilitation of fire safety engineering design in the framework of SOLAS regulation II-2/17.

ANNEX

GUIDELINES ON ALTERNATIVE DESIGN AND ARRANGEMENTS FOR FIRE SAFETY

1 Application

1.1 These guidelines are intended for application of fire safety engineering design to provide technical justification for alternative design and arrangements to SOLAS chapter II-2. The guidelines serve to outline the methodology for the engineering analysis required by SOLAS regulation II-2/17 "Alternative design and arrangements", applying to a specific fire safety system, design or arrangements for which the approval of an alternative design deviating from the prescriptive requirements of SOLAS chapter II-2 is sought.

1.2 These guidelines are not intended to be applied to the type approval of individual materials and components.

1.3 These guidelines are not intended to serve as a stand-alone document, but should be used in conjunction with the fire safety engineering design guides and other literature, examples of which are referenced in section 3.

1.4 For the application of these guidelines to be successful, all interested parties, including the Administration or its designated representative, owners, operators, designers, and classification societies, should be in continuous communication from the onset of a specific proposal to utilise these guidelines. This approach usually requires significantly more time in calculation and documentation than a typical regulatory prescribed design because of increased engineering rigor. The potential benefits include more options, cost effective designs for unique applications and an improved knowledge of loss potential.

2 Definitions

For the purposes of these guidelines, the following definitions apply:

Alternative design and arrangements means fire safety measures which deviate from the prescriptive requirement(s) of SOLAS chapter II-2, but are suitable to satisfy the fire safety objective(s) and the functional requirements of that chapter. The term includes a wide range of measures, including alternative shipboard structures and systems based on novel or unique designs, as well as traditional shipboard structures and systems that are installed in alternative arrangements or configurations.

Design fire means an engineering description of the development and spread of fire for use in a design fire scenario. Design fire curves may be described in terms of heat release rate vs. time.

Design fire scenario means a set of conditions that defines the fire development and the spread of fire within and through ship space(s) and describes factors such as ventilation conditions, ignition sources, arrangement and quantity of combustible materials and fire load accounting for the effects of fire detection, fire protection, fire control and suppression and fire mitigation measures.

Functional requirements explain, in general terms, what function the ship must provide to meet the fire safety objectives of SOLAS.

Performance criteria are measurable quantities stated in engineering terms to be used to judge the adequacy of trial designs.

Prescriptive based design or prescriptive design means a design of fire safety measures which comply with the prescriptive regulatory requirements set out in parts B, C, D, E or G of SOLAS chapter II-2.

Safety margin means adjustments made to compensate for uncertainties in the methods and assumptions used to evaluate the alternative design, e.g. in the determination of performance criteria or in the engineering models used to assess the consequences of fire.

Sensitivity analysis means an analysis to determine the effect of changes in individual input parameters on the results of a given model or calculation method.

SOLAS means the International Convention for the Safety of Life at Sea, 1974, as amended.

3 Engineering analysis

3.1 The engineering analysis used to show that the alternative design and arrangements provide the equivalent level of safety to the prescriptive requirements of SOLAS chapter II-2 should follow an established approach to fire safety design. This approach should be based on sound fire science and engineering practice incorporating widely accepted methods, empirical data, calculations, correlations and computer models as contained in engineering textbooks and technical literature.

3.2 Two examples of acceptable approaches to fire safety engineering are listed below:

.1 *The SFPE Engineering Guide to Performance-Based Fire Protection Analysis and Design of Buildings*, Society of Fire Protection Engineers and National Fire Protection Association, 1999.

.2 ISO/TR 13387-1 through 13387-8, *"Fire safety engineering"*, International Standards Organization, 1999.

Other fire safety engineering approaches recognized by the Administration may be used. See Appendix C for guidance and a list of additional technical literature.

4 Design team

4.1 A design team acceptable to the Administration should be established by the owner, builder or designer and may include, as the alternative design and arrangements demand, a representative of the owner, builder or designer, and expert(s) having the necessary knowledge and experience in fire safety, design, and/or operation as necessary for the specific evaluation at hand. Other members may include marine surveyors, vessel operators, safety engineers, equipment manufacturers, human factors experts, naval architects and marine engineers.

4.2 The level of expertise that individuals should have to participate in the team will vary depending on the complexity of the alternative design and arrangements for which approval is sought. Since the evaluation, regardless of complexity, will have some effect on fire safety, at least one expert with knowledge and experience in fire safety should be included as a member of the team.

4.3 The design team should:

.1 Appoint a co-ordinator serving as the primary contact.

.2 Communicate with the Administration for advice on the acceptability of the engineering analysis of the alternative design and arrangements throughout the entire process.

.3 Determine the safety margin at the outset of the design process and review and adjust it as necessary during the analysis.

.4 Conduct a preliminary analysis to develop the conceptual design in qualitative terms. This includes a clear definition of the scope of the alternative design and arrangements and the regulations which affect the design; a clear understanding of the objectives and functional requirements of the regulations; the development of fire scenarios, and trial alternative designs. This portion of the process is documented in the form of a report that is reviewed and agreed by all interested parties and submitted to the Administration before the quantitative portion of the analysis is started.

.5 Conduct a quantitative analysis to evaluate possible trial alternative designs using quantitative engineering analysis. This consists of the specification of design fires, development of performance criteria based upon the performance of an acceptable prescriptive design and evaluation of the trial alternative designs against the agreed performance criteria. From this step the final alternative design and arrangements are selected and the entire quantitative analysis is documented in a report.

.6 Prepare documentation, specifications, and a life-cycle maintenance programme. The alternative design and arrangements should be clearly documented, approved by the Administration, and a comprehensive report describing the alternative design and arrangements and required maintenance program should be kept on board the ship. An operations and maintenance manual should be developed for this purpose. The manual should include an outline of the design conditions that must be maintained over the life of the ship to ensure compliance with the approved design.

4.4 The fire safety objectives in SOLAS regulation II-2/2 and the purpose statements listed at the beginning of each individual regulation in chapter II-2 should be used to provide the basis for comparison of the alternative design and arrangements to the prescriptive regulations.

5 Preliminary analysis in qualitative terms

5.1 *Define scope*

5.1.1 The ship, ship system(s), component(s), space(s) and/or equipment subject to the analysis should be thoroughly defined. This includes the ship or system(s) representing both the alternative design and arrangements and the regulatory prescribed design. Depending on the extent of the desired deviation from prescriptive requirements, some of the information that may be required includes: detailed ship plans, drawings, equipment information and drawings, fire test data and analysis results, ship operating characteristics and conditions of operation, operating and maintenance procedures, material properties, etc.

5.1.2 The regulations affecting the proposed alternative design and arrangements, along with their functional requirements, should be clearly understood and documented in the preliminary analysis report (see paragraph 5.4). This will form the basis for the comparative analysis in paragraph 6.4.

5.2 *Develop fire scenarios*

5.2.1 Fire scenarios will provide the basis for analysis and trial alternative design evaluation and therefore are the backbone of the alternative design process. Proper fire scenario development is essential and depending on the extent of deviation from the prescribed design, may require a significant amount of time and resources. This process can be broken down into four areas:

.1 identification of fire hazards;

.2 enumeration of fire hazards;

.3 selection of fire hazards; and

.4 specification of design fire scenarios.

5.2.1.1 Identification of fire hazards

This step is crucial in the fire scenario development process as well as in the entire alternative design methodology. If a fire hazard or incident is omitted, then it will not be considered in the analysis and the resulting final design may be inadequate. Fire hazards may be identified using historical and statistical data, expert opinion and experience and hazard evaluation procedures. There are many hazard evaluation procedures available to help identify the fire hazards including HAZOP, PHA, FMEA, "what-if", etc. As a minimum, the following conditions and characteristics should be identified and considered:

.1 pre-fire situation: ship, platform, compartment, fuel load, environmental conditions;

.2 ignition sources: temperature, energy, time and area of contact with potential fuels;

.3 initial fuels: state (solid, liquid, gas, vapour, spray), surface area to mass ratio, rate of heat release;

.4 secondary fuels: proximity to initial fuels, amount, distribution;

.5 extension potential: beyond compartment, structure, area (if in open);

.6 target locations: note target items or areas associated with the performance parameters;

.7 critical factors: ventilation, environment, operational, time of day, etc.; and

.8 relevant statistical data: past fire history, probability of failure, frequency and severity rates, etc.

5.2.1.2 Enumeration of fire hazards

All of the fire hazards identified above should be grouped into one of three incident classes: localised, major, or catastrophic. A localised incident consists of a fire with a localised affect zone, limited to a specific area. A major incident consists of a fire with a medium affect zone, limited to the boundaries of the ship. A catastrophic incident consists of a fire with a large affect zone, beyond the ship and affecting surrounding ships or communities. In the majority of cases, only localised and/or major fire incidents will need to be considered. Examples where the catastrophic incident class will be considered would include transport and/or offshore production of petroleum products or other hazardous materials where the incident effect zone is very likely to be beyond the ship vicinity. The fire hazards should be tabulated for future selection of a certain number of each of the incident classes.

5.2.1.3 Selection of fire hazards

The number and type of fire hazards that should be selected for the quantitative analysis is dependent on the complexity of the trial alternative design and arrangements. All of the fire hazards identified should be reviewed for selection of a range of incidents. In determining the selection, frequency of occurrence does not need to be fully quantified, but it can be utilised in a qualitative sense. The selection process should identify a range of incidents that will cover the largest and most probable range of enumerated fire hazards. Because the engineering evaluation relies on a comparison of the proposed alternative design and arrangements with prescriptive designs, demonstration of equivalent performance during the major incidents will adequately demonstrate the design’s equivalence for all lesser incidents and provide the commensurate level of safety. In selecting the fire hazards it is possible to lose perspective and to begin selecting highly unlikely or inconsequential hazards. Care should be taken to select the most appropriate incidents for inclusion in the selected range of incidents.

