1999

Shipboard fire emergency response plan at sea

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SHIPBOARD FIRE EMERGENCY RESPONSE PLAN AT SEA

By

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A dissertation submitted to the World Maritime University in partial Fulfilment of the requirements for the award of the degree of

MASTER OF SCIENCE

in

MARITIME SAFETY AND ENVIRONMENTAL PROTECTION (Policy)

1999

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

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ACKNOWLEDGEMENTS

I would like to thank the Almighty God for his love, manifested by his great help and protection during the period of my study at the World Maritime University.

I also wish to express my profound gratitude and most sincere appreciation to CDG (Carl Duisberg Gesellschaft) for sponsoring my study and to Capitaine de Vaisseau Rambeloson Henri Lalao for nominating me.

The professional guidance of my supervisor, Professor Johnsson and the support of friends have made the completion of this dissertation possible. I am especially indebted to them and wish to offer my sincere thanks.

Many thanks also go to the WMU library staff for their assistance while searching for materials for this dissertation.

I also owe gratitude to Professor Mukherjee, my course Professor for his valuable advice not only on my studies but also on my future carreer.

I am also grateful to all Maritime Safety and Environmental Protection staff for their help in various ways making my study interesting.

Lastly but most importantly, I would like to acknowledge and express special thanks to my wife Tiana who has provided me with the greatest support and encouragement making our stay in Malmö away from home worthwile.

ABSTRACT

Title of Dissertation: **Shipboard Fire Emergency Response Plan at Sea**

Degree: **MSc**

This dissertation is a study of shipboard fire emergency response plan at sea, showing the different circumstances that may take place and the responses that have to be carried out accordingly.

The first reaction of a seafarer when a fire erupts at sea is to prevent it from spreading and extinguish it if possible. An immediate response consisting of proper individual responses, from the time when a fire is discovered, would eliminate indecision and waste of valuable time in the beginning of a fire emergency.

Knowing that a fire has not been fought despite the efforts in conducting the immediate response or when it is only discovered at a stage when the individual response may not be helpful, participation of the entire crew in the undertaking of the Organisational Response becomes necessary to fight the fire. This response consists of different organised procedures led by the Captain of the ship.

The use of fixed fire extinguishing system becomes necessary when the immediate and organisational response were not succesful or the fire is located in certain spaces where the two first responses cannot be undertaken. There are some procedures on the use of the different fixed fire extinguishing systems that are very important for an effective response to a fire.

The`bad´ and `good´ responses are identified and analysed in the different responses.

All of the above responses cannot be carried out properly unless there is an adequate preparation of the equipment that is used to fight the fire. This preparation comprises proper maintenance and sufficient number. Moreover, the crew members that utilize this equipment should also be prepared in order to use efficiently and effectively the resources that they possess in order to extinguish the fire. This preparation consists of adequate training and proper fire drills conducted on board the ship’s crew.

KEYWORDS: Emergency, Response, Fire, Maintenance, Training,

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LIST OF ABBREVIATIONS

CO2	Carbon Dioxide
ICS	International Chamber of Shipping
IMO	International Maritime Organization
M/S	Motor Ship
MRCC	Maritime Rescue Coordination Center
NTSB	National Transportation Safety Board
O2	Oxygene
OOW	Officer of Watch
SOLAS	International Convention on Safety of Life at Sea 1974
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978, as amended in 1995
USCG	United States Coast Guard

CHAPTER ONE
INTRODUCTION

1.1. Description of the topic

Fire at sea has always been one of the most difficult situations that a ship's crew has to respond to. Being alone at sea, the crew has to utilise its available resources to cope with the fire. This year, two shipboard fires happened on passenger ships, in May onboard Sun Vista and later in July onboard the Norwegian ferry Prinsesse Ragnhild whereby the effectiveness of the response could save human lives onboard. In the light of these statements, this dissertation: `The shipboard fire emergency response at sea ´ is an attempt to describe some of the different events that may occur in case of fire on board ship and the suitable response that has to be undertaken accordingly. First, at its incipient stage, a fire at sea has to be responded to by an immediate response in order to prevent it from growing and spreading. Secondly, the author names: `Organisational response ´, the response of the entire crew that has to be carried out to back up the effort made during the immediate response. Finally, another response deals only with fire in particular spaces requiring the use of fixed fire extinguishers. In addition, the above responses cannot be feasible or effective unless the available resources such as materials and personnel are adequately prepared to carry out such responses.

It is brought to the attention of the reader that the author has exclusively covered a response that only pertains to shipboard fire at sea. Hence, the response is exclusively carried out by the ship's crew to deal with fire.

1.2. Aims

This work does not purport to provide a complete answer to questions in relation to a shipboard fire emergency response at sea. Instead, the aim of the dissertation is to give a basic understanding of the situations that may prevail in case of fire at sea and the possible response that can be carried out to handle them. The author assumes that if basic but proper knowledge is given to seafarers they should be able to develop their own shipboard fire emergency plan depending on different factors. Hence, this work can be considered as a framework when developing a shipboard emergency response plan when the ship is at sea. It has been noticed according to different types of research that the use of an improper plan has led to disasters such as the one in the Scandinavian Star (Norway Committee of Investigation, 1991). In the light of that, the principal aim of this work is to help seafarers to establish their own plan instead of borrowing others' or using outdated response, which may not be suitable for their ship.

1.3. Relevance of the topic

Having had an experience of fire on board, the author could estimate the threat posed by such fire to the ship and the crew. The importance of the flexibility of the pre-

established fire plan has revealed to be the essential factor that permitted the extinction of the fire. In the light of this, the author has chosen the above topic to remind him of the incident and the proper response that should have been used to cope with it in a more effective way. Furthermore, most of the fire disasters at sea that occurred in the last fifty years did not result from lack of equipment but mostly from improper response on the part of the crew. It is therefore interesting to produce a basis in order for seafarers to shape their own plan according to such basis depending on the particularities of the involved ship and its crew.

Furthermore, according to the trends shown below, fire on board ships has been a major concern to the shipping business. Therefore, an analysis on this matter such as the way to improve these trends, as developed by this work, would be beneficial to seafarers and those who are involved in the shipping business.

ANALYSIS OF MAJOR SHIP FIRES FROM 1977 TO 1996

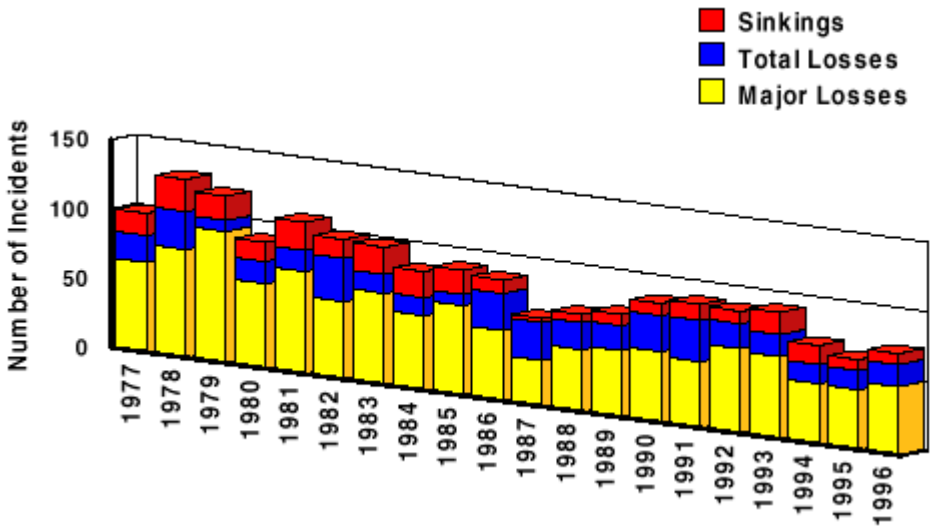

Figure 1

Source: Fire aboard (Rushbrook) and edited by Lygate (1998)

At the same time, it is to be mentioned that fire affects any type of ships according to Figure 2, hence, the need to enhance the ship's crew response to it.

FIRES BY VESSEL TYPE

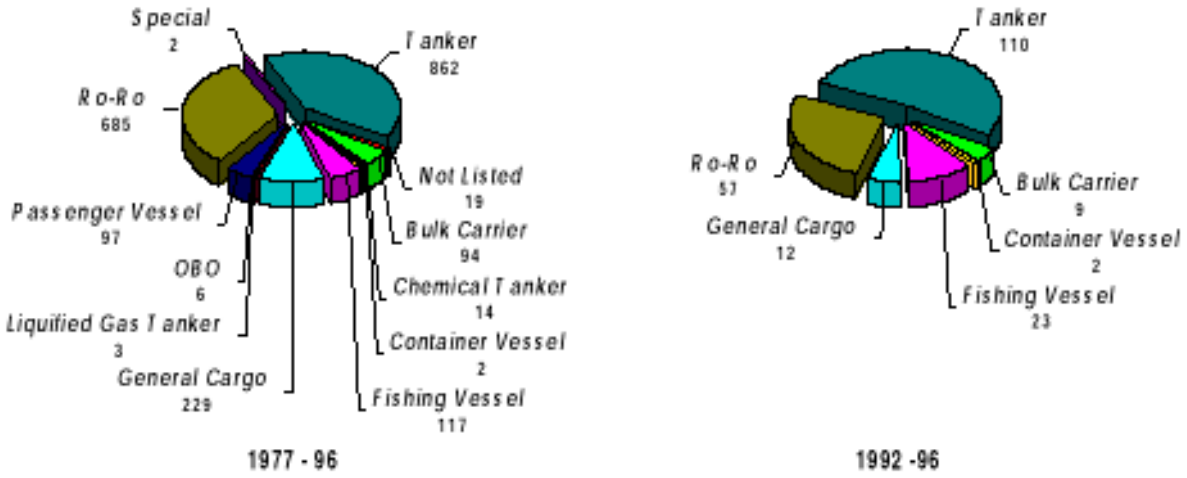

Figure 2

Source: Fire aboard (Rushbrook) and edited by Lygate (1998)

1.4. Research and methods followed

The completion of this dissertation is a result of analysis of reading materials and work during different field studies. Most of the reading materials were available at the World Maritime University library. However, some books were borrowed from other libraries through inter-loans. Apart from books that deal directly with the topic, some shipboard fire disaster reports were also analysed to identify different aspects of good and bad response to a fire at sea. Moreover, the Internet has provided important information concerning the topic. The method used is the analysis of such materials added to the author's own experience in order to draw a strategy that is vital to any fire situation onboard while at sea. The field trips were also a great source of knowledge on the different arrangements on board a modern cargo ship (M/S Öresund) to prepare for a fire emergency.

