ICHCA International Limited

INTERNATIONAL SAFETY PANEL

GENERAL SERIES #2

FIRE FIGHTING

IN PORTS AND ON SHIPS

BY JEFF HURST

ICHCA International Limited

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ICHCA International Limited	*Tel:*	*+44 (0) 1708 735295*
Suite 2, 85 Western Road,	*Fax:*	*+44 (0) 1708 735225*
Romford, Essex, RM1 3LS	*Email:*	*info@ichcainternational.co.uk*
United Kingdom	*Website:*	*www.ichcainternational.co.uk*

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This publication is one of a series developed by the International Safety Panel ("Safety Panel") of ICHCA International Limited ("ICHCA"). The series is designed to inform those involved in the cargo-handling field of various practical health and safety issues. ICHCA aims to encourage port safety, the reduction of accidents in port work and the protection of port workers' health.

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ABOUT THE AUTHOR

Jeffrey Hurst
Chartered Safety Practitioner

An Incorporated Engineer, registered with the U.K. Engineering Council, Member of the Institution of Plant Engineers, Society of Operating Engineers, Chartered Fellow of the Institution of Occupational Safety & Health, Fellow of the International Institute of Risk and Safety Management. Originally trained as an industrial chemist he was employed at the Port of Felixstowe from 1970 to 2006. Until 1993 he was Terminal Manager for Felixstowe Tank Developments Ltd. (FTD), which provides bulk liquid storage facilities at the Port of Felixstowe.

He was a Director of FTD and, Head of Health and Safety for Hutchison Ports UK until 2006 He has been a Member of the International Safety Panel of ICHCA since 1997.

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The original idea for this pamphlet came from Bob Baron of Baltimore. He was a founder member of the Panel, its deputy chairman for many years, an international advisor on firefighting and fire prevention and a dedicated, volunteer fire fighter in his home town. Bob sadly passed away in 2003 before he could develop this work and, with the agreement of the author, this document is dedicated to him.

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FIRE FIGHTING IN PORT AND ON SHIPS

1 INTRODUCTION

1.1 Underwriter's records show that there have been over eight hundred ships destroyed by fire in the two hundred years since 1800. In actual fact this figure is probably much higher, because many ships in the early years were not insured.

1.2 This premise is supported if we consider that in the ten years from January 1965 to January 1975, 300 ships were either lost by fire or suffered such severe damage as to be declared constructive total losses. Of even greater significance is that over one hundred of these ships were in port when the fires occurred.

1.3 It is also of note that between 1941 and 1975, in North America alone there were some fifty seven major fire related disasters in port installations. Among the causes of these fires were faulty electrical wiring, uncontrolled hot work, spontaneous heating of cargo and the careless disposal of smoking materials.

1.4 In the past one hundred years by far the worst disasters involving fire and explosion in ports have been:-

1.4.1 1917–Halifax Nova Scotia – the French freighter '*Mont Blanc*', loaded with high explosives, destined for Europe, was rammed by the Belgian freighter '*Imo*' when entering the harbour to join a convoy, which included the cruiser HMS '*High Flyer'*. Approximately fifteen minutes after the collision the cargo exploded, destroying about 50% of the city of Halifax. It is estimated that over three thousand people died and more than seven thousand were injured.

1.4.2 1944 – Bombay India – A 7000 ton British freight vessel *'Fort Stikene'* was discharging a mixed cargo of TNT, cotton, dried fish, ammunition and other high explosives. A fire was discovered in the baled cotton in a lower hold. The crew stopped work and tackled the fire. Forty minutes later the local fire brigade was told that a ship loaded with explosives was on fire. They arrived to find smoke pouring from the ship. The cotton in the hold was well alight. Despite their best attempts to extinguish what was, in cotton, a fairly routine fire, after about two and a half hours the fire spread to the boxes of TNT which began to burn. Some twenty minutes later there was a colossal explosion and the ship blew up. The force was such that her boiler was found half a mile away intact. A tidal wave ensued, and a second explosion thirty minutes later involved other vessels. After this over twenty five vessels were on fire in all. Over eight hundred and fifty people in all were killed and two thousand injured. Twelve ships were lost, totalling fifty thousand tons, and a further fifty thousand tons severely damaged.

1.4.3 1947 – Texas City, USA – the French vessel *'Grandcamp'* was loading two thousand three hundred tons of ammonium nitrate fertiliser. A fire started, and at first only first aid fire fighting methods were used. Fear of cargo damaged prevented the crew from using water, so steam smothering was tried. However, after a very short time the hatch covers blew off, and the fire intensified. After about thirty minutes the local fire brigade were called. Despite their best efforts, just one hour after the signs of fire were first noted the ship exploded, disintegrating completely. Secondary fires involved other buildings and ships and the local chemical works. Another ship, carrying ammonium nitrate and sulphur was carried from her moorings and collided with another ship. Both these vessels exploded some sixteen hours later, and debris caused further fires in several local tank farms. A state of emergency was declared by the Governor of Texas. Over five hundred people were killed, three thousand were injured, and two thousand had their homes damaged. The financial loss at the time was estimated at sixty seven million dollars.

1.5 Other notable fires in ports have been

- 1948 – Amsterdam, NL; the Amerika Australie Cold Store Warehouse
- 1949 – Bootle U.K; the Gladstone Dock Fire
- 1951 – Baltimore USA; the Baltimore Pier Fire which also caused the loss of the George Washington.
- 1953 – Durban S.A; the Maydon Wharf Fire.
- 1954 – Zaandam, NL: the Nederland Warehouses fire
- 1956 – New York USA; the Luckenbach Pier Fire

1.5 A study of the reports of these and more recent fires involving fires in ports, both aboard ship and ashore reveals that much could have been done to reduce the risk of fire and explosion, and to mitigate the effects of the fire. The basic elements of

- fire prevention
- fire protection
- permits to work
- training
- co-operation between authorities
- emergency planning
- risk assessment

would all assist in this purpose

2 SCOPE

2.1 This publication identifies the essential elements that contribute to a comprehensive port fire fighting response programme.

2.2 Subjects to be considered include:-

- pre-fire planning,
- training,
- vessel familiarisation for land based firefighters
- special hazards.

2.3 Limitations on the size of the document preclude detailed guidance on these issues and indeed on the selection of equipment.

2.4 Reference will be made within the text to source documents where reference will be found.

3 OVERVIEW

3.1 First it should be made clear that in the context of this document major fires are being discussed, ie. those that cannot be put out with a fire extinguisher.

3.2 Fire can be devastating on a ship, particularly a passenger vessel, where large numbers of people may need to be evacuated, or on a ship containing flammable cargo, with serious risks to crew members or to Ports or harbours.

3.3 Thus Port Management are faced with a number of responsibilities and decisions, when a shipboard fire occurs. The decisions that are made will affect the lives of personnel, the free flow of trade and ultimately the profitability of those companies operating within the Port, including the Port Operator.

3.4 Port incidents can provide in one scenario fires, explosions, leakages, spillages and people unaccounted for.

3.5 The tactics and strategies utilised to attack a fire aboard a vessel are in many ways similar to those used routinely in attacking structure fires. Because of the unique environment occurring aboard a vessel however, there are many aspects which require special attention.