5.2.1.4 Specification of design fire scenarios

Based on the fire hazards selected, the fire scenarios to be used in the quantitative analysis should be clearly documented. The specification should include a qualitative description of the design fire (ignition source, fuel first ignited, location, etc.), description of the vessel, compartment of origin, fire protection systems installed, number of occupants, physical and mental status of occupants and available means of escape. The fire scenarios should consider possible future changes to the fire load and ventilation system in the affected areas. The design fire(s) will be characterised in more detail during the quantitative analysis for each trial alternative design.

5.3 *Develop trial alternative designs*

At this point in the analysis one or more trial alternative designs should be developed that will be compared against the developed performance criteria. The trial alternative design should also take into consideration the importance of human factors, operations, and management as reflected in part E of SOLAS chapter II-2. It should be recognised that well defined operations and management procedures may play a big part in increasing the overall level of safety.

5.4 *Preliminary analysis report*

5.4.1 A report of the preliminary analysis should include clear documentation of all steps taken to this point, including identification of the design team, their qualifications, the scope of the alternative design analysis, the functional requirements to be met, the description of the fire scenarios and trial alternative designs selected for the quantitative analysis.

5.4.2 The preliminary analysis report should be submitted to the Administration for formal review and agreement prior to beginning the quantitative analysis. The report may also be submitted to the port State for informational purposes, if the intended calling ports are known during the design stage. The key results of the preliminary analysis should include:

.1 a secured agreement from all parties to the design objectives and engineering evaluation;

.2 specified design fire scenario(s) acceptable to all parties; and

.3 trial alternative design(s) acceptable to all parties.

6 Quantitative analysis

6.1 The quantitative analysis is the most labour intensive from a fire safety engineering standpoint. It consists of quantifying the design fire scenarios, developing the performance criteria, verifying the acceptability of the selected safety margins and evaluating the performance of trial alternative designs against the prescriptive performance criteria.

6.1.1 The quantification of the design fire scenarios may include calculating the effects of fire detection, alarm and suppression methods, generating time lines from initiation of the fire until control or evacuation, and estimating consequences in terms of fire growth rate, heat fluxes, heat release rates, flame heights, smoke and toxic gas generation, etc. This information will then be utilised to evaluate the trial alternative designs selected during the preliminary analysis.

6.1.2 Risk assessment may play an important role in this process. It should be recognised that risk cannot ever be completely eliminated. Throughout the entire performance based design process, this fact should be kept in mind. The purpose of performance design is not to build the fail safe design, but to specify a design with reasonable confidence that it will perform its intended function(s) when necessary and in a manner equivalent to or better than the prescriptive fire safety requirements of SOLAS chapter II-2.

6.2 *Quantify design fire scenarios*

6.2.1 After choosing an appropriate range of fire incidents, quantification of the fires should be accomplished for each of the incidents. Quantification will require specification of all factors that will affect the type and extent of the fire hazard. The fire scenarios should consider possible future changes to the fire load and ventilation system in the affected areas. This may include calculation of heat release rate curves, flame height, length, and tilt, radiant, conductive, and convective heat fluxes, smoke production rate, pool fire size, duration, time-lines etc. References on suggested example correlations and models that may be of use are listed in appendix C. It should be noted that when using any of these or other tools, the limitations and assumptions of these models should be well understood and documented. This becomes very important when deciding on and applying safety margins. Documentation of the alternative design should explicitly identify the fire models used in the analysis and their applicability. Reference to the literature alone will not be considered as adequate documentation. The general procedure for specifying design fires includes fire scenario development completed during the preliminary analysis, time-line analysis and consequence estimation which is detailed below.

6.2.2 For each of the identified fire hazards, a range of fire scenarios should be developed. Because the alternative design approach is based on a comparison against the regulatory prescribed design, the quantification can often be simplified. In many cases, it may only be necessary to analyse one or two scenarios if this will provide enough information to evaluate the level of safety of the alternative design and arrangements against the required prescriptive design.

6.2.3 Develop time-lines for fire scenarios. A time-line should be developed for each of the fire scenarios beginning with fire initiation. Time-lines should include one or more of the following: ignition, established burning, fire detection, fire alarm, fire suppression/control system activation, personnel response, fire control, escape times (to muster station, evacuation stations and lifeboats as necessary), manual fire response, untenable conditions, etc. The time-line will include fire size throughout the scenario, as determined using the various correlations, models and fire data from the literature or actual fire tests.

6.2.4 Consequences of various fire scenarios should be quantified in fire engineering terms. This can be accomplished by using existing correlations and calculation procedures for determining fire characteristics such as heat release rate curves, flame height, flame length, flame tilt, radiant, conductive and convective heat fluxes, etc. In certain cases, live fire testing and experimentation may be necessary to properly predict the fire characteristics. Regardless of the calculation procedures utilised, a sensitivity analysis should be conducted to determine the effects of the uncertainties and limitations of the input parameters.

6.3 *Develop performance criteria*

6.3.1 Performance criteria are quantitative expressions of the fire safety objectives and functional requirements of the SOLAS regulations. The required performance of the trial alternative designs are specified numerically in the form of performance criteria. Performance criteria may include tenability limits such as smoke obscuration, temperature, height of the smoke and hot gas layer in a compartment, evacuation time or other criteria necessary to ensure successful alternative design and arrangements.

6.3.2 Each of the regulations in SOLAS chapter II-2 state the purpose of the regulation and the functional requirements that the regulation meets. Compliance with the prescriptive regulations is one way to meet the stated functional requirements. The performance criteria for the alternative design and arrangements should be determined, taking into consideration the fire safety objectives, the purpose statements and the functional requirements of the regulations. The following example is an illustration of this:

> Example of a performance criterion drawn directly from the regulations in SOLAS chapter II-2:
>
> *Assume that a design team is developing performance criteria for preventing fire spread through a bulkhead separating a galley from an accommodation space. They are seeking a numerical form for this criteria.*

(e.1) Regulation II-2/2 contains the fire safety objective "to contain, control, and suppress fire and explosion in their compartment of origin."

(e.2) One of the functional requirements in which this objective is manifest is "separation of accommodation spaces from the remainder of the ship by thermal and structural boundaries."

(e.3) Regulation II-2/9 contains the prescriptive requirements to achieve this functional requirement; in particular it requires an "A-60" class boundary between areas of high fire risk (like a machinery space or galley) and accommodation spaces.

(e.4) Regulation II-2/3 contains the definition of an "A" class division, which includes the maximum temperature rise criteria of 180 ^{o}C at any one point, after a 60 min fire exposure.

(e.5) Therefore, one possible performance criterion for this analysis is that "no point on the other side of the bulkhead shall rise more than 180°C above ambient temperature during a 60 minute fire exposure."

6.3.3 If the performance criteria for the alternative design and arrangements cannot be determined directly from the prescriptive regulations because of novel or unique features, they may be developed from an evaluation of the intended performance of a commonly used acceptable prescriptive design, provided that an equivalent level of fire safety is maintained.

6.3.4 Before evaluating the prescriptive design, the design team should agree on what specific performance criteria and safety margins will be established. Depending on the prescriptive requirements to which the approval of alternative design or arrangements is sought, these performance criteria could fall within one or more of the following areas:

.1 Life safety criteria - These criteria address the survivability of passengers and crew and may represent the effects of heat, smoke, toxicity, reduced visibility, and evacuation time.

.2 Criteria for damage to ship structure and related systems - These criteria address the impact that fire and its effluents might have on the ship structure, mechanical systems, electrical systems, fire protection systems, evacuation systems, propulsion and manoeuvrability, etc. These criteria may represent thermal effects, fire spread, smoke damage, fire barrier damage, degradation of structural integrity, etc.

.3 Criteria for damage to the environment - These criteria address the impact of heat, smoke and released pollutants on the atmosphere and marine environment.

6.3.5 The design team should consider the impact that one particular performance criterion might have on other areas that might not be specifically part of the alternative design. For example, the failure of a fire barrier may not only affect the life safety of passengers and crew in the adjacent space, but it may result in structural failure, exposure of essential equipment to heat and smoke, and the involvement of additional fuel in the fire.

6.3.6 Once all of the performance criteria have been established, the design team can then proceed with the evaluation of the trial alternative designs (see section 6.4).

6.4 *Evaluate trial alternative designs*

6.4.1 All of the data and information generated during the preliminary analysis and specification of design fires will serve as input to the evaluation process. The evaluation process will differ depending on the level of evaluation necessary (based on the scope defined during the preliminary analysis), but will generally follow the process illustrated in figure 6.4.1.