CHAPTER TWO
IMMEDIATE RESPONSE

2.1. Introduction

An immediate response is, as its name indicates, a response that has to be undertaken promptly when a fire occurs to prevent its spreading and intensity. Some shipboard fires become a disaster because they have not been properly responded to at their incipient stage (Lygate, 1998). For the purpose of this paper, this Chapter deals with the response that takes place from the time a fire is discovered or detected by any equipment until the captain has the command and control of the situation. My aim is to analyse the response on the discovery of the fire, both the crew's response and that of the officer of watch. However, it is not under the scope of this dissertation to cover the response that is carried out automatically by automatic devices on board some particular ships.

2.2. On the discovery of the fire

2.2.1. Introduction

On the discovery of a fire or unexpected strange smoke, a crew member is aware of the possible danger. If he cannot find the flames or the source of the smoke, he should first attempt to locate the fire, then alert the whole ship by raising the alarm, attempt to fight

the fire and finally report the situation to the officer of watch. This procedure can be adopted on board to give a very first response to fire.

2.2.2. Locating the fire

2.2.2.1. Introduction

Locating the fire is of extreme importance because if successfully achieved, it will enable the crew member to assess the situation and conduct his response. The fire can be discovered by the crew member or detected by special equipment. Early detection or discovery provides quick information concerning, not only the place of the fire but also, possibly, its nature. This will enable the selection of an adequate and feasible response. The crew member has various methods and pieces of equipment at his disposal for this purpose.

2.2.2.2. Early detection

Early detection is of prime importance (U.S Coast Guard, 1974). In the case of the two fires on board Scandinavian Star, the one that caused the disaster could have been located fifteen minutes after the start of the fire (Norway Committee of Investigation, 1991). However, the fire on board a US 26,000 dead weight bulk carrier was discovered probably ten minutes after it started (International Chamber of Shipping, 1981). As a result, the fire could be extinguished in time. In the author's opinion, if the attempt to discover the location of a hidden fire is likely to be unsuccessful, the alarm should be raised immediately.

2.2.2.3. Location of the fire

The location of the fire is very important, as it dictates not only the access to the fire for the fighting operation but also the way to escape in case it has to take place. For example, a fire on the main deck is probably less dangerous, considering the accessibility, than one in a cargo hold. The location of the fire also determines the appropriate extinguishing agent to fight it (Nazzaro, 1980). For example, a cargo hold fire is fought with CO2 while a fire in the accommodation, unless involving electricity, is usually fought with water. Furthermore, knowing the location of the fire helps to identify what can be threatened or persons in danger if the fire should spread.

2.2.2.4. Nature of the fire

The nature of the fire determines the fighting agent that is to be used to extinguish the fire. Cooling the burnt material below its ignition temperature fights fires in bedding, or clothing, known as class A fires. Meanwhile, fire in flammable liquids, known as class B fire, is dealt with by cutting off the supply of air. Class A fires are mostly fought by water while class B fires are fought by the use of water fog, foam, carbon dioxide or other gases such as halotrone and argonit, and dry chemicals (US Coast Guard, 1974). Therefore, ignorance and misjudging of the nature of the fire could easily promote its spreading by undertaking inappropriate action.

2.2.2.5. Methods

Several methods can be used to locate the fire. One method is to touch a compartment door or a bulkhead with a bare hand to check for temperature. If it is hot, it means that it is heated by a fire from behind. The presence of discoloured or blistering paint found on a bulkhead may also indicate that fire is present behind it (Nazzaro, 1980). In addition, if smoke can be observed passing through wiring holes or other routes such as portholes or

zipping under a door, it means that fire is present behind. Furthermore, if unusual noise can be heard, it is a possible indication that fire may be present.

2.2.2.6. Precautions

Some precautions should be considered when trying to find the location of a fire. If there is a suspicion that a fire may be hidden behind a compartment door, it is imperative not to open the door during the first response to prevent explosion due to demand of O2 of the fire. The person has to be equipped with charged hose line at hand (Nazzaro, 1980), which is not to be performed during this immediate response. In addition, it is vital that the crew member does not persist in trying to find the location of the fire if it is likely to put his life in jeopardy.

2.2.2.7. Equipment

Many pieces of equipment can be used for automatic detection of fire as it is described in Consolidated edition 1997 of SOLAS International Convention for the Safety of Life at Sea, 1974) such as heat and smoke detectors. There are also three other type of detectors, namely, the flame detector, heart and differential detector. The flame detector is suitable for installation in place where flames can develop rapidly in case of fire. The differential detector is activated when there is abnormal rise of temperature for example 3°C in 20 seconds (Bo O, 1987). The smoke detector is the most efficient among those automatic detectors considering the response time but, in the author's opinion, it is desirable to use a combination of them, if possible, to assist in case one fails when needed.

2.2.2.8. Conclusion

“Serious fires are often the result of small fires, which have not been detected and acted upon quickly, and which, reaching dangerous proportions, overpower the ability of personnel” (US Coast Guard, 1974). Therefore, it is right to mention that with a quick use of appropriate methods using adequate equipment, a disaster can be prevented if early fighting can be conducted. However, it is important to mention that if the attempt to locate the fire fails or is delayed, a quick activation of the alarm should be conducted.

2.2.3. Sounding the alarm

2.2.3.1. Introduction

Sounding the alarm is the next step that is to be followed after the fire is located or after an attempt to locate the fire is undertaken. The purpose of sounding the alarm is to give warning to other people onboard. However, the alarm can warn any person onboard or only the crew depending on the type of the ship. For example, in passenger vessels, if a fire is detected and the automatic alarm is sounded this can only be heard by the person in charge. A further investigation is conducted about the status of the fire, depending on the result, a general alarm throughout the ship will be sounded or not. For sounding the alarm to be effective, it must be sounded as early as possible, and must be heard by everyone on board throughout the ship.

2.2.3.2. Early sounding

Early sounding of the alarm is necessary to give enough time for crew or passengers to get prepared to tackle the fire or escape if it is needed. In the case of fire on board the passenger ship “Universe Explorer”, in July 27, 1996, the alarm was sounded 7 minutes after the start of the fire. Consequently, crew members managed to alert passengers and

evacuate all staterooms in an orderly and efficient manner (NTSB, 1988). On the other hand, if the alarm is sounded too late, it will give much time for the fire to intensify and spread. Different reasons may create delay in sounding the alarm. This can either be the result of a late discovery of the fire or a long and non-efficient attempt to fight it.

2.2.3.3. Effective alarm

For the alarm to be effective, it has to be heard in the whole ship. Many of the survivors in the Scandinavian Star disaster affirmed that they were asleep and did not hear any alarm at all (Norway Committee of Investigation, 1991). This failure resulted in many people being trapped in their accommodation and died. Consequently, especially at night, it would be advisable to use any means to attract attention apart from the common ones, such as by creating noise to the bulkheads with metal objects, and by shouting.

2.2.3.4. Conclusion

Sounding the alarm is of extreme importance as it alerts the whole ship to the fire. This step may come first, when the fire is discovered, if it is deemed necessary to avoid useless delay in trying to find the exact location of the fire. However, it is only effective if it is raised at the early stage of the situation and can be heard throughout the ship.

2.2.4. Attempting to fight the fire

The person who discovers the fire should assess the situation very quickly before acting. It is very important to contain the fire, but he has to assess whether it is safe for him to attempt to fight the fire alone or not. The attempt to fight the fire has to be conducted

with portable fire extinguisher or other items readily available such as blankets (Nazzaro, 1980).

In conclusion, if the crew member who discovers the fire judges that he is able to extinguish it with the available equipment, an attempt is to be undertaken. There are cases on record where a crew member tried to tackle fire situation unequipped and lost his life when trying to be a ` lonely hero ´ (Rusbrook, 1976).

2.2.5. Reporting

Reporting is made to the bridge, more precisely, to the officer of watch. This last step on the discovery of the fire is very important because it provides information on the fire in order to choose appropriate plan for the fighting operation. This information includes the location of the fire, the type of fire to be expected, and its extent (Nazzaro, 1980). In my opinion, a report shall also include general information of the situation such as threat of spreading or endangered persons. However, the reporting has to be as brief as possible in order to move to the next step.

2.2.6. Conclusion

On the discovery of a fire on board, any person even a crew member may panic and undertake inappropriate action, thereby worsening the situation. In the early stage of the fire, various procedures are used in different ships, but the author of this paper has considered that the procedure outlined above seems to be practical, logical and simple. Therefore, the author would recommend its application to give a very first response to a fire.

2.3. Alarm response

2.3.1. Introduction

So far, this research has considered the actions of the crew member who discovers the fire. However, all crew members should respond to the alarm. On some ships, crew members await the order of the captain before responding, but in the author's opinion, the crew should respond immediately to the sounding of the alarm without hesitation. In some cases, they may need to wait until the appointed person relieves them on watch.

2.3.2. Muster station

2.3.2.1. Introduction

The muster station is the designated location where any crew member should proceed when hearing the alarm. Any ship should have muster list and emergency instructions according to SOLAS Chapter III. The number of muster stations depends on the size of the ship and the number of crew (Skipp, 1985). However, three muster team stations are at least to be designated onboard to cope with fire emergency, namely, the emergency team station, the bridge team station and the engine room team station. Furthermore, for passenger ships, passengers are also required to call to their muster stations.

2.3.2.2. Emergency team station

This station is designed for the emergency group whose task is explained in Chapter 3. The location of the station should be chosen carefully. The factors that have to be considered are as follows:

- Direct communication with the bridge has to be available in the emergency station, illustrated by the presence of a telephone set or other types of communication equipment.

- The equipment room has to be located close to the emergency team station.
- The access and egress from the station should be considered. Most of the time, it is on the open deck.
- An alternative site should be selected in case the site of the fire is located at the emergency team station. Some ships adopt two stations, one on each side to cope with such a problem (Skipp, 1985).

2.3.2.3. Bridge team station

This station is normally located, as its name indicates, on the navigating bridge. However, another site should be designated as alternative in case the fire is on the bridge. Communication is very important for the Bridge team station because of the special task assigned to the team (described in Chapter 3). Consequently, the presence of communication equipment has to be considered when designating the alternative site. In the author's point of view, in case the fire is on the bridge, it should also be possible to cone the vessel from the alternative site.