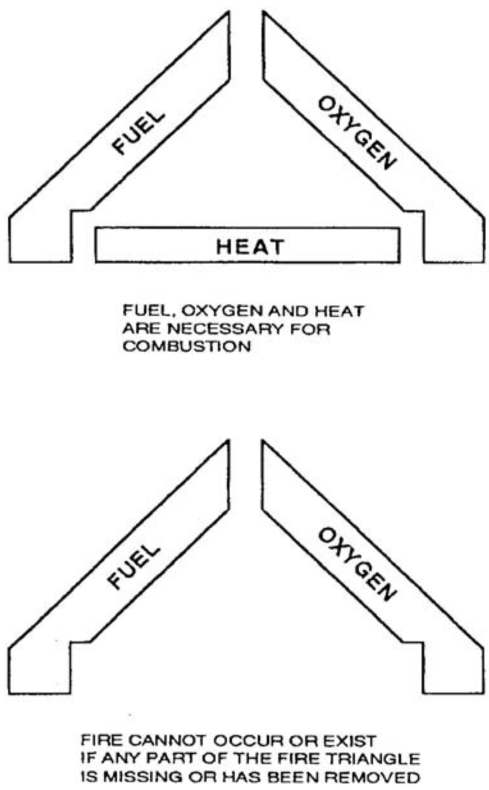
3.6 Percentage wise major fires aboard ship or in port happen rarely however, and consequently few fire-fighters are experienced in such fires.

3.7 Fires aboard ship should be approached in a quick but safe and prudent manner, in a similar way to hazardous substance incidents. It is better to proceed slowly and carefully than to react too quickly, increasing risks and jeopardising success.

4 FIRE THEORY

4.1 General – Fire is a chemical reaction known as combustion. It is defined as rapid oxidation of combustible material accompanied by a release of energy in the form of heat and light.

4.2 Fire Triangle – For years, a 3-sided figure called the **fire triangle** has been used to describe the combustion and extinguishing theory. This theory states that proper proportions of oxygen, heat, and fuel are required for a fire. If any one of the 3 elements is removed, a fire will cease to exist (see below)



Fire Triangle

4.3 A new theory has been developed to further explain fire combustion and extinguishment. This theory can be represented by a 4-sided geometric figure, a tetrahedron. The base of this figure represents a chemical reaction. The 3 standing sides of the figure represent heat, oxygen and fuel. Removing one or more of the 4 sides will make a tetrahedron incomplete and cause a fire to be extinguished.

5 CLASSIFICATION OF FIRES AND FUEL SOURCES

5.1 Class A – This class of fire involves common combustible materials. Fuel sources within this class include wood and wood-based materials, cloth, paper, rubber and certain plastics.

5.2 Class B – This class of fire involves flammable or combustible liquids, flammable gases, greases and similar products. Fuel sources within this class include petroleum products.

5.3 Class C – This class of fire involves energised electrical equipment, conductors, or appliances.

5.4 Class D – This class of fire involves combustible metals. Fuel sources within this class include sodium, potassium, magnesium and titanium.

6 EXTINGUISHING AGENTS

6.1 General – Extinguishing agents are defined as anything that eliminates one or more "sides" of a fire tetrahedron. When any one is removed, fire can no longer exist.

6.2 How it works – Extinguishing agents put out fires by breaking one or more of the 4 elements of a fire tetrahedron. They work by cooling, smothering, chain breaking or by a process called oxygen dilution.

- **Cooling** reduces the temperature of a fuel source below the fuel's ignition point.
- **Smothering** separates a fuel source from its oxygen supply.
- **Chain Breaking** disrupts the chemical process necessary to sustain a fire. The element of a chain that is broken depends upon the class of fire and the type of extinguishing agent used.
- **Oxygen Dilution** is a smothering process that reduces the amount of oxygen available to a level below that required to sustain combustion.

6.3 A standard classification for fire types, dependent upon the fuel source for each class, the type of extinguishing agent for each class, and the primary effect of each agent has been developed and is recognised internationally. This system is described in the table below.

Class	Fuel Sources	Primary	Primary

		Extinguishing Agent	Effect
A	Common combustible materials such as wood and wood based materials, cloth, paper, rubber and certain plastics	Water Dry Powder	Removes the heat element
B	Involves flammable or combustible liquids, flammable gases, greases, petroleum products and similar products	Foam, AFF (Aqueous Film Forming Foam) CO^2 PKP (dry powder)	Removes the oxygen element
C	Involves energised electrical equipment, conductors, or appliances	CO^2 (Carbon Dioxide) PKP (Dry Powder)	Removes the oxygen element and temporarily removes elements of oxygen and heat
D	Involves combustible metals, such as sodium, potassium, magnesium and titanium	Water (high velocity fog) Sand (placed underneath the metal)	Removes the heat and oxygen elements

7 REGULATORY BACKGROUND

7.1 Aboard Ship

7.1.1 The first fire protection requirements for international shipping were developed as part of the 1914 SOLAS Convention which was introduced as a result of the sinking of the Titanic in 1912. It contained basic fire safety requirements which were later carried over to the 1929 SOLAS Convention.

7.1.2 Whilst these Conventions and those of 1948 and 1960 did contain fire safety requirements, they proved inadequate for passenger ships, and in the 1960s there were a series of fires aboard international vessels of this type.

7.1.3 The 1974 Convention (still in force today, but amended) separated the fire requirements into a separate chapter.

- SOLAS, Chapter II-1 (Construction - which dealt with structure, sub division and stability, machinery and electrical requirements and

- SOLAS, Chapter II-2 on Construction – Fire protection, fire detection and fire extinction.

7.1.4 The 1974 SOLAS required all new passenger ships to be built using non-combustible materials and to have either a fixed fire sprinkler system or fire detection system installed. Requirements for cargo ships were also updated with special regulations for specific types of cargo ships such as tankers.

7.1.5 Amendments have been made to the 1974 Convention in 1981, 1992, 1996 and 2000.

7.1.6 The 2000 amendments revised SOLAS Chapter 11-2. System related technical requirements were moved to a new International Fire Safety Systems Code, the remaining regulations start with prevention, detection and suppression, following all the way through to escape. It includes a new Part E that deals exclusively with human element matters such as training, drills and maintenance issues.

7.1.7 The reason for having a separate code was to make a distinction between statutory requirements, which belong in the convention and are meant for the administration, and technical provisions which are there for application by engineers and manufacturers.

7.1.8 The FSS Code provides International Standards for Fire Safety Systems required by the revised SOLAS, Chapter II-2 under which it is mandatory. it consists of 15 chapters, each addressing specific systems and arrangements, except for Chapter 1 which contains several definitions and also general requirements for approval of alternative designs and toxic extinguishing media.

7.1.9 Whilst the new Chapter 11-2 in general applies to all ships constructed on or after 1 July 2002, there are certain parts which apply to ships constructed before that date.

7.1.10 These include the provision of emergency escape breathing apparatus in all machinery spaces, and accommodation for all ships. Fire safety operations manual and training booklets (instructions relating to fire safety systems) must be provided in crew mess-rooms. See Annex I for a summary of SOLAS, Chapter II (2) and the International Fire Safety Systems Code.

7.2 <u>Ashore</u>

7.2.1 Unfortunately there are no International Conventions or Codes which place a legal obligation on Port Authorities, owners, operators or Government Departments to provide fire fighting facilities of a minimum standard in areas where marine fire fighting may be required.

7.2.2 Many countries, however, have specific legislation such as the Federal Fire Prevention and Control Act 1974 (US) and the Fire and Rescue Services Act 2004 (UK) which state which Government State or Metropolitan Authority is responsible for fighting ship alongside fires and/or providing assistance to vessels at sea.

7.2.3 In addition of course, the National Fire Prevention Association (NFPA) Codes (US), the Building Regulations – Fire Safety, and Manuals of Firemanship (UK) provide both schedules of equipment required, and guidance on fire fighting for land based fire fighters in a Port environment. These include the NFPA 1405 Guide for Land Based Fire Fighters who respond to Marine vessel fires.