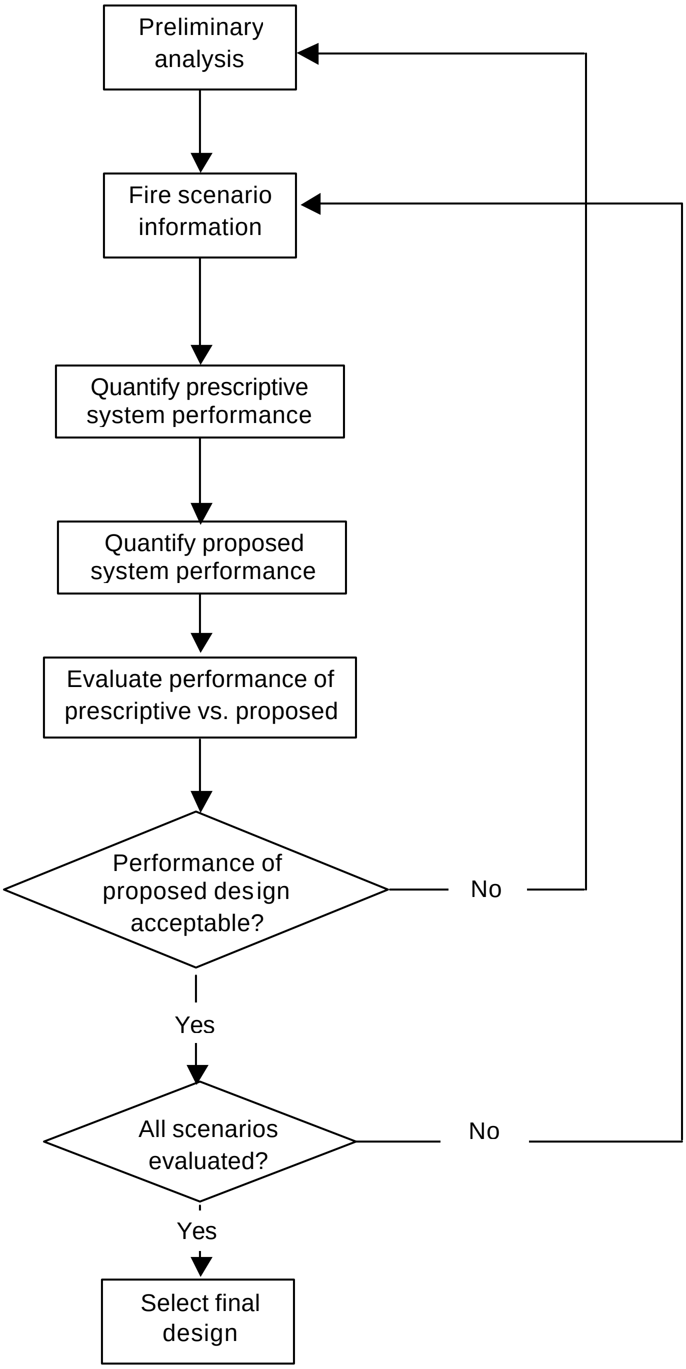

Figure 6.4.1 Alternative design and arrangements process flowchart

6.4.2 Each selected trial alternative design should be analysed against the selected design fire scenarios to demonstrate that it meets the performance criteria with the agreed safety margin, which in turn demonstrates equivalence to the prescriptive design.

6.4.3 The level of engineering rigor required in any particular analysis will depend on the level of analysis required to demonstrate equivalency of the proposed alternative design and arrangements to the prescriptive requirements. Obviously, the more components, systems, operations, and parts of the ship that are affected by a particular alternative design, the larger the scope of the analysis.

6.4.4 The final alternative design and arrangements should be selected from the trial alternative designs that meet the selected performance criteria and safety margins.

7 Documentation

7.1 Because the alternative design process may involve substantial deviation from the regulatory prescribed requirements, the process should be thoroughly documented. This provides a record that will be required if future design changes to the ship are proposed or the ship transfers to the flag of another State as well as providing details and information that may be adapted for use in future designs. The following information should be provided for approval of the alternative design or arrangements:

.1 scope of the analysis or design;

.2 description of the alternative design(s) or arrangements(s), including drawings and specifications;

.3 results of the preliminary analysis, to include:

  .1 members of the design team (including qualifications);

  .2 description of the trial alternative design and arrangements being evaluated;

  .3 discussion of affected SOLAS chapter II-2 regulations and their functional requirements;

  .4 fire hazard identification;

  5 enumeration of fire hazards;

  .6 selection of fire hazards; and

  .7 description of design fire scenarios;

.4 results of quantitative analysis:

  .1 design fire scenarios:

    .1 critical assumptions;

.2 amount and composition of fire load;

.3 engineering judgements;

.4 calculation procedures;

.5 test data;

.6 sensitivity analysis; and

.7 time lines;

.2 performance criteria;

.3 evaluation of trial alternative designs against performance criteria;

.4 description of final alternative design and arrangements;

.5 test, inspection, and maintenance requirements; and

.6 references.

7.2 Documentation of approval by the Administration and the following information should be maintained onboard the ship at all times:

.1 scope of the analysis or design, including the critical design assumptions and critical design features;

.2 description of the alternative design and arrangements, including drawings and specifications;

.3 listing of affected SOLAS chapter II-2 regulations;

.4 summary of the results of the engineering analysis and basis for approval; and

.5 test, inspection, and maintenance requirements.

7.3 *Reporting and approval forms*

7.3.1 When the Administration approves alternative design and arrangements for fire safety, pertinent technical information about the approval should be summarized on the reporting form given in appendix A and should be submitted to the International Maritime Organization for circulation to the Member Governments.

7.3.2 When the Administration approves alternative design and arrangements on fire safety, documentation should be provided as indicated in appendix B.

7.4 *Reference in SOLAS certificates*

A reference to the approved alternative design and arrangements should be included in the appropriate SOLAS certificate.

APPENDIX A

REPORT ON THE APPROVAL OF ALTERNATIVE DESIGN AND ARRANGEMENTS FOR FIRE SAFETY

The Government of ………………………. has approved on ………………… an alternative design and arrangement in accordance with provisions of regulation II-2/17.5 of the International Convention for Safety of Life at Sea (SOLAS), 1974, as amended, as described below:

Name of ship	....
Port of registry	....
Ship type	....
IMO Number	....

1. **Scope of the analysis or design, including the critical design assumptions and critical design features:**

2. **Description of the alternative design and arrangements:**

3. **Conditions of approval, if any:**

4. **Listing of affected SOLAS chapter II-2 regulations:**

5. **Summary of the result of the engineering analysis and basis for approval, including performance criteria and design fire scenarios:**

6. **Test, inspection and maintenance requirements:**

APPENDIX B

DOCUMENT OF APPROVAL OF ALTERNATIVE DESIGN AND ARRANGEMENTS FOR FIRE SAFETY

Issued in accordance with provisions of regulation II-2/17.4 of the International Convention for Safety of Life at Sea (SOLAS), 1974, as amended, under the authority of the Government of ....……………………... by ………..……………………………. .
(name of State) (person or organization authorized)

Name of ship ....

Port of registry ....

Ship type ....

IMO Number ....

THIS IS TO CERTIFY that the following alternative design and arrangement applied to the above ship had been approved under the provisions of SOLAS regulation II-2/17.

1. **Scope of the analysis or design, including the critical design assumptions and critical design features:**

2. **Description of the alternative design and arrangements:**

3. **Conditions of approval, if any:**

4. **Listing of affected SOLAS chapter II-2 regulations:**

5. **Summary of the result of the engineering analysis and basis for approval, including performance criteria and design fire scenarios:**

6. **Test, inspection and maintenance requirements:**

7. **Drawings and specifications of the alternative design and arrangement:**

Issued at ……………………….. on ……………………………….

………………………………...
(signature of authorized official issuing the certificate)

(Seal or stamp of issuing authority, as appropriate)

APPENDIX C

TECHNICAL REFERENCES AND RESOURCES

1 Section 3 of the guidelines states that the fire safety engineering approach should be "based on sound fire science and engineering practices incorporating widely accepted methods, empirical data, calculations, correlations, and computer models as contained in engineering textbooks and technical literature." There are literally thousands of technical resources that may be of use in a particular fire safety design. Therefore, it is very important that fire safety engineers and other members of the design team determine the acceptability of the sources and methodologies used for the particular applications in which they are used.

2 When determining the validity of the resources used, it is helpful to know the process through which the document was developed, reviewed and validated. For example, many codes and standards are developed under an open consensus process conducted by recognised professional societies, codes making organisations or governmental bodies. Other technical references are subject to a peer review process, such as many of the technical and engineering journals available. Also, engineering handbooks and textbooks provide widely recognised and technically solid information and calculation methods.

3 Additional guidance on selection of technical references and resources, along with lists of subject-specific literature, can be found in:

- *The SFPE Engineering Guide to Performance-Based Fire Protection Analysis and Design of Buildings*, Society of Fire Protection Engineers and National Fire Protection Association, 1999.

- ISO/TR 13387-1 through 13387-8, *"Fire safety engineering"*, International Standards Organization, 1999.

4 Other important references include:

- *SFPE Handbook of Fire Protection Engineering*, 2nd Edition, P. J. DiNenno, ed., The Society of Fire Protection Engineers, Boston, MA, 1995.

- *Fire Protection Handbook,* 18th Edition, A. E. Cote, ed., National Fire Protection Association, Quincy, MA, 1997.

- Custer, R.L.P., and Meacham, B.J., *Introduction to Performance-Based Fire Safety*, Society of Fire Protection Engineers, USA, 1997.

- NFPA 550, *Guide to the Use of the Fire Safety Concepts Tree*, National Fire Protection Association, 1995.

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ANNEX 4

DRAFT MSC CIRCULAR

GUIDELINES ON A SIMPLIFIED CALCULATION FOR THE TOTAL AMOUNT OF COMBUSTIBLE MATERIALS PER UNIT AREA IN ACCOMMODATION AND SERVICE SPACES

1 The Maritime Safety Committee, at its [seventy-fourth] session, recognizing the need for improving fire safety on board ships by the development of a simplified calculation for the total amount of combustible materials per unit area in accommodation and service spaces, agreed with the recommendation made by the Sub-Committee on Fire Protection that:

.1 calculation for the total amount of combustible materials per unit area in accommodation and service spaces may be performed using the formula contained in the attached annex; and

.2 mandatory application of the calculation for the total amount of combustible materials per unit area in accommodation and service spaces could be further considered when sufficient experience is gained in the application of the Guidelines,

and approved the Guidelines on a simplified calculation for the total amount of combustible materials per unit area in accommodation and service spaces, set out in the annex.