2.3.2.4. Engine room team station

In case of fire, many pieces of equipment located in the engine room such as the emergency fire pumps should be used; therefore, they have to be ready for immediate use to operate at a very short notice. In case of fire, only well trained engineers or motormen should be allowed to operate in the engine room to ensure appropriate response to fire emergency. However, there may be a case when the fire is located in the engine room and access is not possible for the team. As a result, an alternative site should be selected. From the alternative site, communication with the bridge should be established before fire fighting begins (Skipp, 1985). On the other hand, fuel pumps are to be stopped and fuel valves to be closed from the remote shut-off.

2.3.3. Equipment

The crew members assigned to muster at the emergency team station have to collect their equipment from the equipment room and get equipped before reporting to the muster station in order to be ready for response. The equipment availability varies with each ship. They should be equipped with safety helmets, and safety shoes and life jackets in the immediate response. It is not required to be fully equipped before starting unless instructed by the bridge. Nevertheless, it is also possible to wear directly complete equipment, such as breathing apparatus or other equipment according to the SOLAS Convention in order to be fully prepared for response. However, it should not be conducted in such a way that the report is delayed.

2.3.4. Reporting

Reporting is necessary in order for the supervisor or superior to assess the situation and give further instruction. While mustering, this statement is also valid. The checklist of the assigned crew members, indicating their name and position, should be used and reported to the bridge (Skipp, 1985). The report should be made quickly even if someone is missing at the station. Some crew tends to wait until everybody has arrived before reporting. Thus, the whole plan will be delayed. It is a priority to seek the missing person just after the report even if not instructed to do so, and report whether the person is found or not.

2.3.5. Conclusion

The crew members response to the alarm is a key factor within the immediate response if they delay or undertake it incorrectly, the whole response will not be successful.

Furthermore, if crew members take so much time to get equipped with unsuitable equipment or it has been done in such a way that the report is delayed, the next step will also be delayed. The quicker the crew members are mustered and ready for action, the faster the next response can be undertaken.

2.4. Officer of watch (OOW) response

2.4.1. Introduction

The officer of watch is given the authority by the captain to ensure proper operation of the ship during the time of his watch, including navigation and other operations that may arise. Usually, this task includes the initial response to a fire, but in some ships, the captain insists on undertaking the whole operation. However, if the captain is not on the bridge when the fire is first reported, delay in awaiting the captain and taking appropriate response will result in spreading of the fire and further damage. The responses that the officer of watch can usually undertake without the authorisation of the captain are to set the ship on an appropriate course, to monitor ventilation, to ensure proper use of emergency equipment and finally to give a general announcement.

2.4.2. Appropriate course

An appropriate course should be set depending on the location of the fire and also the direction of the wind. First, the speed of the ship has to be reduced to lower the air pressure. If the fire is located in the stern, for example, the ship should head into the wind, and conversely, she would head down-wind if the fire is located in the forward part of the ship. It actually consists of ` blowing out the fire over board ´ (Rushbrook,

1979). For example, during the fire located in the stern of Scandinavian Star, an attempt was made to head the ship into the wind to avoid the spreading of the fire (Norway Committee of Investigation, 1991). This practice is of extreme importance when the ship experiences a strong wind during the fire.

2.4.3. Ventilation monitoring

Ventilation promotes the supply of oxygen to the fire. Depending on the report made by the crewmember at the discovery of the fire, the officer of watch should order all mechanical ventilation and vent openings to be closed. Normally, this order is only given by the captain according to Rushbrook (1979). Similarly, the captain of the Scandinavian Star ordered to turn off the ventilation to affected areas (Norway Committee of Investigation, 1991). However, it is desirable that the officer of watch immediately close down the ventilation throughout the ship if the report is serious. If the fire is located, only the supply of air to the affected area (or compartment) is to be cut off to diminish oxygen. A further monitoring of the ventilation can also be conducted to help fighting the fire but only if it is safely used.

2.4.4. Emergency equipment

It is also a duty of the officer of watch to order the engineers on watch in the engine room, depending on the report, to make sure that the emergency fire pumps are started and the fire doors are closed. The fire fighting operation assigned to the emergency team (described in Chapter 3) can be directly conducted if the emergency fire pumps have already been started. The closing of the fire doors is very important because together with the ventilation system they affect the supply of air to the fire. For example, in the

case of the disaster on the Scandinavian Star, many fire doors were found open on deck 3, thereby promoting the spread of the fire (Norway Committee of Investigation, 1991). Similarly, onboard the Universe Explorer, findings show that the fire doors to the crew corridors were tied open, thereby contributing to the loss of lives in the accident (National Transportation Safety Board, 1998).

2.4.5. General announcement

General announcement is also called public address system according to the SOLAS Convention. It is usually made by the captain but regarding the emergency situation, it can also be undertaken by the officer of watch within the immediate response. Its purpose is to provide instruction of the situation throughout the ship and also the response that is to be undertaken accordingly. In practice, it consists of stating the location of the fire, the type of fire, the instruction on where the passengers have to muster and other instructions that may be necessary for safety. In the case of the Scandinavian Star disaster where the alarm was not heard, a general announcement could have warned the passengers in time and avoid delay in reporting to the muster stations. In other words, the general announcement could have provided proper instructions to passengers about what they had to do.

2.4.6. Conclusion

“Speed” is the essence of the fire and similarly all steps needed to avoid its spread and to fight it (U.S Coast Guard, 1974). The officer of watch is the first crew member that is to be given the report in the discovery of the fire. He should act promptly, according to the authority conferred to him by the Captain and according to the action plan in order to

contain the fire and initiate an immediate response, depending on the seriousness of the situation. In some cases, the success of the OOW to take a proper response minimises the risk that the fire presents. For example, in the case of a fire onboard a cargo ship on passage from Canada to Europe, the reaction of the OOW to alter the ship in a proper course resulted in the fire being less threatening (International Chamber of Shipping, 1974).

2.5. Summary

In order to tackle a fire, many steps have to be followed. A step depends on the previous one. For example, if the attempt to fight the fire is not successful, the next step could be to deal with a spreading and more serious fire. In the light of this, the immediate response is of extreme importance in order to render the next steps easier or even unnecessary (if the fire is extinguished). This consists of taking appropriate response at the discovery of the fire. The officer of watch should take appropriate initiative to contain the fire at its incipient stage and prepare the organisational part of the fighting operation. The figure below attempts to show the immediate response starting from the discovery of the fire to the time when the general announcement is given.

IMMEDIATE RESPONSE CONDUCTED FROM THE DISCOVERY OF THE FIRE TO THE GENERAL ANNOUNCEMENT

On the discovery of the fire:

- Assessment of the fire:
  - location
  - type
  - intensity
  - extension and exposures

↓

Sounding the alarm → **Crews response:** Crews join muster stations and get equipped

↓

Attempting to fight the fire → reporting to OOW

↓

Reporting → **Officer of watch:**
- appropriate course and ventilation monitoring
- starting of fire pumps and and closing of fire doors
- general announcement.

Figure 3

CHAPTER THREE
ORGANISATIONAL RESPONSE

3.1. Introduction

The organisational response takes place depending on the situation of the fire whether it is extinguished or not. In this Chapter, it is assumed that the fire is not extinguished and more organised response is necessary to cope with the fire after immediate response has been undertaken. In most cases, the Officer of the Watch gives a status report to the captain before the latter takes the command and control of the situation.

This Chapter deals with the fire-fighting organisation during which the captain is in command of the situation, and properly uses the available resources at his disposal. There are different emergency groups ready to respond, using the fighting procedures to fight the fire.

3.2. Emergency teams

3.2.1. Introduction

The emergency teams are teams of crew located at the muster station. They will perform designated tasks in an organisational manner to cope with the fire. The number of

emergency groups varies with the type and size of the ship and also the number of the crew. In large cruise ships, with 100 crew members and more, there are four emergency teams to cope with ship emergency, namely, the bridge team, the attack team, the continuous run ship and the emergency stand-by team. Meanwhile, in cargo ships, there are also four emergency teams, but structured in a different way. Nevertheless, the key element is that one team has to lead the others; this is always the bridge team. Another one will fight the fire, another will help the others to conduct their designated tasks and prepare evacuation, and the last one, the engine room team, is in charge of the engine room.

3.2.2. The bridge team

The bridge team, as its name indicates, is located on the bridge or at an alternative site if necessary (cf. Chapter 2). It is also called operational command team in some ships (Norway Committee of Investigation, 1991) because of its commanding position during the emergency. Led by the master, this team is intended to lead and co-ordinate all efforts and keeps a detailed timed record of events in case of a shipboard fire. Based on the information from the other teams, it shall co-ordinate the entire fire fighting operation. It should normally consist of at least the master, the officer of watch and the helmsman (Stranding, 1986). However, in passenger ships with a large crew, this team is reinforced by other personnel to help in the co-ordination of the emergency. In the author's opinion, due to the importance of the assigned task of this team, the officer of watch and the helmsman should be particularly chosen because of their special qualification. Table 1 provides an example of a typical bridge team.

TYPICAL BRIDGE TEAM

Type of ship	Function aboard	Position in the team
Cargo ship or Tanker	Captain 2nd Mate Boatswain	Leader, in command Officer of watch, external radio communication Helmsman
Passenger ship	Captain 2nd Mate Other deck officer Boatswain Able seamen	Leader, in command Officer of watch Assistant Helmsman Messengers or other tasks

Table 1

3.2.3. The attack team

The attack team, as its name indicates, is intended to attack, more precisely to fight the fire under the direction of the bridge team. Both Nazzaro (1980) and Standring (1986) mention that this team should be led by the chief mate. This is reasonable because the chief mate is the second in command onboard a ship. Therefore, he normally has to act as on scene command in a fire emergency because of his special knowledge of the crew and the ship equipment. However, it is vital that he should have good knowledge of fire-fighting. The attack team is normally composed of ten crewmembers in a typical emergency organisation (Standring, 1986). However, the number mostly depends on the size of the crew and type of the ship. For passenger ships, such as the Scandinavian Star, this team, also called the mobile fire group, comprises three divisions of eight crew members each; the fire fighters, the fire limitation and search ambulance divisions (Norway Committee of Investigation, 1991).