7.2.4 A schedule of relevant NFPA Codes is attached as Annex 2.

8 OPERATIONAL FIREFIGHTING PRIORITIES – WHAT AND HOW?

The priorities for shipboard fire fighters at a marine fire incident are listed below in order of importance:

8.1 Rescue – The saving of life must always be the first consideration in any emergency situation. When lives are in danger the Incident Commander should immediately assess what needs to be done and the hazard to the rescue team.

8.2 Exposures – The fire should be fought so as to prevent the spread of fire. Typical exposures include flammable liquid or gas tanks, open stairways, explosive or any other accelerant. If there is no danger of water reactivity, exposures are best cooled by the application of a water fog until no visible steam is generated. In some cases foam may be an appropriate agent for exposure protection.

8.3 Confinement - Control over the fire must be established by restricting its spread. To facilitate this normally all closures and all ventilation (unless persons are trapped), should be secured. Boundary cooling should take place on all six sides of the fire (above, below, for, aft, port, starboard).

8.4 Extinguishment - The main body of the fire should be attached and suppressed. The object is to stop combustion by disrupting the fire tetrahedron. Tactics and agents to be used may be determined by the fuel source, amount and the location of the fire.

8.5 Overhaul (Damping down) - Actions to complete incident stabilisation and begin to shift to property conservation should be carried out in any overhaul. Key considerations re: checking for concealed fire (structural integrity, hazardous materials and of gassing off gassing of debris. Overhaul should begin at the seat of the fire and work outwards. Once the fire is extinguished the application of positive pressure ventilation to any enclosed areas will greatly assist the progress.

8.6 Stability - The use of water for fire fighting can significantly alter the centre of gravity of a vessel, thus having a detrimental effect on the stability

8.7 Dewatering - Is an essential planning issue for successful vessel fire fighting to ensure vessel stability is maintained. However oil and hazardous materials may enter the waters during fire fighting and de watering operations. Pollution response should be considered at this stage of planning and accommodation for all ships.

9 PERSONNEL

There will be two distinct groups of people who will respond to a shipboard fire. These will be ships crew and land based fire fighters, either full time or part time. Some questions that need to be considered for the purpose of this publication, arise from the fundamental difference between these groups and indeed the very culture and ethos of the group.

If faced with the same scenario the two groups would exhibit a widely differing set of goals, strategies and answers to problems. They also would usually have a vastly different range of equipment and skills to work with when confronting a fire.

9.1 **Ships Crew** -The primary purpose of a ship's fire fighting team is to save the ship in order to stay alive. The concept of saving property is fairly low down on the priority list. From the ships crew point of view, the safest course of action is to fight the fire until they either extinguish it or the threat of death by fire becomes greater than death by drowning.

9.1.1 Finding your way through a network of often dark, smoke filled passageways is a difficult task. In the normal way of things a professional ship's crew are aware of their vessel construction. They know the location of exits, vents and fire systems. They should know what types of stresses and loads the ship's structure is capable of withstanding. A knowledge of stability will ensure that actions taken to put out the fire do not cause the loss of the vessel.

9.1.2 Details of cargo ship construction and other details are readily available to the crew, but not necessarily to land based fire fighters.

9.1.3 Two options exist for ships crew fighting a fire on a ship - indirect and direct attack.

- Indirect attack is the strategy of delaying the fire's spread by closing off ventilation, followed by the application of a fire- extinguishing agent, not on the seat of the fire itself, but in the general area. A word of caution here, whilst some fires can be put out by indirect attack, it is an uncertain process. An indirect attack will buy you time, if nothing else to arrange a direct attack, call for help or abandon ship.

- Direct attack involves directing the fire fighter to the seat of the fire to kill it. Breathing apparatus and fire proof dowsing hoses are all called into play.

9.1.4 These two methods are normally exclusive of each other, because with a direct attack heat and smoke need to be vented, otherwise your fire team's effectiveness will be reduced. But of course the increased ventilation will allow the fire to spread.

9.1.5 An indirect attack usually requires shutting off ventilation.

9.1.6 A direct attack is also the most dangerous, and unless the crew is equipped and truly prepared, both mentally and physically, it is better to prosecute an indirect attack.

9.1.7 In all probability most ship's crews are ill prepared for a direct attack on a major fire. Therefore crews should limit themselves to indirect attacks. Breathing apparatus and fire proof clothing should only be used to rescue trapped personnel, or similar limited tasks.

9.2 **Land Based Fire Fighters** - This term includes Coastguard Fire Fighters, Volunteer Fire Departments, Harbour Authority Fire Departments, Local Authority Fire Departments, State, National and Military Fire Departments and County Fire Services.

9.2.1 The primary goal, and in some countries and jurisdictions, the legal duty, of land based fire fighters are:

- To protect life.
- To protect property.
- To protect the environment.

9.2.2 Whether a professional fire fighter or retained (volunteer), his commitment as a fire fighter is such that he will have made a conscious decision to help others.

9.2.3 If lives are at risk fire fighters will place themselves in harms way to protect others. However, generally professionally trained fire fighters will carry out a risk assessment that balances the risk against the benefit, generally this means that professional firefighters will :-

- Take risks to save saveable lives – ie. enter a burning building with an uncontrolled fire inside, in breathing apparatus (SCBA) and turnouts/ protective clothing (fire proof coats, trousers, helmets, gloves etc.), if they believe a person is trapped inside the property (person reported). This is a justifiable risk.

- Take a small risk to save a saveable property, i.e. when a building has a fire inside but it is not consumed or compromised, crews will be sent in to stop the fire and further damage.

- Take no risk to save a property or life that is already lost, ie. if a building is already fully involved and starting to show some structural compromise, then it is obvious anyone inside is going to be beyond help and the building or ship beyond saving. In this case Defensive Operations will be used to prevent the fire from spreading.

9.2.4 Land based fire fighters arriving at a ship may have no personal knowledge of the layout or arrangements in a ship. Often it is thought that because most fires are fought in buildings that fire fighters have never been in before, then going into a strange ship is similar. This is not so, a land based fire fighter is especially trained to deal with a fire in almost any type of building, but not necessarily in a ship

9.2.4 Not only have they not necessarily had any specialised maritime training, they might not have been on or in a ship before. Lack of familiarity with doors, hatches, access ways and passages becomes an issue, and make their work more hazardous. Gaining access to engine rooms deep in the ship's interior to fight fire may give special problems.

9.2.6 For example, because fire fighters must be taught to watch the duration of their SCBA air bottles and get out before the low air alarm goes off. This will ensure a safe margin of escape. However this may prove restrictive for deep penetration into the lower decks of a ship

9.2.7 Ventilation may be required or not required.

9.2.8 The simple action of putting water on a fire may cause a greater risk than the fire itself, if not properly managed.

9.2.9 In the process of climbing aboard a ship, the competence standard of a land-based fire fighter has gone from a seasoned veteran to a recruit, unless they have someone experienced to guide them.

10 TRAINING

Marine fire-fighting is a team effort. Like any team effort the participants must practise as a team. It is no good expecting a team that have spent five days practicing two years ago to be safe and successful in fighting a fire. They must be properly trained and practise frequently and thoroughly.

The very nature of the environment that they are working in and the hazards that they will face therein means that they have to be able to operate independently, and be well trained enough to continue to operate should the team leader be incapacitated.

10.1 The different range of competencies of these two groups of responders throw up the fundamental differences in their training needs.

10.2 To effectively fight shipboard fires whilst under way, ships crews need to be trained with the skills and equipment of professional fire fighters.

10.3 To respond to fires aboard ship whilst in port land based fire fighters need to learn the marine skills and knowledge of ships commonly found in mariners in addition to their professional fire fighting skills.