2 Member Governments are invited to:

.1 use the annexed Guidelines when considering the calculation for the total amount of combustible materials per unit area in accommodation and service spaces as an improved means of fire safety; and

.2 submit to the Sub-Committee on Fire Protection information on experience gained in the implementation of the Guidelines.

ANNEX

GUIDELINES ON A SIMPLIFIED CALCULATION FOR THE TOTAL AMOUNT OF COMBUSTIBLE MATERIALS PER UNIT AREA IN ACCOMMODATION AND SERVICE SPACES

1 Application

These Guidelines are intended to be used by Administrations to calculate the maximum fire load on board ships. These Guidelines are not intended to support alternative design and arrangements process specified in SOLAS regulation II-2/17.

2 Formula for calculating the total mass of combustible materials

2.1 In accommodation spaces, service spaces and control stations of all types of ships, the total mass of combustible materials of each enclosed space should be calculated based on the following formula:

$$TCMPA = \mathrm{M}_{\mathrm{CMBST}}/\mathrm{A}$$

where:

TCMPA is the total mass of combustible materials per unit area of the space (kg/m^2)

M_{CMBST} is the total mass of combustible materials of the space (kg); and

A is the floor area of the space (m^2).

2.2 The following combustible materials should be included in the calculation required by paragraph 2.1:

.1 construction materials such as cable insulation, plastic pipes, veneers and combustible materials permitted to be used under the relevant regulations of SOLAS chapter II-2; and

.2 outfitting which may be installed during the construction or provided by the ship's owner or crew, including furniture, bedding components and electrical appliances.

2.3 Maximum values for the total mass of combustible materials per unit area *TCMPA* are provided in the table below. Space categories should be classified in accordance with SOLAS regulation II-2/9.

Type of space	Passenger ships carrying more than 36 passengers	Passenger ships carrying not more than 36 passengers	Cargo ships
Stairways, corridors	5 kg/m^2	5 kg/m^2	5 kg/m^2
Control stations	5 kg/m^2	5 kg/m^2	5 kg/m^2
Accommodation spaces	Minor fire risk 15 kg/m^2	35 kg/m^2	35 kg/m^2
	Moderate fire risk 35 kg/m^2		
	Greater fire risk 35 kg/m^2		
Service spaces surrounded by "A" class divisions	45 kg/m^2	45 kg/m^2	45 kg/m^2

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ANNEX 5

DRAFT MSC CIRCULAR

UNIFIED INTERPRETATIONS OF THE INTERNATIONAL CODE FOR APPLICATION OF FIRE TEST PROCEDURES (FTP CODE) AND FIRE TEST PROCEDURES REFERRED TO IN THE CODE

1 The Maritime Safety Committee, [at its seventy-fourth session (30 May to 8 June 2001)], with a view to ensuring uniform application of the fire test provisions of the FTP Code containing vague wording which is open to diverging interpretations, approved unified interpretations prepared by the Sub-Committee on Fire Protection at its forty-fifth session, as set out in the annex.

2 Member Governments are invited to use the annexed unified interpretations as guidance, when applying relevant provisions of the FTP Code for the testing of new materials, tested on or after [the date of approval], in order to fulfill the requirements of the 1974 SOLAS Convention, and to bring the unified interpretations to the attention of all parties concerned.

3 Member Governments are also advised to take into account earlier unified interpretations to the FTP Code and fire test procedures referred to in the Code approved by MSC 72, as given in MSC/Circ.964.

ANNEX

UNIFIED INTERPRETATIONS TO THE FTP CODE AND FIRE TEST PROCEDURES REFERRED TO IN THE CODE

INTERNATIONAL CODE FOR APPLICATION OF FIRE TEST PROCEDURES

5 APPROVAL

Paragraph 5.1.6.5

For cases where an unsuccessful test had been conducted prior to the final approval test, the fire test report should include a description of the modifications made to the test specimen that resulted in the successful test.

ANNEX 1
FIRE TEST PROCEDURES

Part 5 – Test for surface flammability

Section 1 - Application

Where a product is approved based on a test of a specimen applied on a non-combustible substrate, that product should be approved for application to any non-combustible substrate with similar or higher density (similar density may be defined as a density $\geq$ 0.75 x the density used during testing) or with a greater thickness if the density is more than 400 kg/m^3. Where a product is approved on the basis of a test result obtained after application on a metallic substrate (e.g. thin film of paints or plastic films on steel plates), such a product should be approved for application to any metallic base of similar or higher thickness (similar thickness is obtained as a thickness $\geq$ 0.75 x the thickness of metallic substrate used during testing).

Part 6 – Test for primary deck coverings

Paragraph 2.2 – Fire test procedure

The test may be terminated after 40 min.

RESOLUTION A. 653(16), Annex

Paragraph 7

Where a product is approved based on a test of a specimen applied on a non-combustible substrate, that product should be approved for application to any non-combustible substrate with similar or higher density (similar density may be defined as a density $\geq$ 0.75 x the density used during testing) or with a greater thickness if the density is more than 400 kg/m^3. Where a product is approved on the basis of test result obtained after application on a metallic substrate (e.g. thin film of paints or plastic films on steel plates), such a product should be approved for application to any metallic base of similar or higher thickness (similar thickness is obtained as a thickness $\geq$ 0.75 x the thickness of metallic substrate used during testing).

Paragraph 8.3.1

In the first line of the first sentence, the word “or” should read “of”.

Paragraph 10

Q_{sb} means an average of three values of average heat for sustained burning, as defined in paragraph 9.3.

RESOLUTION A. 754(18), Annex

Paragraph 1.6

Doors, windows and other division penetrations intended to be installed in fire divisions made of material other than steel should correspond to prototype(s) tested on a division made of such material, unless the Administration is satisfied that the construction, as approved, does not impair the fire resistance of the division regardless of the division construction.

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ANNEX 6

DRAFT MSC CIRCULAR

UNIFIED INTERPRETATIONS OF VAGUE EXPRESSIONS AND OTHER VAGUE WORDING OF SOLAS CHAPTER II-2

1 The Maritime Safety Committee, [at its seventy-fourth session (30 May to 8June 2001)], approved, with a view to ensuring uniform application of the requirements of SOLAS regulations II-2/3.3.1 and 3.3.2, the unified interpretation prepared by the Sub-Committee on Fire Protection, at its forty-fifth session, as set out in the attached annex.

2 Member Governments are invited to use the unified interpretation attached at annex as guidance when applying the provisions of SOLAS regulations II-2/3.3.1 and 3.3.2, and to bring the unified interpretation to the attention of all parties concerned.

ANNEX

UNIFIED INTERPRETATION TO SOLAS CHAPTER II-2

Regulations II-2/3.3.1 and 3.3.2

Application of "light-weight constructions"

"Light-weight constructions" (honeycomb type, etc.) of steel or equivalent material may be used as non load-bearing internal "A" class divisions in accommodation and service spaces, provided they have successfully passed the relevant standard fire test according to resolution A.754(18)*. These "light-weight constructions" should not be used as an integral part of main fire zone bulkheads and stairway enclosures on passenger ships.

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* Refer to part 3 of the Fire Test Procedures Code.

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ANNEX 7

DRAFT MSC CIRCULAR

GUIDELINES ON FIRE TEST PROCEDURES FOR ACCEPTANCE OF FIRE-RETARDANT MATERIALS FOR THE CONSTRUCTION OF LIFEBOATS

1 The Maritime Safety Committee, [at its seventy-fourth session (30 May to 8 June 2001)], noted that paragraph 4.4.1.4 of the International Life-Saving Appliance (LSA) Code as well as regulation VII/17 of the Torremolinos Protocol of 1993 relating to the International Convention for the Safety of Fishing Vessels, 1977 (1993 Torremolinos Protocol) uses the term “fire-retardant” with regard to materials for the construction of the hull and rigid cover of lifeboats, but there is no definition of fire-retardant material either in the LSA Code or in the 1993 Torremolinos Protocol.

2 The Committee, recalling that resolution 7 of the International Conference on Safety of Fishing Vessels held in 1993 in Torremolinos invited the Committee to develop an appropriate definition of fire-retardant materials together with the corresponding criteria related to the said definition as well as fire test procedures aimed at assessing compliance with the criteria for such materials, approved Guidelines on fire test procedures for acceptance of fire-retardant materials for the construction of lifeboats, as set out in the annex.

3 Member Governments are invited to apply the annexed Guidelines when approving fire-retardant materials used for the construction of lifeboats.

ANNEX

FIRE TEST PROCEDURES FOR ACCEPTANCE OF FIRE-RETARDANT MATERIALS FOR THE CONSTRUCTION OF LIFEBOATS

Application

1 This test procedure should be used for the acceptance of fire-retardant and flame resistant materials used for the construction of lifeboats which are required to be fire-retardant by the International Life-Saving Appliances Code and the Torremolinos Protocol of 1993 relating to the International Convention for the Safety of Fishing Vessels, 1977.

Fire test procedure

2. General

Ignitability for fire-retardant laminate systems for the construction of lifeboats should be determined by ISO 5660-1, "Fire tests - Reaction to fire - Part 1: Rate of heat release from building products (Cone calorimeter method)," as described in paragraph 3. This test should be conducted for each resin used. In addition, a fire retardant resin passing the test in paragraph 3 should undergo the test contained in paragraph 4.