3.2.4. The support team

The support team is normally assigned to support the attack team when the latter is performing its tasks in a fire fighting operation. It is usually intended to provide extra manpower by helping the members of the attack team to get equipped and by fetching equipment and breathing apparatus (Standring, 1986). In the vicinity of the fire, the support team has to establish a staging area, which is a smoke free area that is protected from the fire. Supplies of, inter allia, hose nozzles, axes and spare cylinders for breathing apparatus should be brought to this area by the support team (Nazzaro, 1980). Apart from the tasks mentioned above, Skipp (1985) also identifies the following:

- Providing first aid to injured persons
- Preparing lifeboats and life rafts for evacuation
- Recharging self contained breathing apparatus cylinders
- Conducting security patrols
- Providing boundary cooling.

3.2.5. Engine room team

This team is located in the engine room team station, normally led by the chief engineer. It may also be called the Technical Department in some ships (Norway Committee of Investigation, 1991). Its task is to control the technical, mechanical and electrical devices that are needed to support the emergency response and to maintain and provide maximum readiness to engines and auxiliaries in the engine room. In practice, such tasks are to control the operation of the emergency pumps and generator and react promptly but safely to the command from the bridge. Moreover, it should also advise the bridge if the emergency has any adverse effect on the equipment and suggest alternative actions to remedy the deficiencies to the equipment.

3.2.6. Exception for passenger ships

Apart from the above-mentioned teams, on passenger ships the crew must also deal with the passengers in case of fire. Another team will be responsible for ensuring that all passengers are mustered at designated muster stations after a general announcement has been made on the public address system. The alarm sounded by the crew discovering the fire is normally only addressed to the crews in charge for further investigation, but if the situation is worsened, a general alarm is sounded to warn the passengers, otherwise, the public address system is also used for this purpose. The team is responsible for guiding the passengers to the muster stations and also for ensuring that they are wearing their life jackets properly. It is also under its responsibility to divide the passengers into groups and accompany them to the lifeboats if evacuation is necessary (Norway Committee of Investigation, 1991). In the author's point of view, this team should also show confidence to the passengers in conducting their task to avoid panic.

3.2.7. Conclusion

The size of the ship and the number of the crew determine the organization of the emergency teams. However, the above mentioned teams are the basis for any type of ship. It is essential that one of the teams has to manage the others to achieve effectiveness while the others have to help each other and mainly act as instructed by the leading team, the bridge team. Another team, which is the engine room team, is crucial because of the monitoring of the engines and other types of equipment in operation during the emergency. However, some personnel are not included in the above teams because of their special duties in emergency (cf. 3.3). Table 2 provides an example of typical emergency teams.

TYPICAL EMERGENCY TEAMS

Bridge team
Master: in command ***2nd Mate: on watch*** ***Unassigned officer: Assistant and radio*** ***Able seaman: helmsman***

Attack team	**Support team**	**Engine room team**
Chief officer: leader ***Engineer officer: assistant*** ***Deck officer: assistant*** ***Able seamen and ordinary seamen***	***2nd Engineer officer: leader*** ***Deck officer: assistant*** ***Engineer officer: assistant*** ***Remaining crew***	***Chief engineer: leader*** ***Engineer officer: assistant*** ***Motorman: assistant***

Table 2

3.3. The fire fighting procedures

3.3.1. Introduction

After the different emergency teams involved in a shipboard fire emergency have been identified, the following will deal with the different procedures on how to use efficiently and effectively these teams in order to fight a fire in an organisational response. In other words, what remains to be done when the OOW has handed over the command to the captain regarding the fire fighting operation? In order to answer this question, it is important to determine the captain's role and that of the team leaders during a shipboard fire emergency.

3.3.2. The captain's role

3.3.2.1. Introduction

It is known by all seafarers that the captain's authority is second only to God's. In this sense, he has the ultimate responsibility for the ship. In an emergency situation, such as fire onboard, his role is very important and intended for the direction and control of the emergency response to cope with the fire. His role consists of different tasks that are described below.

3.3.2.2. Establishing communication

After the status report from the OOW is given to the captain, the first thing he has to do is to establish the communication. This communication is internal as well as external.

3.3.2.2.1. Internal communication

An internal communication has to be established between the captain and the other team leaders. The success of fire emergency response depends on the quality of the communication (Skipp, 1985). It is intended, for the captain, to let the other teams know that he is now in command of the situation. For the other team leaders, this enables them to report the situation and ask for directives from the captain. The most versatile equipment that can be used for communication purposes is the walkie-talkies or portable radios because these cannot be threatened by fire whereas, fixed telephones may be out of order if the wire is burnt by the fire. However, all available means have to be considered in a fire emergency to optimize efficiency.

3.3.2.2.2. External communication

An external communication has to be established based on the reports from the team leaders. The captain has to decide if it is necessary to communicate with others about the

fire. There are different kinds of messages that have to be sent depending on the situation.

- A distress message to the MRCC (Maritime Rescue Co-ordination Center) and other ships if outside help is necessary mentioning the type of help needed.
- An “alert message” to “all ships” or “stations” in the vicinity announcing the fire and asking them to stand by for more information.
- An “advice message” in order to update the alert message
- A “cancellation message”, transmitted when the fire is extinguished (Skipp, 1985).

3.3.2.3. Assessing the situation

Assessing the situation is the basis of all measures taken during the immediate response; the OOW has to assess the situation based on the reports he has received. Similarly, the captain also has to undertake a further assessment both from the status report given by the OOW and from the other team leaders. The captain should normally work with the drawing of the ship and other drawings in relation to fire safety (fire safety plan) to help him to assess the situation (Hobday, 1994). He should try, at least, to determine the following factors when assessing the situation:

- Threat of life and injured persons.
- Current situation and actions previously taken.
- Assessment of the fire: its type, location, extension and intensity.
- Means of escape.
- Access to the fire.
- Ventilation situation.
- Eminent risks and exposures if the fire should spread.
- Access to fire fighting equipment.
- Area affected and damages.
- The actions being taken by the emergency teams.

- The difficulties encountered by the emergency teams.

The order of this list is not strictly followed. However, it could be mentioned that the safety of life is the most important in such an emergency. Hence, this factor should be considered first.

3.3.2.4. Issuance of commands

In order to direct the teams, the captain has to issue commands or orders. His orders are very crucial and any mistake on his part may be fatal. The command depends mostly on the assessment of the situation. However, the captain's decision should be proactive, i.e. based on the information available, he should predict the evolution of the fire situation and issue commands accordingly without waiting for it to happen. The purpose of the command is first to supervise the initiative of the team leaders. For example, the safety of life is a priority in an emergency, and if a crew is missing a search has to be ordered to look for the missing crew. Secondly, the command's role is to provide alternative action when the action plan cannot be followed due to any constraints. For example, if the team leader reports encountered problems by his team, the captain should find another alternative action to undertake the fighting of fire or in the worst case, to order for escape or evacuation.

3.3.2.5. Control and feedback

Whatever the seriousness of the fire situation is, the captain should remain in control (Hobday, 1994). Apart from the above mentioned tasks, the captain should reassess the situation and issue other commands accordingly. Those two tasks are linked and dependent on each other. They have to be carried out together and repeatedly by the captain until the emergency is over, which means, the fire is extinguished. In other words, feed back should be given to the issued commands according to the ongoing fire

situation and its probable evolution. For example, the captain should keep an eye on a situation when he has ordered to monitor the ventilation in order to ventilate a compartment where the attack team is fighting the fire because the ventilation can be a factor to worsen the fire situation.

3.3.2.6. Conclusion

The role of the captain is not limited to manage and control the normal operation of the ship. He also has to cope with unusual situations such as fire onboard. The success or failure of a fire emergency depends on the ultimate decision of the captain. Good flow of communication between the captain and the other team leaders is a key factor for the captain to assess thoroughly the situation and take appropriate action. Based on the assessment, coupled with proactivity, the command is issued to supervise and lead the available resources. However, the role of the captain is not straightforward, he has to revise the actions he has previously taken, depending on the evolution of the situation, and issue ` up dated ´ commands. The figure below provides a summary of the role of the captain in a shipboard fire emergency.

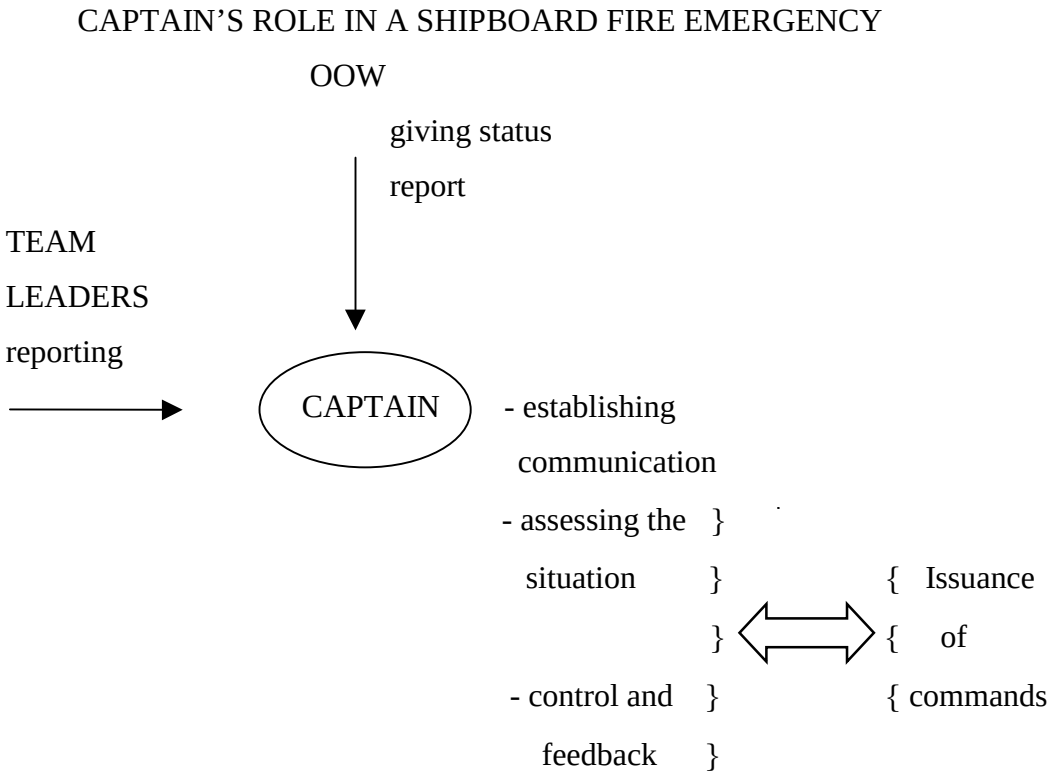

Figure 4

3.3.3. The team leaders' role

3.3.3.1. Introduction

The role of the team leaders is very important during a fire emergency. Apart from being officers, they should have the ability to carry out the tasks assigned to the team members (Skipp, 1985). The captain may have a very efficient strategy to tackle the fire, but if the team leaders do not know how to lead their team members in carrying out their duties properly, the emergency will result in chaos (Skipp, 1985). It is right to mention that the success of the emergency response depends on team members' performance, but if they

are not properly led and guided, this efficiency does not always bring success in a shipboard fire situation. The team leader is the person in charge therefore he is responsible for controlling and supervising the tasks carried out by his team members. The role of the team leaders comprises various tasks that are given in details as follows.