10.3 Shipboard fire fighting also requires a variety of specialised equipment. All fire fighting personnel shall be able to use this equipment.

10.4 To train in this way successfully will require several things:

- Development of an appropriate lesson plan.
- Development of training standards.
- Funding.
- Availability of quality training.
- Sharing of resources
- Practice, practice, practice

10.5 Topics covered during training should include:

10.5.1 Importance of vessel location

10.5.1.1 Mooring locations

- Structural flammability
- Water supply
- Access – marine and land
- Risk to navigation
- Risk to vessels, facilities and people

10.5.1.2 Anchorage or grounding locations

- Bottom material
- Water depth
- Environmental conditions

10.5.2 Operational Fire fighting Priorities (see Section 8)

10.5.3 Vessel stability considerations

- Consultation – finding the 'expert'
- Factors affecting stability
- Stability effects on fire fighting
- Vessel factors
- Vessel documentation
- Water discipline
- De-watering
- Counter flooding

10.5.4 Fixed Fire fighting systems

- Fire mains
- Water sprinklers
- Carbon dioxide and other smothering systems
- Foam systems

10.5.5 International Ship/Shore Connection

- See Annex 3

10.5.6 General tactics for common vessel spaces

- Public and accommodation spaces
- Engine rooms and machinery spaces

10.5.7 Special Considerations for Vessel Type

10.5.7.1 Freight vessels

- Dry bulk
- Break bulk
- Container
- RoRo
- Commercial fishing vessels

10.5.7.2 Bulk Liquid Tankers

- Petroleum
- LNG/LPG
- Chemical

10.5.7.3 Passenger Vessels

10.6 The Basic Fire Fighter Training

10.6.1 The National Fire Protection Association in the United States provides an entry level training standard for professional fire fighters in NFPA 1001.This training provides:

- Basic fire science
- Fire inspection requirements
- Safety, first aid and rescue techniques
- Concepts and hands on experience in the use of breathing apparatus, ropes, fire appliances, sprinkler systems, water streams, ventilation techniques and communications during fire fighting operations.

10.6.2 Any proposed basic training scheme for maritime fire fighters should meet or exceed these standards.

10.7 Follow-up training should be intended to broaden the basic knowledge obtained and apply it to situations aboard vessels.

10.7.1 Any course should consist of classroom and fire ground exercises designed to familiarise the students further with the chemistry and physics of fire, shipboard fire fighting agents and equipment, fixed extinguishing and detection systems. In addition it should include considerations for hazardous cargoes, fire prevention, shipboard search and rescue and first aid.

10.7.2 If financially and practically possible, the example of some European and North American Seaports should be followed and a mock up ship be built. It can be electronically controlled and propane fuelled for easy operation and environmental safety. It is possible to have a number of fire simulations, engine room fire, cabin fire, generator fire, pump room fire or cracked flange/fuel spill fire. Fire teams can then be trained from the various ship operators and Fire Departments on a regular basis.

10.7.3 If this is not possible, then arrangements should be made via the Port Authority for local fire fighting teams to visit ships that are regular callers, for familiarisation. In addition it may be possible to organise 'drills' aboard these ships to simulate actual events

10.8 In addition to the above the NFPA have developed a publication called NFPA 1405 – A Guide for Land Based Fire Fighters Who Respond to Marine Vessel Fires. This was developed for use by local fire fighting organisations that may be confronted with a fire aboard a vessel. It identifies the elements required to formulate a comprehensive marine fire fighting response programme and covers all the issues discussed in this Briefing Pamphlet in detail. Copies of all their publications are available from:

The National Fire Protection Association
1 Battery March Park
Quincy, Massachusetts
02269 USA
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11 EQUIPMENT AND INFRASTRUCTURES - LANDSIDE

11.1 When equipping a Port with the resource to fight fire, the first requirement is to carry out a comprehensive risk assessment as, much will depend on the number and types of fire risk which the Port environs accommodates. This risk assessment will then allow you to match your resource availability to the type and likelihood of risk. In order to prepare such an assessment the following needs to be determined:-

11.1.1 Type of cargo handled

- Bulk liquids – chemicals, oils, fuels
- Bulk gases – LPG, LNG
- Bulk solids
- Packaged dangerous goods

- Vehicles – RoRo – cars
- Timber
- Paper – reels – pallets
- Cruise

11.1.2 Buildings

- Construction – timber – brick – modular
- Type – sheds – warehouses – offices
- Number of storeys

11.1.3 People

- Numbers
- Type – public – employees – passengers
- Location
- Escape

11.1.4 Support

- Local Authority/National Fire Service – capability, distance and intervention time
- Fire Tugs

- Industrial Fire Services – mutual aid agreements

11.1.5 Sources of Ignition

11.2 One should also always bear in mind that installation of new fire protection equipment normally requires the approval of the local regulatory jurisdiction. In most countries this implies that the local fire department will need to sign off and approve the design.

it is important however to select a standard code to be applied which is globally accepted and acknowledged for its professionalism. As such the NFPA standard may be considered the best fit because it allows for the protection of property and machinery as well as people and the environment.

11.3 In a fire situation water is a universal requirement since it has a high cooling potential for those areas around the fire, which are put at risk by heat generated by the fire.

11.3.1 Water can also be used for the manufacture of foam, which is capable of controlling and extinguishing fires. Water in fire spray foam can protect equipment and people from high radiated heat flash, and can also be used to dilute or divert toxic or inflammable vapours.

11.4 Fire fighting foam can be satisfactorily manufactured using fresh, sea or estuarine water. A most crucial factor in designing any Port fire water system is an appreciation of how that water will be deployed. this will have a direct impact on the pressure, volume and capacity of any fire fighting system.

11.4.1 For example an installation using large fixed monitors delivering foam, as on a bulk liquid jetty will need between 11 and 16 bar (1430 to 2080 kilopascals) to ensure correct foam generation and throw. If the monitors are to produce a water spray or jet cover only, the minimum pressure on the monitor is 8 bar.

11.5.2 Alternatively should hand held nozzles attached to hoses connected directly to hydrants be used the pressure should not be more than 4 or 5 bar. this is because higher pressure will cause excess jet reaction and be difficult for a man to hold.

11.4.3 Higher pressures can be handled if the hoses are fitted with a variable nozzle or passed through a mobile fire pump and the pressure on the outlet side of the pump controlled.

11.4.3 However, to have an acceptable reach with a 2 ½ " (65 mm) fire hose or mobile monitor the residual pressure (dynamic pressure at required flow rate) must be at least 6 bar (90 psig) at the point of use.

11.4.4 Fixed pipe systems in buildings can operate at pressures as low as 3.3 bars /50 psi/430 kilopascals but adequate allowance must be made for pressure drop. Sometimes a static tank feed may be required.

11.4.5 A modern fire appliance (water tender) will deliver two thousand, two hundred and fifty litres of water a minute, but may only have a capacity of 10,000 litres. Adequate capacity of fire fighting water is therefore of prime importance.

11.4.6 Fire monitors will deliver in the region of 3,200 litres per minute of water, or 500 gallons per minute of foam.

11.5 From this information it will be appreciated that an adequate supply of water must be available for both mobile and fixed systems. NFPA 307 recommends a supply duration of four hours. This is considered not unrealistic considering the requirements for damping down.

11.6 Therefore given the flow rates and capacities above, the provision of a static water supply may not be considered adequate except in the smaller, low risk applications. Similarly the provision of water from a town main will seldom provide either adequate pressure or volume at point of use.

11.7 Ports usually have a readily available source of water and because of their berthing requirements such water will be able to be pumped at all states of the tide. The additional cost of construction of the water intake and pumping system, will, if the system is properly designed and sized, provide sufficient fire fighting capacity for all stages of development of the Port.