Fire-retardant test

3 Test specimens

Three test specimen laminates should be prepared reinforced with glass fibre of any form with a thickness of 5 mm and a minimum resin content of 40% by weight. Alternatively, three specimens of the specific laminate system should be tested as built. When similar laminates of different thickness are used, the minimum thickness should be tested. For laminates with normal thickness of greater than 50 mm, including sandwich construction, the requisite specimens shall be obtained by cutting away the unexposed face to reduce the thickness to 50 mm. All specimens should be square with sides measuring 100 mm.

3.1 Conditioning of specimens

Before the test, the specimens should be conditioned in sunlight to 300 MJ/m^2 (below 385 nm) of natural UV radiation exposure of outdoor weathering or acceptable equivalent accelerated artificial weathering exposure to the satisfaction of the Administration. Both natural and artificial exposures should include elevated temperatures of at least 30°C for substantial periods of the exposure and 20 % wet time.

3.2 Test conditions

The test should be performed in the horizontal position using a sample edge frame and the irradiance to the specimen during the testing should be kept constant. The test specimens should be tested to an irradiance of 50 kW/m^2.

3.3 Duration of tests

The test should terminate when ignition occurs in the test specimen or at 10 min.

3.4 Test results

The average ignition time should be calculated as the arithmetic mean of the ignition time of the three specimens.

3.5 Acceptance criteria

The average ignition time should be greater than 40 s.

Flame resistant tests

4.1 Test procedure

GRP laminates representing the lay-up of a prototype boat, which should be based upon the minimum hull and/or canopy thickness to be used, for the boat under consideration; should be tested to determine their resistance to the effects of flame impingement and strength. The test sample should be cut from a one metre square panel of the above minimum thickness, which has been allowed to cure for not less than 21 days and then stored for 30 days at ambient temperature as stated below. The test should be carried out using the following methods:

.1 the heat source to conduct the fire test should be provided by a gas torch fitted with a Sievert burner type No. 2944 or equivalent, giving a maximum flame temperature of approximately 1,600°C and burning propane at the rate of 4,110 grams per hour with a pressure of 0.2 MPa. During this procedure the rate of burning should be carefully controlled, with the length of blue flame being approximately 200 mm to the point of the greatest heat; and

.2 the centre of a 450 mm by 450 mm test sample, cut from the one metre square panel (which should not be cut from the edges) should be exposed in the vertical plane perpendicular to the gel-coat surface to the tip of the blue flame of the propane gas torch for an initial period of one minute. This test sample should be contained in a suitable steel frame to prevent the spread of flame igniting the sample's edges. During this time observations of the heat effects on the sample should be recorded.

4.2 Acceptance criteria

At the end of the one minute period, the burner should be removed and the area of flame impingement should not support combustion more than 30 s after being removed from the burner.

4.3 Additional information

After completing the test specified in paragraph 4.1, the sample should then be immediately re-exposed, on the impingement point, by the heat source to establish the total burn-through time of the respective lay-up. Total burn-through time is taken as flaming to appear on the un-exposed surface.

Test report

5.1 The fire-retardant test report should include the following information:

.1 name of testing body;

.2 name of manufacturer of the material;

.3 date of supply of the materials and of tests;

.4 name or identification of the material;

.5 description of the material;

.6 density of the material;

.7 description of the specimens;

.8 test method;

.9 test results including all observations; and

.10 designation of the material according to the test criteria specified in paragraph 3.5.

5.2 The flame-resistant test report should include the following information:

.1 name of testing body;

.2 boat manufacturer;

.3 date of material test;

.4 boat type;

.5 description of the specimen;

.6 time for flame extinguishments;

.7 burn-through time; and

.8 designation of the material according to the test criteria specified in paragraph 4.2.

***

ANNEX 8

DRAFT MSC CIRCULAR

GUIDELINES FOR THE APPROVAL OF FIXED AEROSOL FIRE-EXTINGUISHING SYSTEMS EQUIVALENT TO FIXED GAS FIRE-EXTINGUISHING SYSTEMS, AS REFERRED TO IN SOLAS 74, FOR MACHINERY SPACES

1 The Maritime Safety Committee, [at its seventy-fourth session (30 May to 8 June 2001)], approved the Guidelines for the approval of fixed aerosol fire-extinguishing systems equivalent to fixed gas fire-extinguishing systems, as referred to in SOLAS 74, for machinery spaces, as set out in the annex.

2 Member Governments are invited to apply the annexed Guidelines when approving fixed aerosol fire-extinguishing systems for use in machinery spaces of category A.

ANNEX

GUIDELINES FOR THE APPROVAL OF FIXED AEROSOL FIRE-EXTINGUISHING SYSTEMS EQUIVALENT TO FIXED GAS FIRE-EXTINGUISHING SYSTEMS, AS REFERRED TO IN SOLAS 74, FOR MACHINERY SPACES

General

1 Fixed aerosol fire-extinguishing systems for use in machinery spaces of category A equivalent to fire-extinguishing systems required by SOLAS regulation II-2/7* should prove that they have the same reliability which has been identified as significant for the performance of fixed gas fire-extinguishing systems approved under the requirements of SOLAS regulation II-2/5**. In addition, the system should be shown by testing according to the appendix to have the capability of extinguishing a variety of fires that can occur in machinery spaces.

2 Aerosol fire-extinguishing systems involve the release of a chemical agent to extinguish a fire by interruption of the process of the fire.

There are two methods considered for applying the aerosol agent to the protected space:

.1 condensed aerosols are created in pyrotechnical generators through the combustion of the agent charge; and

.2 dispersed aerosols that are not pyrotechnically generated and are stored in containers with carrier agents (such as inert gases or halocarbon agents) with the aerosol released in the space through valves, pipes and nozzles.

Definitions

3 *Aerosol* is a non ozone depleting fire-extinguishing medium consisting of either condensed aerosol or dispersed aerosol.

4 *Generator* is a device for creating a fire-extinguishing medium by pyrotechnical means.

5 *Design density (g/m³)* is the mass of an aerosol forming composition per m³ of the enclosure volume required to extinguish a specific type of fire, including a safety factor.

6 *Agent – medium* for the purpose of these guidelines, these words are interchangeable.

Principal requirements

7 All requirements of SOLAS regulations II-2/5.1***, 5.3.1, 5.3.2 to 5.3.3 except as modified by these guidelines, should apply, where applicable.

8 The minimum agent density should be determined and verified by the full-scale testing described in the test method, as set out in the appendix.

* Refer to regulation II-2/10.5 of SOLAS chapter II-2, as adopted by resolution MSC.99(73).

** Refer to regulation II-2/10.4 of SOLAS chapter II-2, as adopted by resolution MSC.99(73).

*** Refer to regulations II-2/10.9.1.1.1 of SOLAS chapter II-2, as adopted by resolution MSC.99(73)

9 For aerosol systems, the discharge time should not exceed 120 s for 85% of the design density. Systems may need to discharge in a shorter time for other reasons than for fire-extinguishing performance.

10 The quantity of extinguishing agent for the protected space should be calculated at the minimum expected ambient temperature using the design density based on the net volume of the protected space, including the casing.

10.1 The net volume of a protected space is that part of the gross volume of the space, which is accessible to the fire-extinguishing agent.

10.2 When calculating the net volume of a protected space, the net volume should include the volume of the bilge, the volume of the casing and the volume of free air contained in air receivers that in the event of a fire may be released into the protected space.

10.3 The objects that occupy volume in the protected space should be subtracted from the gross volume of the space. They include, but are not necessarily limited to:

.1 auxiliary machinery;

.2 boilers;

.3 condensers;

.4 evaporators;

.5 main engines;

.6 reduction gears;

.7 tanks; and

.8 trunks.

10.4 Subsequent modifications to the protected space that alter the net volume of the space shall require the quantity of extinguishing agent to be adjusted to meet the requirements of this paragraph and paragraphs 10, 10.1, 10.2, 10.3, 11, 11.1 and 11.2.

11 No fire suppression system should be used which is carcinogenic, mutagenic or teratogenic at concentrations expected during use. All systems should employ two separate controls for releasing the extinguishing medium into a protected space. Means should be provided for automatically giving audible warning of the release of fire-extinguishing medium into any space in which personnel normally work or to which they have access. The alarm should operate for a suitable period* before the medium is released. Unnecessary exposure to aerosol media, even at concentrations below an adverse effect level, should be avoided.

11.1 Pyrotechnically generated aerosols: Pyrotechnically generated aerosol systems for spaces that are normally occupied should be permitted in concentrations where the aerosol particulate matter does not exceed the adverse effect level as determined by a scientifically accepted

* Refer to MSC/Circ.847

technique* and any gases produced by the pyrotechnic generator do not exceed the No Observed Adverse Effect Level (NOAEL) for the critical toxic effect as determined in a short term toxicity test.

11.2 Dispersed aerosols: Dispersed aerosol systems for spaces that are normally occupied should be permitted in concentrations where the aerosol particulate matter does not exceed the adverse effect level as determined by a scientifically accepted technique**. If the carrier gas is a halocarbon, it may be used up to its NOAEL.If a halocarbon carrier gas is to be used above its NOAEL, means should be provided to limit exposure to no longer than the time specified according to a scientifically accepted physiologically based pharmacokinetic** (PBPK) model or its equivalent which clearly establishes safe exposure limits both in terms of extinguishing media concentration and human exposure time. If the carrier is an inert gas, means should be provided to limit exposure to no longer than 5 min for inert gas systems designed to concentrations below 43 percent (corresponding to an oxygen concentration of 12 percent, sea level equivalent of oxygen) or to limit exposure to no longer than 3 min for inert gas systems designed to concentrations between 43 and 52 percent (corresponding to between 12 and 10 percent oxygen, sea level equivalent of oxygen).