3.3.3.2. Taking proper initiative

It has been previously mentioned that it is the captain that issues orders and commands. However, the team leaders can take initiatives when it is deemed necessary. The safety of life is the primary concern of the team leader, then the limitation of the spreading of the fire, leading to its extinction. The team leader has to bear in mind this priority and take action if necessary. For example, before the captain has the control of the situation, the team leader of the attack team can order his team to conduct the fighting of the fire if such a task has to be performed in order to save life or prevent the fire from spreading. In some cases, the team leaders wait for instructions from the bridge before acting, which may promote the spreading of the fire.

3.3.3.3. Communication

In this part and in the others, communication is a key factor for success. Communication is not only established between the team leaders and the captain, but between the team members and the team leaders. Good flow of communication enables the involved elements to carry out their designated tasks according to the prevailing situation (Rushbrook, 1979). Through communication, the team leaders are given reports of the situation of the fire and the problems encountered from the fighters. Consequently, they are able to give proper guidance and instructions after they have conducted an assessment of the situation. Nowadays, certain breathing apparatus are equipped with a radio. Similarly, the team leaders provide enough information to the captain in order for

him to assess the situation and provide instructions accordingly to the team leaders. Lastly, in the author's opinion, communication between the emergency teams should also be established, as co-operation may be needed to achieve better performance.

3.3.3.4. Maintenance of resources

The team leaders are responsible for providing support and maintenance of the resources at their disposal for maximum readiness. For the attack team, the team leader's role is to ensure that each team member knows his designated task and provides brief instruction to fill a possible gap. He also has to ensure that fire fighters are relieved and rested after expending a long effort (Skipp, 1985). Before and during the operation, the team leader is responsible for ensuring that the fire fighters are properly equipped. A close co-operation with the support team is necessary to ensure efficiency in providing filled breathing apparatus and other support, such as boundary cooling to help the attack team. The fire fighters should provide enough information to the team leader in order for the latter to properly maintain the resources available. According to Skipp (1985), the equipment resources comprise:

- Self-contained breathing apparatus
- Trolley sets
- Distress signal units
- Guideropes
- Personal guideropes
- Lifelines

SOLAS Chapter II-2, Regulation 17, also mentions about the "fireman's outfit" that consists of:

1. Protective clothing of material to protect the skin from the heat radiating from the fire and from burns and scalding by steam. The outer surface shall be water-resistant.

2. Boots and gloves of rubber or other electrically non-conducting material.

3. A rigid helmet providing effective protection against impact.

4. An electric safety lamp (hand lantern) of an approved type with a minimum burning period of 3 h.

5. An axe to the satisfaction of the Administration.

3.3.3.5. Directing the team

The team leaders cannot be involved directly in the fighting operation nor is he involved directly in the supporting task (Stranding, 1989). In any case, the team leader should get involved in a fire fighting operation or support tasks. He should provide concise and precise orders to his team. Basically, based on the directives of the captain and the assessment of the situation, the team leader issues commands to his team members. He has to make sure that the team members do not take improper initiatives that may endanger their lives or worsen the fire situation. However, based on the team leader's knowledge of the qualification of the team members, he can give them the opportunity to respond without his order, but a report should be given to the team leader afterwards about this action (Stranding, 1989).

3.3.3.6. Conclusion

The team leaders play an important role in the achievement of the fire emergency. Being the on scene command, the team leader can see the situation directly, assess its severity and report to the master on the bridge. He can suggest alternative actions if the action plan cannot be implemented, but he has to seek for approval from the captain. A lot of responsibility is in his hands as to maintain the resources at his disposal and to use them in an efficient way. An emergency response can never succeed if the team leaders do not respond efficiently to the emergency.

3.3.4. Conclusion

The fire fighting procedure is undertaken when an immediate response has been carried out. It is of extreme importance to use the available resources in a proper way. The success of the shipboard fire emergency response lies on the close co-operation of all the involved elements. The ability of individuals to fight the fire leads to a success if they are properly led and given appropriate support.

3.4. Summary

One of the factors that may lead to a disaster in a shipboard fire emergency situation is the failure of the organizational response. The organizational part of the response takes place after individual actions during the immediate response have been carried out. The entire crew is involved in such emergency response in order to provide an organised response to the fire. It may not be needed if the immediate response has managed to put out the fire but this only happens when the fire is small and limited therefore its extinction is easy. Table 3 provides a summary of an organizational response that may be applied onboard. This table does not purport to give a final organizational response to any ship, but it can be extended to a certain proportion depending on the size of the ship.

TEAMS AND THEIR FUNCTIONS

Bridge team	Functions
Master: in command 2nd Mate: on watch Unassigned officer: Assistant Radio officer: radio Able seaman: helmsman	Establishing communication Assessment of situation Issuance of commands Control and feedback

Attack team	Support team	Engine room team
Chief officer: leader Engineer officer: assistant Deck officer: assistant Able seamen and ordinary seamen	2nd Engineer officer: leader Deck officer: assistant Engineer officer: assistant Remaining crew	Chief engineer: leader Engineer officer: assistant Motormen: assistant

Functions:

Taking proper initiatives
Assessment of the situation
Establishing communication: report and suggestion of alternative actions, reception of commands
Execution of commands from bridge team
Control and feedback

Table 3

It is observed in this figure that all the teams involved in the emergency should conduct an assessment of the situation. Basically, the issuance of commands belongs to the bridge team while the other teams mostly carry out the commands and report, but they can also suggest alternative actions or take initiatives if necessary. All carried out actions need feed back to cope with new situation.

CHAPTER FOUR
EMERGENCY RESPONSE INVOLVING FIXED FIRE FIGHTING SYSTEMS

4.1. Introduction

It has been previously described that a shipboard fire can be responded to by undertaking immediate response and also, if necessary, organisational response. These responses can be considered routine responses. However, those responses are not always successful because they are based on the fact that the fire can be fought with water through hoselines and that it is located in spaces where it is reachable. Other pieces of equipment are more effective and suitable to respond to certain types of fire and in certain spaces in an emergency. According to Nazzaro (1980), the fixed extinguishing system is, in most cases, a back up that should be used only as a last resort. In this Chapter an attempt is made to describe the fire emergency response involving fixed fire-fighting equipment systems. For the purpose of this paper, this equipment only includes the commonly used systems such as:

- Carbon dioxide system
- Halon system
- Sprinkler system.

4.2. Carbon dioxide system

4.2.1. Introduction

The carbon dioxide system is efficient and has certain advantages when extinguishing fire onboard ships. It is installed in places where fire may commonly occur and is readily available for use when necessary and does not need a deployment of fire fighting groups. It is also advantageous because its use does not leave residue to be cleaned off and does not damage cargo and equipment. It is especially efficient against fires involving flammable liquids. It is common to many ships to have their cargo spaces and engine room protected by this system (Nazzaro, 1989). This Chapter deals with the emergency response involving fire in cargo spaces and engine room.

4.2.2. Fire in a cargo hold

4.2.2.1. Introduction

Fighting a fire located in a cargo hold may not be effective if using only hose lines because of the high probability of the spreading of the fire. This system is only possible when the fire is limited and well located and identified. However, the most effective means to fight the fire is to use the carbone dioxyde system through which the fire is smothered, i.e. the oxygen is removed from the cargo hold. Moreover, it has also a second effect, which is to cool the hold involved in the fire. This system prevents the spreading of the fire and extinguishes it completely, if properly used. The emergency response comprises different steps starting from the hearing of the alarm to the extinguishing of the fire.

4.2.2.2. On hearing the alarm

As noted earlier, when an alarm is sounded or heard, it is the responsibility of the OOW to find out what is happening. The identification of the exact location of the fire can be observed from the bridge if the ship is equipped with detector alarms, which is a regulatory requirement for most ships. Although, it is vital to verify that the detector indication is correct, it must be assumed that the fire is affecting the entire cargo in the involved hold. For this reason, an attempt to fight the fire by portable extinguishers or hose lines should not be conducted. Once, the involved hold is located, the OOW can undertake the next step.

4.2.2.3. Confining the fire

One of the immediate responses that have to be conducted when the fire is located is to confine it in the involved space. In any circumstance for safety reasons, the cargo hold should not be opened while at sea (Lygate, 1998). Therefore, the hatch cover will already be closed. However, if the ventilation is operating, it has to be shut off. Moreover, the vent openings have to be covered, and flaps and any route leading to the hold closed. If it is observed that smoke can escape from the hold therefore any suitable material should be used to prevent it. Furthermore, it is still possible that the fire may spread to other holds therefore a careful watch should be kept on the alarm, to monitor adjoining holds (Nazzaro, 1980).

4.2.2.4. Release of CO2

The release of CO2 is to be conducted only after the above steps have been taken. An officer will be responsible for releasing the CO2 in the CO2 control room. He will select and activate the appropriate valve required to direct the CO2 to the involved cargo hold. If two or more superposed holds are affected, the CO2 should be discharged into the

lowest involved space, then into the next higher space and so on (Nazzaro, 1980). It is also the responsibility of the officer to determine the number of gas cylinders to be discharged into the involved cargo hold or to protect adjoining holds.