11.8 A brief description of the design criteria for fire water pumping systems, mains and hydrants follows.

11.8.1 Reliability must be a prime factor in the design of any fire water pumps. The following factors will, of course, affect this reliability and should be borne in mind when designing a system:

- Failure of a pump driver will interrupt supply
- All equipment requires maintenance – routine or breakdown – and need out of service time
- Quick start up is always required for emergency supplies
- Start up against closed valves should be avoided as it may cause an overload in the drive and thus trip the pump

11.8.2 To avoid these issues causing problems:

- Pumps should be of the centrifugal type to avoid overload
- There should be more than one pump to ensure supply during maintenance or breakdown
- Whilst electric pumps provide fast response in case of supply failure, there should be alternative power units (diesel or gas turbine) fitted to one pump

11.8.3 To further enhance flexibility and efficiency it is preferable to have 4 pumps each at 50% duty – 2 electric, 2 other power. This arrangement would also provide further redundancy cover if each of the electric pumps have a separate supply. It is also important to ensure in these cases that the pump performance characteristics are such that they can run in parallel.

11.8.4 When installing both hydrants and fire mains it is always worthwhile considering the following:

- Above ground hydrants are generally more quickly put in service, however they are more subject to damage by terminal vehicles and weather conditions. A proper maintenance and inspection regime should be developed.

- Underground hydrants require a hydrant standpipe to be fitted into the underground outlet and have reduced visibility and are thus more vulnerable to being covered. A clear identification system should be developed as well as an inspection and testing regime.

11.8.5 The distribution and spacing of fire hydrants is influenced by the following factors:

- Site or building occupancy
- Accessibility of hydrants
- Obstructions to hose spray when using the hydrant
- Training level of the emergency response team
- The results of the risk assessment carried out under 11.1 above

11.8.6 For example, in container terminals, especially the container park, combustible loading is low, but there may be IMO classified dangerous goods stacked within the piles.

11.8.7 From a fire suppression point of view this requires that sufficient water should be available to provide cooling of containers, in addition to having water to fight the fire. This cooling capability should be possible independently of the wind direction. Insufficient cooling can result in IMO goods develop0ing very challenging fire conditions, e.g. sudden violent rupture of containers because of the radiant and reflected heat exposure.

11.8.8 Because of this exposure it is considered good practice to try and space fire hydrants in such a way that any point within a container pile can be reached by hose streams from two separate fire hydrants without excessive loss of flow by pressure drop.

11.8.8 Based on this, it is recommended to provide a fire hydrant spacing of between seventy- five and eighty metres along the fire main. Provided that the fire main is sized and served with water to ensure sufficient pressure and flow, this will enable a fire to be fought using two standard hose lengths (25 metres). Hydrants should be placed in areas that are accessible by emergency response vehicles transporting the equipment (hoses, branches, hydrant keys, standpipes etc).

11.8.8 It is advantageous to ensure adequate coverage to plot hydrant position and water throw on to a scale drawing of the area concerned. In this way it is possible to identify masked areas. In all cases of course it should be ensured that all hydrants are compatible with the equipment and fittings that the fire brigade responsible for the terminal will use.

11.9 Fundamental questions as to the size of a fire main will depend on the duty requirement and the overall length between pumping stations. However a pipeline diameter of at least 150 mm (6 inches) should be specified even for short runs. This will ensure adequate supplies to secondary pump such as mobile fire pumps, water tenders and fire appliances.

11.10 The choice of whether to install the fire main above or underground will also depend on a number of factors. These include minimum wintertime temperature, whether the system is normally wet or dry and proposed route.

11.11 If winter temperatures are such that there is a risk of freezing, and the cost of trace heating and insulating is too high, an over-ground main must remain dry. In such instances an automatically controlled valve should be fitted between the pump/underground main and over-ground main. This should be capable of remote operation so that it can be opened immediately to allow water to flow into the main. It is recommended that the time to fill the main should not exceed thirty seconds. By fitting a full bore hand operated valve bypass around the automatic valve a wet system can be operated during the summer and a dry system in winter.

11.12 Detailed specifications for the material and design of the fire mains are beyond the scope of this document. However as a general guide all underground fire mains sho9uld be constructed of High Performance Polyethylene pipe suitable for pressures up to 16 bar at 20°C. This has a 50 year lifespan. This pipe should be fusion welded. Filters should be of ductile iron with cement mortar lining, wrapped in protective petroleum jelly coated scrim tape. Concrete plinths should be fitted below all hydrants and valves to support them and avoid stressing the polyethylene pipe-work.

11.12.1 In addition all changes of direction of pipelines should be provided with specially designed concrete anchor or thrust blocks to prevent pipeline distortion and joint separations. Trenches should be graded to provide support for the pipe along the entire length of the mains and should be laid on a granular bed and backfilled.

11.12.2 Overground pipe should be made of mild steel or stainless steel to the appropriate specification for the duty. Stainless steel is more expensive initially but normally has longer service and maintenance cost. Pipe supports should be of adequate strength and fitted with rollers to allow movement. Fittings should be full bore cast or stainless steel. concrete anchor or thrust blocks should be fitted in a similar manner to that discussed above.

12 FIXED FIRE SUPPRESSION EQUIPMENT- LANDSIDE

12.1 The type and number of monitors fitted to permanent locations within a Port will (if any) depend on the outcome of the risk assessment. However there are certain basic questions regarding the purpose of the monitors. Is it to:-

- wet all vertical and horizontal surfaces likely to be exposed to the heat of a fire and so minimise the damage by removing heat?
- provide personal protection only – to provide a water curtain on a restricted escape route and thus allow personnel, otherwise trapped, to escape?
- apply foam in sufficient quantities to bring a fire on a vessel superstructure under control and extinguish it?

12.1.1 Once these questions are answered, others will then arise, such as:

- Monitor height?
- Throw distance required?
- Elevation and depression?
- Remote operation capability (preferred)?

12.2 Once again the decision as to whether it is necessary to provide fixed sprinkler systems, either water or foam will depend on both the risk assessment and/or local legislation.

12.2.1 NFPA 13 provides a guide to the minimum requirements for the design and installation of the automatic fire sprinkler systems and exposure protection sprinkler systems.

12.2.2 NFPA 16 provides a similar guide for foam water sprinkler and spray systems.

12.2.3 A note of caution with sprinklers, the risk of damage from fire should be balanced against the risk of damage to the cargo (say paper reels or pallets) from water emitted from malfunctioning or frost damaged sprinklers.

12.2.4 In some cases where the risk from fire is considered low and the risk from water damage high, warehouse hose reel and sprinkler systems may need to be disconnected and blanked off. In these cases adequate automatic fire alarm systems and portable extinguishers may be considered an alternative and approved as such by insurers.

13 MOBILE FIRE SUPPRESSION EQUIPMENT -SHORESIDE

13.1 Mobile Monitors offer extreme flexibility of use to fire fighters. They can be set up to provide boundary cooling or personal protection. They can also be used to provide air foam solution for oil fire and flammable liquid fires, or water fog, spray or stream for Class A or B fires.

13.1.1 There are a number of types of this equipment available, both new and second-hand. The ideal unit should feature the ability to focus its jet stream, long distance throw at maximum pressure, free horizontal and vertical rotation and a self aspirating concentrate device. It should be able to be used in combination with all kinds of fire fighting truck, fire fighting boat, or fixed fire pump.

13.2 The need for mobile fire fighting equipment to be operated and manned by the Port Authority will depend on the result of the risk assessment. The design and equipment on fire trucks and ladder trucks will vary from country to country, but in general the following generic type of vehicle may be required.