11.3 In no case should a dispersed aerosol system be used with halocarbon carrier gas concentrations above the Lowest Observed Adverse Effect Level (LOAEL) nor the Approximate Lethal Concentration (ALC) nor should a dispersed aerosol system be used with an inert gas carrier at gas concentrations above 52% calculated on the net volume of the protected space at the maximum expected ambient temperature, without the use of controls as provided in SOLAS regulations II-2/5.2.5.1 and 5.2.5.2.***

12 The system and its components should be suitably designed to withstand ambient temperature changes, vibration, humidity, shock, impact, clogging, electromagnetic compatibility and corrosion normally encountered in machinery spaces. Generators in condensed aerosol systems should be designed to prevent self-activation at a temperature below 250°C.

13 The system and its components should be designed, manufactured and installed in accordance with standards acceptable to the Organization. As a minimum, the design and installation standards should cover the following elements:

.1 safety:

  .1 toxicity;

  .2 noise, generator/nozzle discharge;

  .3 decomposition products and;

  .4 obscuration

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* Reference is made to the United States' EPA's Regional Deposited Dose Ratio Program "Methods of Derivation of Inhalation Reference Concentrations and Application of Inhalation Dosimetry" EPA/600/8-90/066F, October 1994.

** Refer to document FP 44/INF.2 submitted by the United States – Physiologically based pharmacokinetic model to establish safe exposure criteria for halocarbon fire extinguishing agents.

*** Refer to regulation II-2/10.4.1.1.1 of SOLAS chapter II-2 as adopted by resolution MSC.99(73).

.2 storage container design and arrangement:

  .1 strength requirements;

  .2 maximum/minimum fill density, operating temperature range;

  .3 pressure and weight indication;

  .4 pressure relief; and

  .5 agent identification, production date, installation date and hazard classification.

.3 agent supply, quantity, quality standards, shelf life and service life of agent and igniter;

.4 handling and disposal of generator after service life;

.5 pipes and fittings:

  .1 strength, material properties, fire resistance; and

  .2 cleaning requirements;

.6 valves:

  .1 testing requirements; and

  .2 elastomer compatibility;

.7 generators/nozzles:

  .1 height and area testing requirements; and

  .2 elevated temperature resistance;

.8 actuation and control systems:

  .1 testing requirements; and

  .2 backup power requirements;

.9 alarms and indicators:

  .1 predischarge alarm, agent discharge alarms and time delays;

  .2 supervisory circuit requirements;

  .3 warning signs, audible and visual alarms; and

  .4 annunciation of faults;

.10 enclosure integrity and leakage requirements:

.1 enclosure leakage;

.2 openings; and

.3 mechanical ventilation interlocks;

.11 design density requirements, total flooding quantity;

.12 agent flow calculation:

.1 verification and approval of design calculation method;

.2 fitting losses and/or equivalent length;

.3 discharge time

.13 inspection, maintenance, service, and testing requirements; and

.14 handling and storage requirements for pyrotechnical components.

14 The generator/nozzle type, maximum generator/nozzle spacing, maximum generator/nozzle installation height and minimum generator/nozzle pressure should be within limits tested.

15 Installations should be limited to the maximum volume tested.

16 Agent containers may be stored within a protected machinery space if the containers are distributed throughout the space and the provisions of SOLAS regulation II-2/5.3.3, as applicable, are met. The arrangement of generators, containers, electrical circuits and piping essential for the release of any system should be such that in the event of damage to any one power release line through fire or explosion in the protected space, (i.e. a single fault concept), at least the design density of the fire-extinguishing charge as required in paragraph 10 above can still be discharged having regard to the requirement for uniform distribution of medium throughout the space.

17 The release of an extinguishing agent may produce significant over and under pressurization in the protected space. Measures to limit the induced pressures to acceptable limits may have to be provided.

18 For all ships, the fire-extinguishing system design manual should address recommended procedures for the control of products of agent decomposition. The performance of fire-extinguishing arrangements on passenger ships should not present health hazards from decomposed extinguishing agents, (e.g., on passenger ships, the decomposition products should not be discharged in the vicinity of muster (assembly) stations).

19 Spare parts and operating and maintenance instructions for the system should be provided as recommended by the manufacturer.

APPENDIX

TEST METHOD FOR FIRE TESTING OF FIXED AEROSOL FIRE-EXTINGUISHING SYSTEMS

1 Scope

1.1 This test method is intended for evaluating the extinguishing effectiveness of fixed aerosol fire-extinguishing systems for the protection of machinery spaces of category A

1.2 The test method is applicable to aerosols and covers the minimum requirements for fire-extinguishing.

1.3 The test programme has two objectives:

.1 establishing the extinguishing effectiveness of a given agent at its tested concentration; and

.2 establishing that the particular agent distribution system puts the agent into the enclosure in such a way as to fully flood the volume to achieve an extinguishing concentration at all points.

2 Sampling

The components to be tested should be supplied by the manufacturer together with design and installation criteria, operational instructions, drawings and technical data sufficient for the identification of the components.

3 Method of test

3.1 Principle

This test procedure is intended for the determination of the effectiveness of different aerosol agent extinguishing systems against spray fires, pool fires and class A fires.

3.2 Apparatus

3.2.1 Test room

The tests should be performed in 100 m^2 room, with no horizontal dimension less than 8 m, with a ceiling height of 5 m. The test room should be provided with a closable access door measuring approximately 4 m^2 in area. In addition, closable ventilation hatches measuring at least 6 m^2 in total area should be located in the ceiling. A larger room may be employed if approvals are sought for larger volumes.

3.2.2 Integrity of test enclosure

The test enclosure is to be nominally leak tight when doors and hatches are closed. The integrity of seals on doors, hatches and other penetrations (e.g., instrumentation access ports) must be verified before each test.

3.2.3 Engine mock-up

.1 An engine mock-up of size (width x length x height) 1 m x 3 m x 3 m should be constructed of sheet steel with a nominal thickness of 5 mm. The mock-up should be fitted with two steel tubes diameter 0.3 m and 3 m length that simulate exhaust manifolds and a solid steel plate. At the top of the mock-up a 3 m^2 tray should be arranged. See figures 1, 2 and 3.

.2 A floor plate system 4 m x 6 m x 0.75 m high shall surround the mock-up. Provision shall be made for placement of the fuel trays, as described in table 1, and located as described in table 2.

3.2.4 Instrumentation

Instrumentation for the continuous measurement and recording of test conditions should be employed. The following measurements should be made:

.1 temperature at three vertical positions (e.g., 1 m, 2.5 m and 4.5 m);

.2 enclosure pressure;

.3 gas sampling and analysis, at mid-room height, for oxygen, carbon dioxide, carbon monoxide, and other relevant products*;

.4 means of determining flame-out indicators;

.5 fuel nozzle pressure in the case of spray fires;

.6 fuel flow rate in the case of spray fires;

.7 discharge nozzle pressure; and

.8 means of determining generator discharge duration.

3.2.5 Generators/nozzles

3.2.5.1 For test purposes, generators/nozzles should be located within 1 m of the ceiling.

3.2.5.2 If more than one generator/nozzle is used, they should be symmetrically located.

3.2.6 Enclosure temperature

The ambient temperature of the test enclosure at the start of the test should be noted and serve as the basis for calculating the concentration that the agent would be expected to achieve at that temperature and with that agent weight applied in the test volume.

* Refer to SOLAS regulation II-2/5.1.1 on regulation II-2/10.4 of SOLAS chapter II-2 as adopted by resolution MSC.99(73).

3.3 Test fires and programme

3.3.1 Fire types

The test programme, as described in table 3, should employ test fires as described in table 1 below.

Table 1
Parameters of test fires

Fire	Type	Fuel	Fire size, MW	Remarks
A	76 - 100 mm ID can	Heptane	0.0012 to 0.002	Tell tale
B	0.25 m^2 tray	Heptane	0.35	
C	2 m^2 tray	Diesel /Fuel oil	3	
D	4 m^2 tray	Diesel /Fuel oil	6	
E	Low pressure, low flow spray	Heptane 0.03 ± 0.005 kg/s	1.1	
F	Wood crib	Spruce or fir	0.3	See Note 2
G	0.10 m^2 tray	Heptane	0.14	

Notes to table 1:

1 Diesel/Fuel oil means light diesel or commercial fuel oil.

2 The wood crib should be substantially the same as described in ISO Standard 14520, *Gaseous fire extinguishing systems, Part 1: General Requirements* (2000). The crib should consist of six, trade size 50 mm x 50 mm by 450 mm long, kiln dried spruce or fir lumber having a moisture content between 9% and 13%. The members should be placed in 4 alternate layers at right angles to one another. Members should be evenly spaced forming a square structure.

Ignition of the crib should be achieved by burning commercial grade heptane in a square steel tray 0.25 m^2 in area. During the pre-burn period the crib should be placed centrally above the top of the tray a distance of 300 to 600 mm.

Table 2
Spray fire test parameters

Fire type	Low pressure, Low flow(E)
Spray nozzle	Wide spray angle (80°) full cone type
Nominal fuel pressure	8.5 Bar
Fuel flow	0.03 $\pm$ 0.005 kg/s
Fuel temperature	20 $\pm$ 5°C
Nominal heat release rate	1.1 $\pm$ 0.1 MW

3.3.2 Test programme

The fire test programme should employ test fires singly or in combination, as outlined in table 3 below.