4.2.2.5. Cooling the surrounding area

Heated decks, hatch covers and bulkheads take a long time to cool down because of the low cooling effect of CO2. After releasing the CO2, the responsible officer should check if heat is felt on the open deck or the hatch cover of the involved hold. If so, the affected areas should be well hosed with water to assist in cooling to prevent spreading of the fire. The use of hoselines is required for this purpose. If it is possible to establish that the adjoining holds are not affected but the bulkheads separating the holds are heated, it is vital to cool them down (Lygate, 1998). However, using water in holds may affect the stability of the ship therefore a light spray of water should be used to cool heated surfaces. Nevertheless, if the involved cargo hold adjoins the engine room, it may be crucial to cool the separating bulkhead to protect the engine room.

4.2.2.6. Precautionary measures

Precautions are to be observed in relation to the number of gas cylinders available on board. It may be necessary to discharge CO2 in adjoining holds if they are likely to be threatened. Moreover, the maker's instructions on the use of the system using ` topping up ´ requires an additional use of the CO2 in the involved hold. Should the ship run out of CO2, it might be necessary to use the CO2 installed for engine room protection on the involved hold. However, the quantity of gas onboard is limited. Therefore, it is advisable to consider factors such as the distance of the ship from land where supply of CO2 can be obtained and the important threats observed onboard, after the first necessary release

of CO2 in the hold is made. In the author's opinion, the CO2 intended for the protection of the engine room can also be used but only as a last resort.

4.2.3. Fire in the engine room

4.2.3.1. Introduction

A fire in the engine room may be small or very threatening. If it is small, it can be fought with portable extinguishers or by using hose lines. But, in case of a big fire, more efficient means are necessary. In either case, when an engine room fire is discovered the normal routine responses are followed. If these responses are not successful, a more effective response is the use of the CO2 system, which is described below.

4.2.3.2. Evacuation

If the fire cannot be tackled by means of hoselines, the engine room has to be evacuated immediately with the intention of using the CO2 system. During the attempt to fight the fire with hoselines, the group assigned to this task should always be prepared to leave the engine room once it is deemed necessary. However, the chief engineer has the ultimate decision to do so. CO2 is hazardous to humans because if inhaled it raises the acidic level in the blood and leads to respiratory arrest (Nazzaro, 1980). In any circumstance, since a total flooding of CO2 system is to be used in the engine room, evacuation is imperative before any release.

4.2.3.3. Confinement

As in cargo spaces, fires in the engine room also have to be confined properly to prevent spreading. After the engine room is evacuated, the attack team together with the engine room team conduct an external inspection to ensure that doors, skylights, funnel flaps and other openings are properly closed. All ventilation systems must also be shut off to permit a proper confinement of the engine room. However, most ships should now have an automatic shut off ventilation as required by SOLAS Convention. If this task is not properly conducted, using CO2 system may be in vain.

4.2.3.4. Cooling and internal inspection

Cooling the heated areas is necessary to protect them from overheating, which may lead to their deformation or, even worse an explosion (Lygate, 1998). Two or three hours after the release of CO2, it is important to check if the fire is extinguished. An internal inspection can be made by engineers wearing breathing apparatus. Hoselines should be ready to respond in case the fire has persisted. However, the door should only be opened wide enough for the hoselines. Otherwise, there is a risk that the fire will start again because the CO2 may be replaced by entering oxygen. If the fire is out, ventilation of the engine room should be put on to draw out the smoke (Nazzaro, 1980). Due to the fact that it is difficult to find out whether the fire is extinguished or not when entering a smoke-filled engine room, the ventilation can wait until it is really safe to use it. The failure to observe this remark may result in the rekindling of the fire due to the presence of oxygen from air.

4.3. Halon 1301 system

Halon 1301 is a very efficient extinguishing agent for fires involving flammable liquids and gases and electrical equipment. It is able to chemically interrupt the combustion process (Nazzaro, 1980). According to SOLAS Chapter II-2 Regulation 5 Paragraph 3, it can only be used in engine rooms, pump rooms and cargo spaces for vehicles not transporting cargo. The use of Halon 1301 system is practically the same as for a CO2 system. Moreover, the emergency procedure relating to its use in the engine room is carried out in the same way as for a CO2 system. It is not the objective of this part to describe the details of its use in an emergency situation because its use on new ships is forbidden according to SOLAS Convention Chapter II-2 Regulation 5.3 due to its adverse impact on the stratosphere.

4.4. Sprinkler system

The sprinkler system is generally used only to protect accommodation, adjacent passageways, public spaces, and vehicle decks on ferryboats. The utility of this system is mainly to protect people in these areas and maintain escape routes in case of emergency by keeping them cooled. In the fire on board the Universe Explorer, it was identified that the cause of the disaster was the lack of a sprinkler system (National Transportation Safety Board, 1998). The system mainly consists of piping, valves, sprinkler heads, a pump and a water supply. Two options can be used for the sprinkler system, the automatic and the manual one. In the case of an automatic system, the heat from the fire automatically activates it but the use of the manual sprinkler system requires procedural steps.

In case of fire, the response includes the following steps as described by Lygate (1998):

a. Sounding the general alarm to warn the crew.

b. Seeking where the location of the fire is. This location may be checked either on the scene or on the fire control panel on the bridge.

c. Proceeding to the fire, if this has not been done, to identify its extent.

d. Ordering someone to get ready to activate the main valve in order to release the water. Releasing is only to be made when someone is ordered to do so.

e. Ensuring that fire is out after the use of the system. Hose lines and portable fire extinguishers have to be ready for use if small pockets of fire, which cannot be reached by the sprinkler spray, are still burning.

4.5. Conclusion and summary

In conclusion, the emergency response involving fixed fire extinguishing systems is effective if proper precautions are observed on the use of such systems. Such systems are not immediately used when a fire occurs onboard, because the ordinary response comprising the immediate and the organisational one is to be carried out first. Nevertheless, there are certain situations when the use of these systems is the only solution to tackle the fire.

In summary, Table 4 attempts to provide an emergency checklist for the use of fixed fire fighting equipment.

EMERGENCY CHECKLIST FOR THE USE OF FIXED FIRE EXTINGUISHING SYSTEMS

Responses	**Systems**		
	CO2 and Halon system		Sprinkler system
	Cargo hold fire	Engine room fire	
Identification of location of the fire			
Evacuation	If occupied		
Confining			Not necessary
Release			
Cooling			Not necessary
Inspection			
Shortcomings	Only limited quantity of resources available onboard		stability
	Stability when cooling		

 means that it has to be carried out

CHAPTER FIVE
EQUIPMENT PREPARATION FOR SHIPBOARD FIRE EMERGENCY RESPONSE

5.1. Introduction

Chapter two to four have so far attempted to describe the procedures for conducting a shipboard fire emergency response. It has been observed though, through experience, that the effectiveness of fighting a fire emergency does not only depend on the correct undertaking of the procedures and the use of the resources. It also depends on the readiness and direct availability of the resources without which the emergency response cannot be successful. When a real fire emergency erupts, crew members often rush into their equipment, which may be not in a proper order nor prepared for the emergency and thereby delaying the response. In this Chapter, the focus is put on the direct availability of the material resources in order to effectively respond to shipboard fires. The author's intention is to outline briefly the equipment commonly provided for fighting and to comment on the number of pieces, and their installation and maintenance for a better preparation for an emergency.

5.2. Portable fire extinguishers

As noted earlier in Chapter 2, this equipment is mostly used for immediate response to a fire on board. It can extinguish fire at its incipient stage. If the fire becomes more intense, hoselines will be needed to back up the portable extinguishers. There are different types of portable fire extinguishers. They differ depending on which type of fire they are intended to be used for.

5.2.1. Number

The SOLAS Convention, in its Chapter II-2 Regulation 6 Paragraph 7, provides a Regulation on the number of portable fire extinguishers. However, it mostly gives to the State's Administration the onus of approving the number of portable fire extinguishers onboard. In the author's opinion, the minimum requirement of five portable fire extinguishers set by SOLAS on ships of 1,000 tons or more is not sufficient. Accommodation areas, bridge, engine room and other places where fire may commonly occur should be provided with portable fire extinguishers. It should be borne in mind that a sufficient number of such equipment is extremely needed onboard to fight a fire at its incipient stage.

5.2.2. Installation

Instructions on the installation of potable fire extinguishers are vaguely provided by the SOLAS Convention. It only states in its Chapter II-2 Regulation 6 Paragraph 6 that they have to be installed in the entrance of spaces that are to be protected. According to Lygate (1998), the extinguishers should be suspended on a bracket at 76mm above the floor; they should also be clearly indicated and kept at a recognised `fire point ´. This

`fire point ´ is normally identified by its red colour. The number varies with the type and size of the ship. Through the author's experience, the fire points are mostly located at exit doorways, at foot of stairways and in the corridors.

5.2.3. Maintenance

The SOLAS Convention mentions in its Chapter II-2 Regulation 6 Paragraph 5 that fire extinguishers are to be periodically examined as required by the State's Administration. In the United States, the US Coast Guard requires that portable fire extinguishers should be tested and inspected at least once every twelve months (Nazzaro, 1980). The maintenance of such equipment varies with its type. However, it is in general observed through regular inspections and tests. In most cases, it is advisable to refer to the manufacturers' instructions when conducting the maintenance. For example, the portable CO2 fire extinguishers are to be examined each year and ensured that they are not empty. They also have to be stowed at temperatures below 54°c to keep their internal pressure at a safe level (Nazzaro, 1980).

5.3. Semi portable fire extinguishers

The semi portable fire extinguisher is used in an organisational response to a shipboard fire as noted earlier in Chapter 3. When portable fire extinguishers fail to extinguish the fire, this system becomes necessary to provide a sustained attack on the fire. It mainly consists of hydrants, hoselines and nozzles. There are of course other pieces of equipment constituting this system such as pumps and pipes. However, it is assumed in this paper that such pieces of equipment are part of the ship itself, thereby complying

with the Regulations governing the ship in terms of installation and maintenance. This paragraph primarily focuses on hoselines and nozzles.

5.3.1. Hydrants

A requirement in the number and the position of hydrants is provided by the SOLAS 1974 Convention in its Chapter II-2 Regulation 4 and Paragraph 5, which is devoted to the number and position of hydrants therefore it is important to quote this requirement in full before giving a comment on it.