13.2.1 The Fire Engine (US) / Water Tender (UK) is the standard and familiar piece of equipment of all fire services all over the world, carries a crew of up to six including OC, ladders of various sizes and about 2,000 litres of water. A rear locker contains the pump and other equipment is carried in side lockers. This includes breathing apparatus, portable pumps, axes, hammers, bars and other hand tools, hydraulic pumps and cutters, branches (hose nozzles), air bags for rescue. In some cases, in Ports also dry suits, buoyancy aids, lifejackets, floating throw lines are carried.

13.2.2 Turntable ladders and hydraulic platforms (UK) /Aerial Truck Apparatus (US) is usually a tractor-trailer unit in the US and may consist of a truck with three or four sections of straight ladder of up to 75 feet each. In the UK this tends to be about 30 metres or 100 feet. An elevating platform or snorkel consists of a hydraulically operated articulating boom with a passenger platform or basket. Both types can be used for search and rescue, ventilation and damping down (overhaul). However in Ports they can also be used as a water tower via a large monitor at the top, a rescue ladder, a sling rescue and to recover injured personnel from cranes.

13.2.3 A Hazardous Materials Rig is a specialised unit equipped to handle hazardous material at incidents such as chemical spills. They may be staffed by specialist crew and carry extra equipment such as BA, gas tight suits and a decontamination unit.

13.2.4 A Foam Tender is usually assigned to duties when protection of tank farms is required, or other petrochemical risks. They may carry light water and foam concentrate and can produce low, medium and high expansion foam.

13.2.5 The design of Fire Rescue Marine Vessels will vary across the world, depending on duty. However a typical vessel for a port will probably be between 30 and 40 feet long. It will have the ability to pump up to 4,500 litres of sea-water per minute using either a bow monitor or by connecting fire hoses to deck mounted stand pipes. They may also be adapted to pump water out of sinking vessels. Later craft are often fitting with Automatic Direction Finders (ADF), which allow the rescue vessel to home in on distress signals as well as GPS and radar. They are as standard equipped with SCBA, SCUBA and medical equipment.

13.2.6 Many Ports around the world have a complement of ocean or harbour tugs. These may be privately owned or operated by the Port or Local Government. Many of these are filled with fire fighting equipment and materials such as 3,500 LPM electric pumps and monitors, manifolded hydrants and foam stocks. In the absence of fire rescue vessel it may be possible for the Harbour Authority to enter into a contract with the tug company to provide contracted response with a certain timescale.

14 FIRE-FIGHTING EQUIPMENT SHIPSIDE

14.1 The fire main system is the primary tool for defending the vessel from fire. There are two basic design of fire main system, the single main and the looped main.

14.1.1 The looped (or ring) main has the advantage that sections can be isolated without disrupting services to stations beyond the isolated section. Water-pressure is provided by the ships' on board fire pumps.

14.1.2 Generally a ship will have at least two fire pumps, a primary dedicated to the fire main and a reserve which probably has other duties such as sanitary, bilge or ballast.

14.1.3 Fire main pumps must be capable of supplying 50 psig (340 kilopascals) streams (75 psig for tankers) to the two static mains with the highest pressure drop (usually in the bow). These pumps will be powered by the primary generators, with emergency back up. The hydrants supplied by the main must be of sufficient number and location so that any part of the vessel can be reached with two streams of water from separate stations, with at least one stream though a single length of hose.

14.2 In machinery spaces any area must be able to be reached by two streams through single hoses from separate hydrants.

14.2.1 Hose connections on board foreign ships are likely to differ in size and thread pattern and adaptors may not be available.

14.2.2 The International Ship Shore Connection is designed to connect fire main systems aboard one vessel to another or to a shore facility. It is constructed of a suitable material for 150 psi (1,034 kilopascals) service. It must have a flat faced flange on one side, and a permanently attached coupling that will fit the vessel's fire main piping and hoses on the other. The flange can be fitted with a gasket and bolted quickly, enabling an assisting vessel or facility to provide fire main pressure to a distressed vessel.

14.3 The SOLAS Convention requires that fire protection in ships is provided through non-combustible construction materials – therefore sprinkler systems are not widely used on merchant ships other than in accommodation spaces and Ro-Ro decks. The purpose of the system is to provide structural protection and maintain escape routes.

14.3.1 Sprinklers are of two types:

- Automatic – wet pipe, which are maintained under pressure and activated by a fusible link in the sprinkler head, and manual, and

- Manual – which is more common and serviced by opening an isolation valve, supplied to the ship's fire mains.

14.3.2 Both systems require power for their pumps to supply pressure. However an automatic system is fitted with a pressure tank for its initial dump of about 800 litres at 1 bar /15 psi/130 kPa. Water sprinklers possibly can cause flooding and affect stability.

14.4 Carbon Dioxide (CO_2) is a useful extinguishing agent because it does not damage cargo or conduct electricity and provides its own discharge pressure. However as it smothers the fire it is only effective if all ventilation and openings are shut.

14.4.1 CO_2 lacks any great cooling properties, and therefore a high enough concentration of CO_2 in the space must be maintained until heat levels drop to below the ignition temperature of the fuel source.

14.4.2 CO_2 poses a significant threat to life due to its ability to displace oxygen. Ships crew should always be consulted before its use.

14.5 Chemical agents work by chemically interfering with the combustion process and extinguishing fires. Halon was used extensively until banned by the Montreal Protocol. FE 241 (Chlorotetrafluoroethane) has now been approved as a replacement. It is a non-conductor and can be used in Class B and C fires. These systems require manual activation via pull boxes outside the protected space. As the gas is poisonous an evacuation alarm precedes the discharge..

14.6 Foam systems are used to combat flammable liquid (Class B) fires. Mechanical foam is produced by mixing a foam concentrate with water and rapidly aerating the resultant solution. Foam with a low expansion ratio will be wetter, heavier and more heat resistant and less affected by wind. This type of foam is well suited for Class B fire in machinery decks and tanker deck fires.

15 EMERGENCY PLANNING FOR FIRE FIGHTING ACTIVITIES IN PORTS

15.1 In the summer of 1992, ICHCA port members were invited to answer a series of questions from the International Safety Panel concerning emergency response plans for incidents in their Port area. Replies were received from 88 Port Members in 25 countries.

15.1.1 Of those replying 94% had plans covering fires and 89% had plans covering fires in ships. 72% of the responders had not revised their plans in the previous two years.

15.1.2 49% had provided fire fighting training, (not ship board specific) and 75% provided fire fighting equipment.

15.2 There are more than 2,000 Ports worldwide from single berth locations handling a few hundred tonnes per year to multi purpose facilities handling up to 300 million tonnes. How many of these Ports have put adequate provisions in place to deal with an emergency involving a fire in their Port, whether ashore or afloat?

15.2.1 What is very evident is that Port or Terminal Operating Company (TOC) Management will be faced with a number of responsibilities and decisions when a shipboard or waterfront fire occurs. The decisions made may affect lives, valuable property and the free flow of marine traffic.

15.2.2 Many are required by statute to have emergency procedures and plans in place. However, as can be imagined, lack of an appropriate, practical and cohesive plan could have a negative effect on the future commercial viability of any Port.

15.3 Therefore the Harbour Authority or TOC should develop a Marine Fire Fighting Contingency Plan (the Plan). This plan should describe the responsibilities of the organisations involved in marine fire fighting, both lead and support, for various types and locations of fire.