Table 3
Test programme

Test No.	Fire combinations (See table 1)
1	A: Tell tales, 8 corners. See note.
2	B: 0.25 m^2 heptane tray under mock-up G: 0.10 m^2 heptane tray on deck plate located below solid steel obstruction plate Total fire load: 0.49 MW
3	C: 2 m^2 diesel/fuel oil tray on deck plate located below solid steel obstruction plate F: Wood crib positioned as in figure 1 E: Low pressure, low flow horizontal spray - concealed - with impingement on inside of engine mock-up wall. Total fire load: 4.4 MW
4	D: 4 m^2 diesel tray under engine mock-up Total fire load: 6 MW

Note to table 3:

Tell-tale fire cans should be located as follows:

.1 in upper corners of enclosure 150 mm below ceiling and 50 mm from each wall; and

.2 in corners on floors 50 mm from walls.

3.3.2.1 All applicable tests of table 3 should be conducted for every new fire-extinguishing media.

3.3.2.2 Only test 1 is required to evaluate new nozzles and related distribution system equipment (hardware) for systems employing fire-extinguishing media that have successfully completed the requirements of paragraph 3.3.2.1 above. Test 1 should be conducted to establish and verify the manufacturer's minimum nozzle design pressure.

3.4 Extinguishing system

3.4.1 System installation

The extinguishing system should be installed according to the manufacturer's design and installation instructions. The maximum vertical distance should be limited to 5 m.

3.4.2 Agent

3.4.2.1 Design density

The agent design density is the net mass of extinguishant per unit volume (g/m^3) required by the system designer for the fire protection application.

3.4.2.2 Test density

The test density of agent to be used in the fire-extinguishing tests should be the design density specified by the manufacturer, except for test 1, which should be conducted at not more than 77% of the manufacturer's recommended design density.

3.4.2.3 Quantity of aerosol agent

The quantity of aerosol agent to be used should be determined as follows:

$$W = V \text{ x } q \text{ (g)},$$

where:

W = agent mass (g);
V = volume of test enclosure, m^3;
q = fire-extinguishing aerosol density (g/m^3).

3.5 Procedure

3.5.1 Fuel levels in trays

The trays used in the test should be filled with at least 30 mm fuel on a water base. Freeboard should be 150 ± 10 mm.

3.5.2 Fuel flow and pressure measurements

For spray fires, the fuel flow and pressure should be measured before and during each test.

3.5.3 Ventilation

3.5.3.1 Pre-burn period

During the pre-burn period the test enclosure should be well ventilated. The oxygen concentration, as measured at mid-room height, shall not be less than 20 volume per cent at the time of system discharge.

3.5.3.2 End of pre-burn period

Doors, ceiling hatches, and other ventilation openings should be closed at the end of the pre-burn period.

3.5.4 Duration of test

3.5.4.1 Pre-burn time

Fires should be ignited such that the following burning times occur before the start of agent discharge:

.1 sprays - 5 to 15 s

.2 trays - 2 min

.3 crib - 6 min

3.5.4.2 Discharge time

Aerosol agents should be discharged at a rate sufficient to achieve 85% of the minimum design density in 120 s or less.

3.5.4.3 Hold time

After the end of agent discharge the test enclosure should be kept closed for 15 min.

3.5.5 Measurements and observations

3.5.5.1 Before test

.1 temperature of test enclosure, fuel and engine mock-up;

.2 initial weights of agent containers;

.3 verification of integrity agent distribution system and nozzles; and

.4 initial weight of wood crib.

3.5.5.2 During test

.1 start of the ignition procedure;

.2 start of the test (ignition);

.3 time when ventilating openings are closed;

.4 time when the extinguishing system is activated;

.5 time from end of agent discharge;

.6 time when the fuel flow for the spray fire is shut off;

.7 time when all fires are extinguished;

.8 time of re-ignition, if any, during hold time;

.9 time at end of hold time; and

.10 at the start of test initiate continuous monitoring as per 3.2.4.

3.5.6 Tolerances

Unless otherwise stated, the following tolerances should apply:

.1	length	±2% of value;
.2	volume	±5% of value;
.3	pressure	±3% of value;
.4	temperature	±5% of value; and
.5	concentration	±5% of value.

These tolerances are in accordance with ISO standard 6182/1, February 1994 edition 4.

4 Classification criteria

4.1 Class B fires should be extinguished within 30 s of the end of agent discharge. At the end of the hold period there should be no reignition upon opening the enclosure.

4.2 The fuel spray should be shut off 15 s after extinguishment. At the end of the hold time, the fuel spray should be restarted for 15 s prior to reopening the door and there should be no reignition.

4.3 The ends of the test fuel trays should contain sufficient fuel to cover the bottom of the tray.

4.4 Wood crib weight loss should be no more than 60%.

4.5 A reignition test should be conducted after the successful extinguishments of the tell tale fires in Test 1 (Fire A) within 30 s after completion of agent discharge. The test should involve the attempted ignition of two of the tell tale fire containers. One container should be at the floor level and the other at the ceiling level at the diagonally opposite corner. At 10 min after extinguishment of the fires, a remotely operated electrical ignition source should be energized for at least 10 s at each container. The test should be repeated at one min intervals four more times, the last at 14 min after extinguishment. Sustained burning for 30 s or longer of any of these ignition attempts constitutes a reignition test failure.

5 Test report

The test report should include the following information:

.1 name and address of the test laboratory;

.2 date and identification number of the test report;

.3 name and address of client;

.4 purpose of the test;

.5 method of sampling system components;

.6 name and address of manufacturer or supplier of the product;

.7 name or other identification marks of the product;

.8 description of the tested product;

  .1 drawings;

  .2 descriptions;

  .3 assembly instructions;

  .4 specification of included materials; and

  .5 detailed drawing of test set-up;

.9 date of supply of the product;

.10 date of test;

.11 test method;

.12 drawing of each test configuration;

.13 identification of the test equipment and used instruments;

.14 conclusions;

.15 deviations from the test method, if any;

.16 test results including measurements and observations during and after the test; and

.17 date and signature.