> 5.1 The number and position of hydrants shall be such that at least two jets of water not emanating from the same hydrant, one of which shall be from a single length of hose, may reach any part of the ship normally accessible to the passengers or crew while the ship is being navigated and any part of any cargo space when empty, and ro/ro cargo space or any special category space in which latter case the two jets shall reach any part of such space, each from a single length of hose. Furthermore, such hydrant shall be positioned near the access to the protected spaces.
>
> 5.2 In the accommodation, service and machinery spaces of passenger ships the number and position of hydrants shall be such that the requirements of paragraph 5.1 may be complied with when all watertight doors and all doors in main vertical zone bulkheads are closed.
>
> 5.3 Where, in a passenger ship, access is provided to a machinery space of category A at a low level from an adjacent shaft tunnel, two hydrants shall be provided external to, but near the entrance to that machinery space. Where such access is provided from other spaces, in one of the spaces two hydrants shall be provided near the entrance to the machinery

space of category A. Such provision need not be made where the tunnel or adjacent spaces are not part of the escape route.

The provision in Subparagraph 5.1 is very important in ensuring effectiveness of the hydrants onboard. First, their number should be sufficient in order to prevent failure to extinguish the fire arising from lack of hydrants. Secondly, they also have to be installed in a place where passengers or crew may reach them and use them on fires that may occur in any location or space of the ship. Moreover, a further requirement is provided for the protection of the engine room in subparagraph 5.3.

5.3.2. Hoses

In Regulation 4 paragraph 7of the SOLAS Convention 1974 Chapter II-2, requirements are also set out on the number, type and length of the hoses that are to be used to fight a fire. Once again, the onus is on the Administration to approve the material in relation to the effectiveness of the use of such material in case of emergency. In short, the length of the hoses should be sufficient to allow fighting of fire in any location of the ship. Moreover, necessary couplings are to be provided for each hose, ready for use near the hydrants and connections. Furthermore, other provisions are developed concerning the requirements on passenger ships carrying more than 36 passengers and cargo ships of 1,000 tons or more. The provision of subparagraph 7.3 forbidding the use of hoses for other purposes is of extreme importance in terms of maintenance, because it has been noticed in some ships that they are also used to transfer water.

5.3.3. Nozzles

The SOLAS Convention 1974 only contains provisions on the size of nozzles in its Chapter II-2 Regulation 4 paragraph 8. As far as installation is concerned, no provisions on where they are to be installed have been developed. However, it is advisable that they have to be ready for connection with the hose when needed to be used. In the author's experience, they are mostly stowed in a box located under the hose. In relation to their maintenance, Lygate (1998) mentioned that nozzles have a tendency to stick, and application of oil is sometimes needed to release them. In the author's point of view, a frequent test may prevent this problem to occur and avoid waste of time when the equipment is really needed to fight an actual fire.

5.4. Fixed fire extinguisher

5.4.1. Number

Ships have to be equipped with appropriate fixed fire extinguishers. The number and the type of the fire extinguishers depend on the size of the room they are intended for and also the type and the size of the ship. For example, apart from the engine room the cargo space is also to be protected by CO2 system in cargo ships. According to SOLAS Convention Chapter II-2, Regulation 5.19, the installation of such equipment is to be made in a way that it can cover the biggest space that is intended for protection. The same Convention in the same Chapter, Regulation 5 Subparagraph 1.12 gives the responsibility to the Administration to approve the location of the equipment. Subparagraph 1.13 contains another provision on the stowage of such equipment outside the protected space.

5.4.2. Maintenance

Regular maintenance and inspection would ensure that such equipment is ready for use when needed. For a sprinkler system, basic measures include verifying that all valves are secured in open position, that sea suctions are open, the system is pressurised and the sprinkler heads are not obstructed (Gustafson, 1993). However, this requirement applies only to automatic sprinkler. As for the CO2 systems, the maintenance mostly consists of verifying that there is no leakage from the bottles or the system to ensure readiness and also to prevent hazardous situations for the crew. Furthermore, particular attention should also be given to the quantity of resources and spare parts available onboard as provided in the Regulation 5. Annual control of CO2 is practised in the US but it is now adopted by many countries.

5.5. Fireman's outfit

Regulation 17 of SOLAS Convention in its Chapter II-2 provides complete requirements on the elements constituting a fireman's outfit. It also describes the number of fireman's outfit to be required onboard depending on the type and size of the ship. However, in any type of ship, at least two fireman's outfits should be onboard. In paragraph 4 of the same Regulation, a provision is developed on the requirement through which such equipment should be easily accessible and ready for use. As far as maintenance is concerned, in an actual fire the author came across a case when a breathing apparatus was fetched for use. Unfortunately, the wearer did not realise that the equipment was out of order until he had a problem to breathe. Time was wasted and the equipment was useless because of lack of surveys and tests.

5.6. Conclusion

The success or failure of a shipboard fire emergency response depends on the preparation of the resources assigned for this purpose. A better preparation of equipment prevents the waste of valuable time that should be spent for fighting the fire. In conclusion and summary of what has been covered in this Chapter, the author suggests the following rules governing the fire equipment on board:

- Equipment must be held in a sufficient quantity to ensure use without restriction.
- Equipment must be maintained in perfect state through surveys and tests.
- Equipment must be installed in a place where it is immediately available for use.

CHAPTER SIX
TRAINING AND FIRE DRILLS

6.1. Introduction

The knowledge of the procedures to conduct the shipboard fire emergency response does not necessarily ensure that a shipboard fire emergency can be properly responded to. Chapter five mentioned the equipment preparation that has to be made to prepare a shipboard emergency fire. This Chapter especially covers the preparation of human resources to efficiently respond to a shipboard fire, which is in other words, the training and drills that have to be undergone. The STCW Code provides in its Part B of Annex 2 Chapter VI guidance on the content of fire prevention and fighting courses. Futhermore, SOLAS Convention provides in its Chapter III Regulation 18 Regulations on emergency training and drills. Moreover, the IMO Resolution A.437(XI) on `Training of crews in fire-fighting ´ also provides with important knowledge on basic and advanced training in fire-fighting.

However, the author suggests that training should consist, at least, of providing with sufficient knowledge to the crew of fire fighting and fire fighting organisation for an effective response. On the other hand, drills also have to be conducted onboard to familiarise the crew with the established plan.

6.2. Training

6.2.1. Introduction

Effective training is an assurance that the crew onboard is provided with the necessary knowledge that is needed for a shipboard fire emergency. Fire training should not only aim at enhancing the individual ability of each crew member but also the entire crew's performance to fight a fire in an organised manner. As noted earlier, different materials are written on this subject. However, the purpose of this paper, more precisely this Chapter, is not to give details on fire training in general but to develop certain factors that are important in training for shipboard fire emergency response. Based on the different steps that include fire-fighting response at sea, the author suggests that training comprise at least instructions on theory of fire, fire-extinguishing agents, fire fighting equipment, fighting a fire and a fire-fighting organisation.

6.2.2. Theory of fire

6.2.2.1. Introduction

It has been previously stated that it is very important to properly assess a situation before responding to it and in order to give an accurate report. For this purpose, it is highly important that the crew is provided with a sufficient knowledge of the theory of fire, which consists of their classifications and their spread ability. It is not the purpose of this paper to go in details in different parts that comprise the theory of fire but to emphasise some important factors that play an important role on the knowledge of fire.

6.2.2.2. The Classification of fires

This part of training is normally provided to any certified crew members onboard as basic training on fire safety according to the STCW Code. The classification of fire

depends on the materials involved in such a fire. For example, fires involving wood and wood-based materials are known as class A fires. This training should focus on familiarisation of the trainees with any type of fire. In effect, the objective of such classification is to select different kinds of fires into four known classes including combined classes. Therefore, it is easy to assign which extinguishing equipment is to be used for different classes of fire (Rushbrook, 1979). Practical fighting can be conducted on different kinds of fire during which opportunity is given to the trainees to choose between the use of different types of fire extinguishers.

6.2.2.3. Spread of fires

6.2.2.3.1. Properties of flammable materials

The objective of this training is to provide a proper knowledge to the trainees on the properties of flammable materials which are, inter allia, the ignition point, flammability, flash point, flammable range, lower flammable limit and upper flammable limit. Knowing these properties, the trainees can select appropriate way to prevent a possible fire from spreading or even from occurring. It is also important to explain the different sources of ignition, depending on which a fire may occur or not. A practical example should be demonstrated in order to help the trainees to realise the behaviour of a fire depending on its properties.

6.2.2.3.2. Factors of spread and fire development

Conduction, radiation and heat flows are factors that contribute to the spread of fire. In fact, the spread of fire takes place when there is an equalisation in temperature between the fire and its vicinity through the above mentioned factors (IMO, 1991). Therefore, the trainees should understand that spread of fire is possible through different methods of propagation. In order to properly assess a fire situation, it is also of extreme importance to understand the development of fire. There are four possible phases of fire

development: ignition (incipient), developing (surface), absolute (deep-seated) and burning out (IMO Model Course 2.03). It is therefore indispensable to demonstrate different developments of fire to trainees to help them to carry out proper response to the fire.

6.2.3. Fire extinguishing agents

It has been previously noted that it is important to know the nature of fire in order to assign which type of fire extinguisher can be used to extinguish it. It is equally important to know how the extinguishing agents are acting to extinguish the fire and how to use them appropriately. In fact, at the end of the training, the trainees should be familiar with different fire extinguishing agents. The training should include the description of the use of the common fire extinguishing agents such as water, carbon dioxide, halon and foam. In my opinion, it is also important to describe the danger of misusing such agents. For example, the use of water on an electrical fire is extremely dangerous; therefore trainees should be completely aware of such danger.

6.2.4. Fire fighting equipment

The training of seafarers on fire fighting is now possible when appropriate knowledge of fire extinguishing agent is gained. In fact, a further knowledge is given to the seafarers on the fire extinguishers themselves. The training should include explanation on the location and the use of portable, mobile and fixed fire-extinguishers including other equipment such as the fireman’s outfit. It is more interesting to conduct such training on board ships to help the seafarers to familiarise themselves with such equipment. For example, in the case of the fireman’s outfit, each seafarer should be given a knowledge

of how to don protective clothing quickly and how to use and check if a breathing apparatus is ready for use.

6.2.5. Fighting a fire

Training on how to fight a fire is the most necessary training that has to be conducted onboard ships. This should first include familiarisation with the emergency equipment such as emergency generator, emergency fire pumps and all the different valves that have to be acted upon for the use of some fire extinguishers. As part of the training, the seafarers are also given instructions on personal safety during fighting operation by putting them in a condition similar to an actual fire. In this respect, finding the way in restricted visibility, moving through small areas and exposing themselves on a simulated fire will enhance their ability for fire fighting responses.