15.3.1 The Plan should not be seen as intending to relieve the Master of his command, nor restrict his authority concerning normal shipboard operation. However it must be recognised that the local Fire Chief normally will have more experience in fire fighting generally. In addition he is responsible for his fire fighters, his equipment and to the community, or his employers, to contain and extinguish any fires. For example had the local fire chief overriding responsibility at the time of the Bombay catastrophe, mentioned in section 1, he may well have succeeded in his attempts to scuttle the *'Fort Stikene'* at the quayside and so prevented the explosions that caused so much damage and cost so many lives.

15.3.2 The success of any fire fighting operation is reliant upon one person being in charge of all the fire fighting aspects. In the case of shipboard fires within Port areas or territorial waters, National Legislation or Local Bye Laws will mean that the Local Fire Chief will be the person in charge of the fire fighting operation. The Master plays a very important role in lending his experience and assisting the Fire Chief to ensure a successful operation. The presence of the Fire Chief in no way relieves the Master of his command. In the absence of the Master, the Chief Mate or Chief Engineer is expected to represent the vessel.

15.3.3 The presence of land based fire fighters aboard ship does not relieve the Master of command of, or transfer the Master's responsibility for overall safety on the vessel. However the Master should not normally countermand any orders given by the local fire fighters in the performance of fire fighting activities on the vessel, unless the action taken or planned clearly endangers the safety of the vessel and its crew.

15.4 The ICHCA International Safety Panel Briefing Pamphlet No. 6 – Guidance on the Preparation of Emergency Plans, gives guidance on preparing emergency plans in Port Areas. The UNEP Publication, APELL for Port Areas, although primarily concerned with chemical incident preparedness, will be found of great help to those unfamiliar with emergency planning. Equally, the IMO's Recommendations on the Safe Transport of Dangerous Cargoes in Port Areas (edition 2007) refers extensively to emergency planning. It is therefore not considered necessary to reiterate within this document the content of these publications. However the readers may find the following useful.

15.5 As part of the planning process the fire fighting partners – Port, local and national should appoint and train a Marine Fire-fighting Co-ordinator (MFC). in turn he should recruit and train, to be used on an 'as required' basis, a small team of assistants. Each of these should be:

- Competent to perform assigned tasks
- An effective team member
- Self disciplined and able to work under the control of decisions made by the MFC
- Adaptable to changing circumstances
- Vigilant for their own and others safety
- Able to recognise his or her abilities and limitations

15.5.1 During an incident these personnel will be charged with communications and support. They will be responsible for contacting and liaising with:

- Vessel owners and agents
- Port facility owners and operators
  Fire Services
- Police Services
- Ambulance Services
- Port Authorities
- Local Authorities
- Hazardous Waste Companies
- Pilots
- Towage Companies
- VTS
- Salvage
- Labour Organisations
- Railways
- Utilities
- Ship Repairers
- Media Representatives
- Fire Fighting Supply Companies

15.5.2 Each individual should, as part of his training, be allocated specific organisations to liaise with and become familiar with their contact details. This will ensure that the necessary support can be given to fire fighters during the incident.

16 COMMUNICATIONS

16.1 The successful conclusion of all emergency incidents relies on the three Cs:

- Command
- Control and
- Communication

16.2 Pre-established and effective communications procedures are essential to the prosecution of a safe and successful fire fighting operation. The larger the incident the more different agencies are likely to be involved in the response. Pre-planning of incident communications will reduce many of the difficulties that may arise during fire fighting operations.

16.2.1 Consideration should be given to the following:

- Can all responders communicate on common frequencies?
- Have standard procedures and call signs been established?
- Has the effectiveness of communications been tested practically? Ships are made of steel, which acts as a shield to radio communications.
- A ship's communications network is not necessarily an effective alternative if damage has occurred
- Terminology must be commonplace. Nautical jargon should not be used.
- Resources for additional radios and batteries need to be identified.

Annex 1

SUMMARY OF SOLAS CHAPTER 11-2

CONSTRUCTION – FIRE PROTECTION, FIRE DETECTION AND FIRE EXTINCTION

Entry into force: 1 July 2002

PART A – GENERAL

Regulation 1 – Application – The chapter applies to ships built on or after 1 July 2002. Ships constructed before that date should comply with the chapter in force prior to 1 July 2002, however there are some requirements for existing ships in the revised chapter.

Regulation 2 – Fire safety objectives and functional requirements – Provides the fire safety objectives and functional requirements for the chapter.

Regulation 3 – Definitions – Gives definitions of terms used in the chapter.

PART B – PREVENTION OF FIRE AND EXPLOSION

Regulation 4 – Probability of ignition – The purpose of this regulation is to prevent the ignition of combustible materials or flammable liquids.

Regulation 5 – Fire growth potential – The purpose of this regulation is to limit the fire growth potential in every space of the ship.

Regulation 6 – Smoke generation potential and toxicity - The purpose of this regulation is to reduce the hazard to life from smoke and toxic products generated during a fire in spaces where persons normally work or live.

PART C – SUPPRESSION OF FIRE

Regulation 7 – Detection and alarm – The purpose of this regulation is to detect a fire in the space of origin and to provide for alarm for safe escape and fire fighting activities.

Regulation 8 – Control of smoke spread – The purpose of this regulation is to control the spread of smoke in order to minimise the hazards from smoke.

Regulation 9 – Containment of fire – The purpose of this regulation is to contain a fire in the space of origin.

Regulation 10 – Fire fighting – The purpose of this regulation is to suppress and swiftly extinguish a fire in the space of origin.

Regulation 11 – Structural integrity – The purpose of this regulation is to maintain structural integrity of the ship preventing partial or whole collapse of the ship structures due to strength deterioration by heat.

PART D – ESCAPE

Regulation 12 – Notification of crew and passengers – The purpose of this regulation is to notify crew and passengers of a fire for safe evacuation.

Regulation 13 – Means of escape – The purpose of this regulation is to provide means of escape so that persons on board can safely and swiftly escape to the lifeboat and liferaft embarkation deck.

PART E – OPERATIONAL REQUIREMENTS

Regulation 14 – Operational readiness and maintenance – The purpose of this regulation is to maintain and monitor the effectiveness of the fire safety measures the ship is provided with.

Regulation 15 – Instructions, on board training and drills – The purpose of this regulation is to mitigate the consequences of fire by means of proper instructions for training and drills for persons on board responsible for carrying out ship procedures under emergency conditions.

Regulation 16 – Operations - The purpose of this regulation is to provide information and instructions for proper ship and cargo handling operations in relation to fire safety.

PART F – ALTERNATIVE DESIGN AND ARRANGEMENTS

Regulation 17 – Alternative design and arrangements – The purpose of this regulation is to provide a methodology for approving alternative design and arrangements for fire safety.

PART G – SPECIAL REQUIREMENTS

Regulation 18 – Helicopter facilities – The purpose of this regulation is to provide additional measures in order to address the fire safety objectives of this chapter for ships fitted with special facilities for helicopters.

Regulation 19 – Carriage of dangerous goods – The purpose of this regulation is to provide additional safety measures in order to address the fire safety objectives of this chapter for ships carrying dangerous goods.

Regulation 20 – Protection of vehicle, special category and ro-ro spaces – The purpose of this regulation is to provide additional safety measures in order to address the fire safety objectives of this chapter for ships fitted with vehicle, special category and ro-ro spaces.