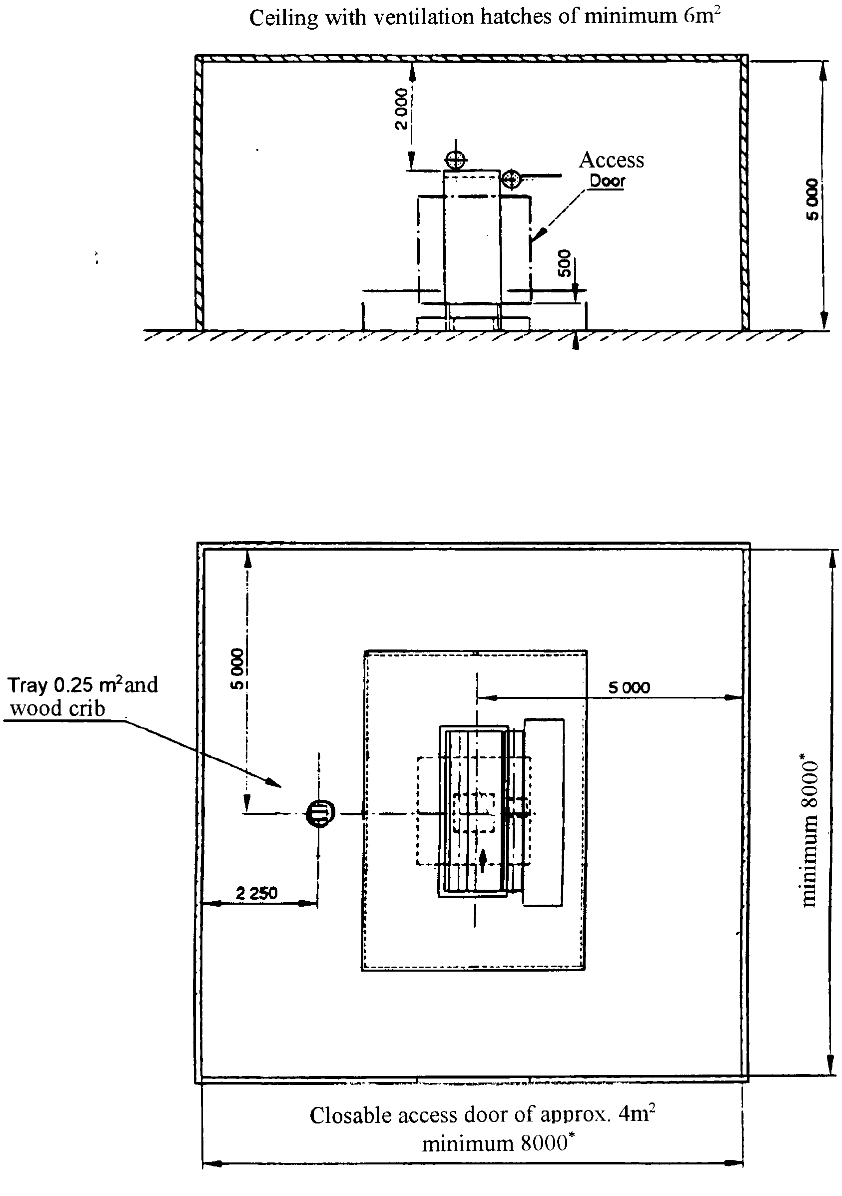

Figure 1

*The area should be $100m^2$

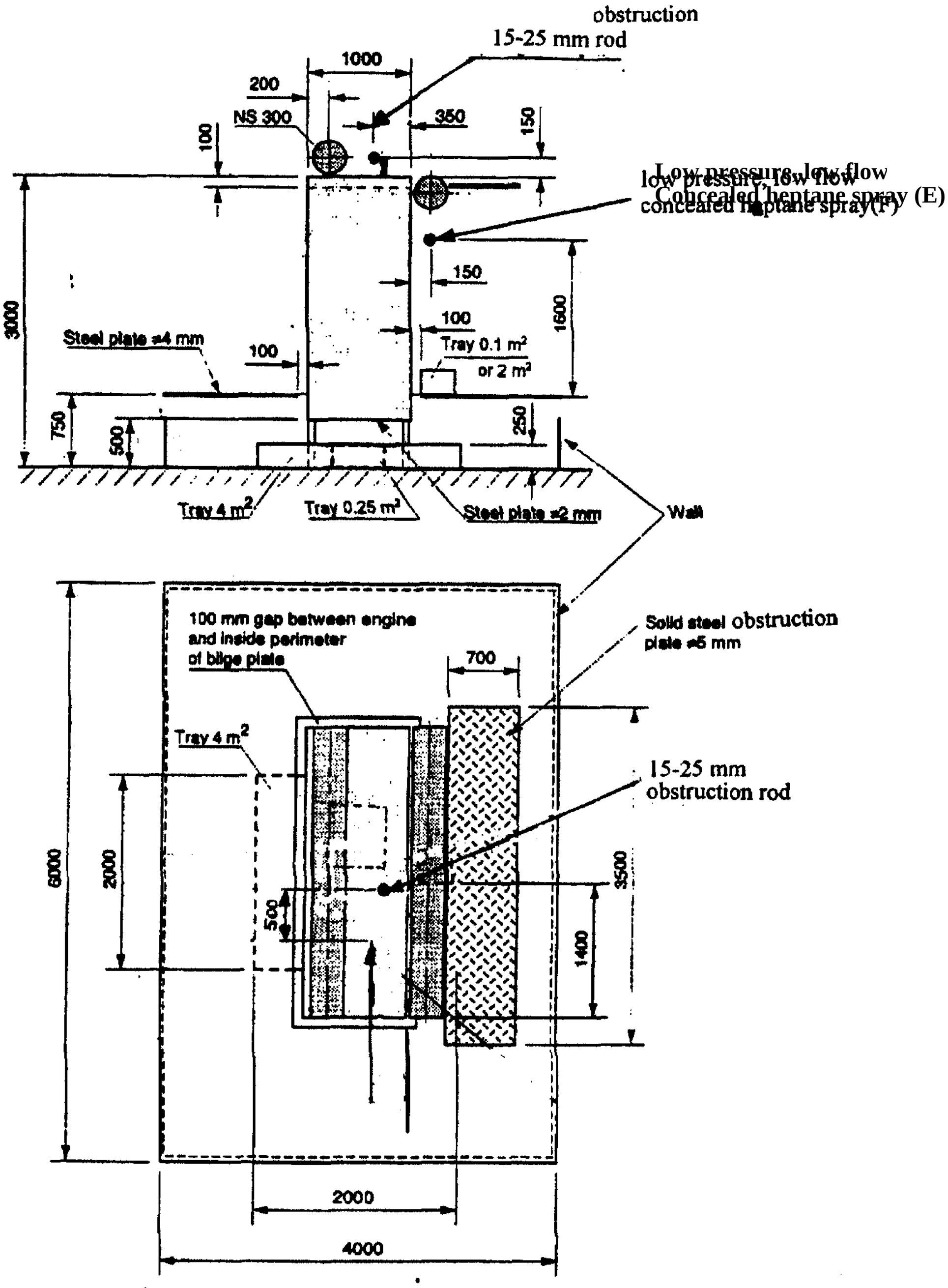
obstruction
15-25 mm rod
1000
200
NS 300
350
100
150
Low pressure, low flow
Concealed heptane spray (E)
low pressure, low flow
concealed heptane spray(F)
150
100
1600
3000
Steel plate ≠4 mm
100
Tray 0.1 m²
or 2 m²
750
500
250
Tray 4 m²
Tray 0.25 m²
Steel plate ≠2 mm
Wall
100 mm gap between engine
and inside perimeter
of bilge plate
700
Solid steel obstruction
plate ≠5 mm
Tray 4 m²
15-25 mm
obstruction rod
6000
2000
500
3500
1400
2000
4000

Figure 2

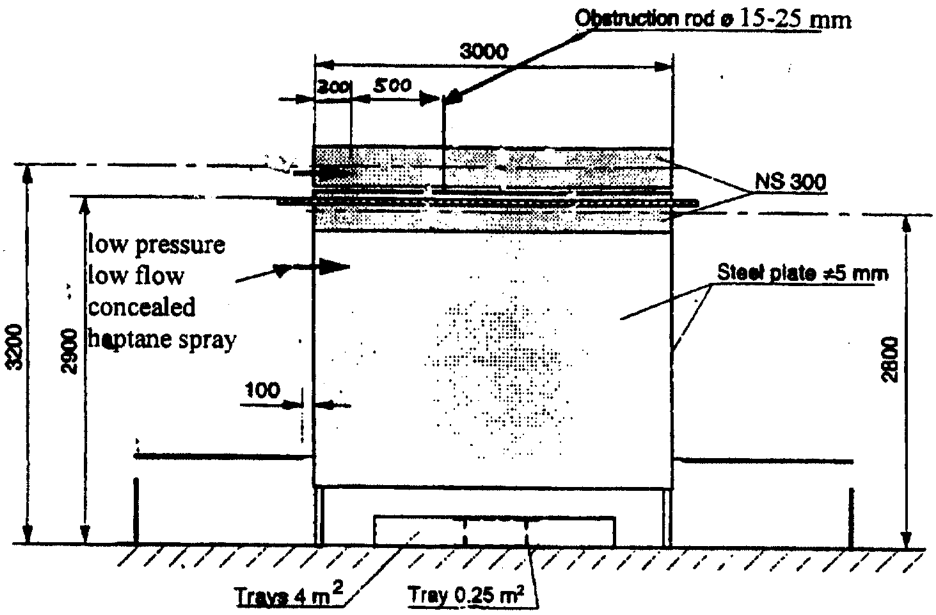
Obstruction rod ø 15-25 mm
3000
300
500
NS 300
low pressure
low flow
concealed
heptane spray
Steel plate ±5 mm
3200
2900
2800
100
Trays 4 m2
Tray 0.25 m2

Figure 3

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ANNEX 9

PROPOSED REVISED WORK PROGRAMME OF THE SUB-COMMITTEE AND PROVISIONAL AGENDA FOR FP 46

Revised work programme of the Sub-Committee

		Target completion date/number of sessions needed for completion	Reference
1	**Analysis of fire casualty records**	Continuous	FP 45/16, section 10; FSI 8/19, section 11
~~H.1~~	~~**Guidelines on alternative design and arrangements for fire safety**~~	~~2001~~	~~FP 44/19, section 4 and paragraph 16.1.4~~; ~~MSC 72/23, paragraph 21.21.1~~
~~H.2~~	~~**Fire-fighting systems in machinery and other spaces**~~	~~2001~~	~~FP 43/18~~, ~~paragraph 8.1~~; ~~FP 44/19, section 9 and paragraph 16.1.2.2~~
~~H.3~~ H.1	**Recommendation on evacuation analysis for new and existing passenger ships** ~~**and high-speed passenger craft**~~	2002	MSC 73/21, paragraph 4.16; FP 45/16, section 3
~~H.4~~ H.2	**Unified interpretations of SOLAS chapter II-2 and related fire test procedures**	2002	~~FP 43/18, paragraphs 5.7, 7.25 and 15.3.5.1;~~ FP 44/19, section 6 and paragraph 16.1.2.6 FP 45/16, section 6
L.1	~~**Role of the human element:**~~ **Revision of resolution A.654(16)** ~~**on Graphical symbols fire control plans**~~	~~2001~~ 2003	FP 41/22, section 12; FP 45/16, section 11
~~L.2~~	~~**Fire-test procedures: fire-retardant materials for the construction of lifeboats**~~	~~2002~~	~~FP 43/18, paragraph 15.3;~~ ~~FP 44/19, section 8 and paragraph 16.1.2.4~~

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Notes: 1 "H" means a high priority item and "L" means a low priority item. However, within the high and low priority groups, items have not been listed in any order of priority.

2 The struck-out text indicates proposed deletions and the shaded text shows proposed additions or changes.

3 Items printed in bold letters have been selected for the provisional agenda for FP 46.

		Target completion date/number of sessions needed for completion	Reference
~~L.3~~ L.2	**Development of guidelines for ships operating in ice-covered waters** (co-ordinated by DE)	~~2001~~ 2003	MSC 71/23, paragraph 20.43; FP 45/16, section 9
~~L.4~~ L.3	**Smoke control and ventilation**	2002	FP 39/19, section 9; FP 45/16, section 5
~~L.5~~ L.4	**Revision of resolution A.602(15)**	2002	FP 45/16, section 12; MSC 72/23, paragraph 21.21.2

Draft provisional agenda for FP 46*

Opening of the session

1 Adoption of the agenda

2 Decisions of other IMO bodies

3 Recommendation on evacuation analysis for new and existing passenger ships

4 Smoke control and ventilation

5 Unified interpretations to SOLAS chapter II-2 and related fire test procedures

6 Development of guidelines for ships operating in ice-covered waters

7 Analysis of fire casualty records**

8 Revision of resolution A.654(16)

9 Revision of resolution A.602(15)

10 Work programme and agenda for FP 47

11 Election of Chairman and Vice-Chairman for 2003

12 Any other business

13 Report to the Maritime Safety Committee

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* Agenda item numbers do not necessarily indicate priority.

** Item under continuous review.