6.2.6. Fire fighting organisation

This part of the training provides a knowledge of the functioning of a fire-fighting organisation. In other words, each crew member should be familiar with the way an organised fire fighting operation should be conducted. This part of the training is specific to a particular ship; therefore, it is better to conduct it onboard the crew's ship. A seafarer, who is familiar with the effective use of fire extinguishers is not directly operational unless he or she has undergone training on the organisation of the fire fighting onboard his ship. Table 5 provides a typical training for a fire-fighting organisation.

TYPICAL TRAINING ON FIRE FIGHTING ORGANISATION

Instructions	Necessary information on the ship in fire emergency	Communications	Functions of each team	Containment of fire
D **E** **T** **A** **I** **L** **S**	Accesses and escapes from different zones of the ship	The Chain of Command	Functions of the leaders	Fire and smoke boundaries- Closing of water tight doors, fire doors
	Use and location of fire alarm	Communication procedures in an emergency	Functions of each team members	Stopping of ventilation fans
	Information on the established plan for emergencies onboard	Location and use of the equipment such as telephones and walkies talkies	Co-operation between teams	Closing of dampers on funnel
	Location and use of fire extinguishing equipment	Location and use of communication equipment	Co-ordination of tasks within the team	Monitoring of ventilation

Table 5

6.2.7. Conclusion

Training is an instrument that is used to make sure that seafarers are provided with a proper knowledge, which gives them the ability to overcome the threat presented by a fire on board (Kjaeruff J, 1995). Training on fire protection normally takes place on two levels: training offered at a training centre ashore and the training conducted aboard the seafarers' own ship. In the training centre, seafarers are familiarised with fire and the way it is to be fought by theoretical and practical instructions. On the other hand, training conducted onboard the seafarers' ships builds familiarity and confidence with the use of the equipment carried onboard and the ship itself. It also makes sure that the knowledge gained from the training centre is properly conducted onboard ship taking into account the different parameters such as crew number and type and size of the ship.

6.3. Shipboard fire drills

6.3.1. Introduction

During training, the seafarers are provided with knowledge of the fire and the related strategy to fight it, either individually or in an organisational way. They are also instructed on the specificity of their ship in dealing with a shipboard fire emergency through training. The objective of shipboard fire drills is to make sure that in case of fire the seafarers undertake a proper response to extinguish it. In most cases, fire drills request the undertaking of an organisational response to a fire during which the crew is expected to demonstrate the ability to carry out properly the different steps that include such response. It is not the intention of the paper to go in details in the conduct of such drills, but to stress the points at which such drills should focus to ensure effectiveness. These points include:

- Full application of the plan

- Proper equipment
- Record and feed back

6.3.2. Full application of the plan

It is not the purpose of a fire drill to apply textually the written plan for a shipboard fire emergency because the crew has been given the ability to understand a fire situation and to respond to it accordingly. Instead, a fire drill should stimulate the crew's ability to think fast and be flexible in demanding and ever-changing situations. On the other hand, it is vital that the crew properly apply the established plan in a fire drill to cope with a fire situation. In fact, the plan itself may change if the fire drill has revealed a deficiency. In the light of this, a non-application of the established plan will not help to find deficiencies. Moreover, a persistent non-application or a wrong application of the plan may lead to inadequate response to an actual fire. A crew who always considers any alarm to be a fire alarm emergency may waste its time to get prepared if the emergency may be different from a fire.

6.3.3. Proper equipment

It has been noticed that most fire drills have been conducted without emphasis on the way the crew is fitted with proper outfit. A survey on fire drills conducted by Kjaerulff (1995) on a ship processing vessel has revealed that the breathing apparatus were only set on deck unopened. It was therefore advised to put them on during the drill. When attempt was made to put them on, it was observed that some crew members did not know how to don it. Apart from that, most of the apparatus did not fit the crew members. In the light of this, if a real fire occurred, the crew would not be able to use the outfit and

breathing apparatus and a disaster might happen. The purpose of wearing such equipment during a drill is also to test and survey its state. Apart from the suitability of the materials with the crew size, a deficiency on the equipment may also be found during a drill.

6.3.4. Record and feed back

The importance of a full application of a shipboard fire emergency plan in order to check its adequacy has been previously stated. In order to verify if such an application is properly undertaken, it is important to keep records of the different steps, followed by the crew, while carrying out the response during the fire drills. For the purpose of verifying the adequacy of the plan, it is of extreme importance to hold a feed back briefing after a drill. Different matters can be discussed during such a briefing. A discussion on the problems encountered by the crew during the fire drills will help to take remedial actions by furthering instructions on the application of the plan. The strengths and weaknesses of such a plan may also be discussed during the feed back in order to amend it if needed. In some ships, the author discovered that when the fire drills had been performed the crews were just supposed to restore their equipment and continue the normal operation of the ship. Such practice does not take any benefit from the fire drill that has been carried out.

6.3.5. Summary

As a summary, it is possible to mention that fire drills are the assurance that the eruption of any kind of fire on board does not present a high threat to the crew because of its adequate preparation. The main objective of the drills is to encourage the crew to always

think in terms of “what if”. It is though to be stated that such fire drills should be as realistic as possible and the established plan should be thoroughly followed to check its effectiveness and take remedial actions if needed. They also have to be undertaken frequently and competently on board.

6.4. Conclusion

Training and fire drills are two indispensable ingredients to make a crew safe from the risk that a fire may present to its life or its ship. The crew is given the ability to understand a fire situation and to respond to it accordingly through training. It is also the purpose of training to give to the crew the ability to think fast and be flexible in demanding and ever-changing situations. Training may be conducted ashore but also onboard crew’s ship in which, acquaintance with the fire equipment, its use and the undertaking of the organisational fire fighting operation in a fire situation can be made possible. On the other hand, the fire drills should make sure that such training, especially on the organisational response to a fire, is properly carried out onboard and to review such response for its improvement. Lastly, it is of extreme importance to train the crew to cope with changing situations instead of sticking to a strict plan that may not be proper for the prevailing fire situation.

CHAPTER SEVEN
CONCLUSION AND RECOMMENDATIONS

7.1. Conclusion

This paper can be divided into two main parts. Chapters two to four cover the procedures for a response to a shipboard fire while Chapters four and five deal with the preparation that has to be made to ensure the effectiveness of such response.

The first part of this paper has shown the different situations that may prevail in case of a shipboard fire and the response that has to be given accordingly. The author has first pointed out the different steps that comprise an immediate response, which is a response that has to be conducted promptly when a fire erupts. This response starts from the time when a fire is discovered and ends to the time when an organisational response is needed as a back up. It is pointed out that a succession of responses has to be followed step by step to cope with the fire. However, it is possible to alter the pre-established response plan depending on the prevailing situation.

Secondly, the author has developed how an organisational response plan can be carried out. This response is undertaken with the co-operation of the entire crew. An effective organisation of the teams involved in such response is of extreme importance to ensure effectiveness.

Lastly, it has been pointed out that fire affecting certain spaces such as cargo holds and engine room, involves a response that requires the use of a fixed fire extinguishing

equipment. Moreover, the organisational response may not be successful thereby requiring the use of more efficient equipment. It is worth pointing out that any fire onboard when erupting should be responded to directly with the immediate response, followed by the organisational response and then by the use of fixed fire extinguishers if needed. However, if the fire is so intense it may be necessary to undertake directly the last response (not in the case of fire in cargo holds where the use of fixed fire extinghishing system is the only response).

In the second part of this paper, the author has pointed out the importance of a good preparation comprising materials and personnel preparations for a successful undertaking of the response. In Chapter five, the author suggests that sufficient number, good maintenance and proper installation are the key elements that ensure effectiveness. On the other hand, as far as the preparation of human resources is concerned, training and drills are a prerequisite for the crew's assurance to respond effectively and efficiently to a shipboard fire at sea. Training includes training in shore-based facilities and onboard the ship's crew. Theory of fire and its corresponding response together with the fire-fighting organisation include the minimum knowledge that the crew has to know to carry out effectively a shipboard fire response.

Finally, it is worth pointing out that this paper has given a basic understanding of what a response to a fire can be at sea. It has not gone in details on how such response can be carried out in different types of ships nor has this paper given a fixed response plan to any fire situation on board. However, the objective achieved by this paper is to provide a framework of a shipboard fire response plan that is valid for any ship. This framework can then be developed by seafarers taking into account the particularities of the ship and the crew. Although the response plan developed in this paper is a basic and indispensable tool, it is to be stated that a fire on board does not only require a textual application of a response plan but a full understanding of a fire situation in order to

respond to it competently. In order to acquire such understanding, the crew should undergo training and the key factor for an effective response is only through drills conducted onboard.

In terms of training, it can be concluded that although different matters encompass training for fire safety, the ones that are necessary and vital to the crew, for the purpose of this paper, comprise the knowledge of fire, fire fighting equipment, fire fighting and fire fighting organisation. The application of such training on board the ship's crew, especially the fire-fighting organisation, is of extreme importance to provide familiarisation of the crew with its ship and the way a fire can be fought onboard.
As far as fire drills are concerned, the importance of the full application of the pre-established plan and the conduct of drills in a possible realistic scenario have been pointed out. The failure to follow such suggestions does not take any advantage of fire drills.

7.2. Recommendations

As pointed out in the introduction, fire onboard is a real threat to the shipping business. The author suggests the following items attempting to minimise such threat by the way of improving a shipboard fire emergency response plan at sea, as mentioned in the this paper.

- It is recommended that the crew be familiar with the immediate response to a fire. This response, as provided in Chapter one, has to be part of the safety culture of each crew member, enabling him to undertake appropriate individual response when a fire first erupts at sea.

- It is recommended that all crew members have knowledge of fire, be able to assess a fire situation and respond properly to it according to its position and nature and other relevant factors. Training is the guarantee to it, which is conducted ashore and aboard.

- It is recommended that any member of the crew know his or her task in an organisational response to a fire. Such knowledge is acquired through adequate training and maintained through frequent and appropriate fire drills.

- It is recommended that equipment preparation be given an important consideration in order to use it in a proper condition when a fire erupts onboard. Such objective is only achieved through proper and frequent maintenance and with the provision of sufficient number of such equipment onboard.

- It is highly recommended that training and drills be not considered as waste of time nor money. Training and drills must not be neglected because these are the only assurance seafarers and shipping managers can have in hand that their ships operate safely with competent crew that can cope efficiently with possible fire onboard.

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