THE INTERNATIONAL FIRE SAFETY SYSTEMS (FSS) CODE

Contents

Chapter 12 Fixed emergency fire pumps

Chapter 13 Arrangement of means of escape

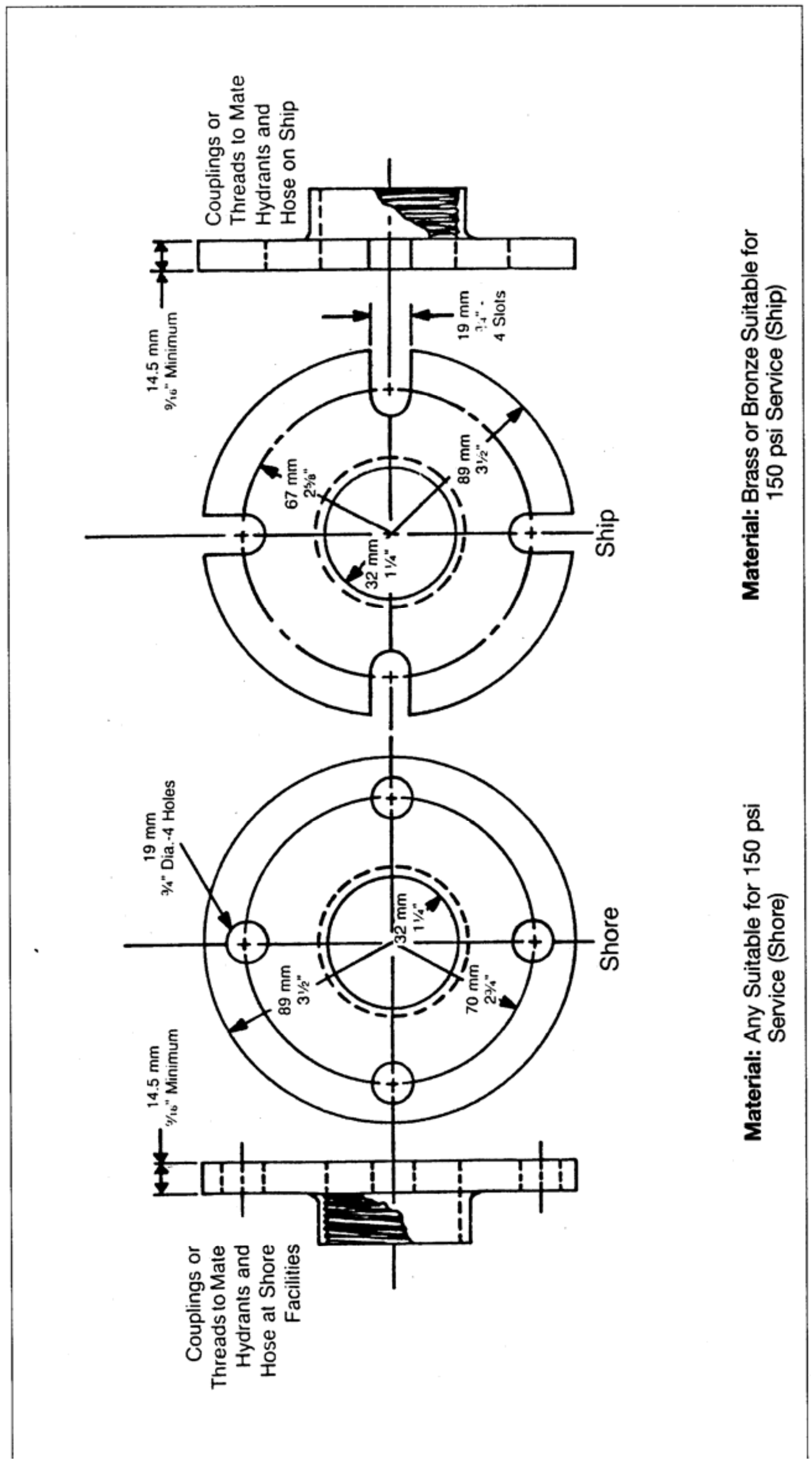
Chapter 14 Fixed deck foam systems

Chapter 15 Inert gas systems

Annex 2

NUMBER	DESCRIPTION
NFPA 921	Guide for Fire and Explosion Investigations 2004 Edition
NFPA 1000	Standard for Fire Service Professional Qualifications Accreditation and Certification Systems 2000 Edition
NFPA 1001	Standard for Fire Fighter Professional Qualifications 2002 Edition
NFPA 1002	Standard on Fire Apparatus Driver/Operator Professional Qualifications 2003 Edition
NFPA 1081	Standard for Industrial Fire brigade Member Professional Qualifications 2001 Edition
NFPA 1250	Recommended Practice in Emergency Service Organisation Risk Management 2004 Edition
NFPA 1401	Recommended Practice for Fire Service Training Reports and Records 2001 Edition
NFPA 1403	Standard on Live Fire Training Evolutions 2002 Edition
NFPA 1404	Standard for Fire Service Respiratory Protection Training 2002 Edition
NFPA 1405	Guide for Land-Based Fire Fighters Who Respond to Marine Vessel Fires 2001 Edition
NFPA 1410	Standard on Training for Initial Emergency Scene Operations 2005 Edition
NFPA 1451	Standard for a Fire Service Vehicle Operations Training Programme 2002 Edition
NFPA 1521	Standard for Fire Department Safety Officer 2002 Edition
NFPA 1561	Standard on Emergency Services Incident Management System 2005 Edition
NFPA 1583	Standard on Health-Related Fitness Programmes for Fire Fighters 2000 Edition

Annex 3



For Both —
Flange Surface: Flate Face
Gasket Material: Any Suitable for 150 psi Service
Bolts: Four (⅝ inch) Diameter, 50mm (2 inches) long Threaded to within 25mm (1 inch) of the bolt head
Nuts: Four, to Fit Bolts
Washers: Four, to Fit Bolts

ANNEX 4

ACTION PLAN

The following has been developed to assist the relevant authorities to take the first steps in developing and enhancing their marine fire fighting capability.

The relevant sections of text in GS 2 are given in bold in parenthesis.

1) Port Operators will, in conjunction with Government/ Local Authority (town/ city/state/county) departments, establish a Marine Incident Response Group (MIRG). This Group will:-

- Develop a Marine Fire-fighting Contingency Plan **(13.3)**
- Ensure that comprehensive Fire Risk Assessments for areas within their responsibility are carried out. **(11.1)**
- Appoint and train a Marine Fire Fighting Co-ordinator (MFC) **(13.5)**

2) The MFC will:-

- Recruit and train a small number of assistants to act as liaison officers. During an incident these personnel will be responsible for ensuring communications and support between the different organisations involved **(13.5.1)**
- Pre-establish effective communications procedures and equipment logistics.
- Recruit a 'first response team' that will be trained specifically to operate on board ship.

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- Ensure that specialist items of equipment for shipboard fire-fighting such as hose adaptors and International ship shore connectors are available in sufficient numbers.

3) This team will be made up of a mix of local authority/port/national firefighters plus representatives drawn from local shipping companies/ terminal operators experienced in Port/shipboard operations.

4) The training should include full familiarisation with the following issues as well as basic firefighting **(10.5)**

- The importance of vessel location including draft availability.
- Operational fire-fighting priorities
- Vessel stability considerations including the use of an inclinometer to determine list
- Shipboard fire fighting systems
- General shipboard fire-fighting tactics

- Vessel types and layouts

- Special considerations for vessel type including Ro-Ro stability

- Special requirements for fighting fires on bulk liquid tankers **(BP 26)**

- Familiarisation with the IMDG Code **(BP3)**

- Training in the properties of dangerous substances and hazardous material that may be carried both as bulk and packaged cargo in dry or liquid form.

- Specialist techniques for fighting fires involving these substances both ashore and afloat. This to include specific reference those substances that may specifically ignite.

- Safety, first aid and rescue techniques

5) The MFC will arrange for follow up training as necessary including, via local terminal operators, visits to the various types of ships that are ‘frequent callers’.

6) Members of the team should be capable of acting as leaders for further teams of less experienced fire-fighters that it may be necessary to establish should an incident escalate.