THE CAUSE AND PREVENTION OF MARINE FIRES

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1. INTRODUCTION

The occurrence of a fire or explosion on a vessel at sea is potentially one of the most hazardous occurrences that can face a Master and crew. The danger to life may be great, particularly in the case of a large passenger-carrying vessel. There is also the potential for extensive damage to be sustained by the vessel. Over the past 26 years, I have been involved in the investigation of several hundred fires and explosions on vessels of all types, including cruise liners. During this brief talk, I will attempt to outline the major causes of fires onboard cruise liners, as revealed by my investigations into such events. The investigations into the causes of fires on ships have also revealed problems that can arise in connection with fire fighting, fire protection equipment, methods of construction, equipment maintenance, training, and work practices onboard ships. Attention to these potential problems can reduce the likelihood of fires occurring on vessels and can also mitigate the effects of unwanted fires and explosions.

2. THE CAUSES OF FIRES AND EXPLOSIONS ON CRUISE VESSELS

2.1 The Basic Requirements

In order for a fire to occur, we need three things, namely, a source of oxygen, a source of fuel and a sufficiently potent source of ignition.

The oxygen is usually in the form of air and will generally be present in all locations in which fires might occur on cruise liners. There are of course exceptions to this on other vessels, such as in the case of unusual cargoes and inerted tank ships.

The fuel will depend on the space in which the fire originates. For example, we are generally concerned with solid combustible material in cabins and other accommodation spaces. Liquid fuels such as diesel oil, lubricating oil or fuel oil are often the combustibles involved in engine room fires. Liquid fuels may also be involved in galley areas. Flammable gases such as acetylene and propane may be involved in certain spaces such as workshops.

The source of ignition will also be situation dependent to some extent. Some sources of ignition, such as electrical faults or carelessly discarded smoking materials, may appear in a number of different spaces. However, spontaneous ignition of fuels by hot surfaces is more often encountered in engine spaces or galley areas.

2.2 Fires in Different Spaces

The cruise vessel, because of her service requirements, must provide extensive and luxurious accommodation and leisure facilities for her passengers. This usually means large circulation spaces and numerous cabins, together with restaurants, ballrooms, bars, casinos and promenade areas. The quest for comfort and luxury in early designs led to extensive use of combustible finishes and furnishings. The effects of such finishes in terms of extensive and rapid fire spread were amply demonstrated by fires on vessels such as the LEONARD DA VINCI, ANGELINO LAURO and SEAWISE UNIVERSITY. These vessels were largely gutted by fires that swept through the vessels consuming most of the combustible material that was present. More recent legislation has sought to reduce the available fuel in accommodation sections and thus reduce the risk of extensive and severe fire, which would likely be accompanied with fire spread to other areas of the vessel.

The sources of ignition for fires in accommodation and service spaces is often related to accidental human agency, such as carelessly discarded smoking materials, or galley accidents as on the ANGELINO LAURO. They may also be caused by repair work involving welding, flame cutting or grinding. A recent example of this is a fire that occurred in 1998, which was due to an electric arc being accidentally struck from welding equipment positioned in a laundry area prior to a repair being carried out. Electrical faults or faults in electrical appliances may also cause ignition.

Finally, fires in accommodation and service areas have been deliberately set on several occasions. The perpetrator may be a crewmember or a passenger.

Engine room fires, broadly speaking, fall into one of two types. First, they may be electrical in origin and involve electrical machinery, switchboards or wiring. Causes may include damaged cables, resistance faults at poor connections, or arcing of contactors or overheated components. The spread of fire may not be extensive but the effect on the vessel may be disastrous in terms of a total loss of power for a significant period of time.

The second type of fire encountered in the engine room usually involves a leakage of oil. Typical examples include the failure of oil lines carrying fuel or lubricating oil under high pressure. The failure of such a line can give rise to a significant jet, or spray of oil, which may encounter hot surfaces such as the exhaust uptakes of main and auxiliary engines. These surfaces are often sufficiently hot to cause spontaneous ignition of the spilling fuel and produce a serious oil-fueled fire. In addition to oil leakage through the failure of components, there are many examples of crew error leading to a leakage of oil under pressure. A typical example is the incorrect manipulation of filter assemblies on engines giving rise to an oil spray or jet. Similarly, filter covers may be incorrectly secured, or bleed cocks left open, thereby giving rise to jets of fuel oil.

In addition to machinery spaces, fires may also occur in workshop areas and have previously been associated with the use of welding and flame cutting equipment. A typical example being the lack of an adequate flame arrestor in a cutting torch allowing a flashback to occur through an acetylene hose to rupture the regulator on top of a cylinder, thereby causing a continuing acetylene fire in a workshop area. Such fires can spread to upper areas of the engine room and, for example, incapacitate the main engine control room and switchboard areas.

In addition to accommodation areas, service spaces, and engine rooms, fires can develop in goods contained in storage and cargo spaces. There may be significant quantities of solid combustible materials in these spaces, including for example cardboard packaging material. There may also be liquid fuels available in the form of cooking oils. Causes of fires in storage areas and cargo spaces often relate to human agency, such as carelessly discarded smoking materials. Alternatively they may be caused by faults in electrical cables and lighting equipment. Given the nature of the materials present, the fire may well be of a smoldering nature and not immediately apparent.

3. PREVENTION OF FIRES AND MITIGATION OF EFFECTS

The three elements required for the outbreak of a fire have been listed above. As noted, a supply of oxygen is nearly always going to be available and little or nothing can be done to remove this leg of the triangle. In order to reduce the risk of fire, we must

therefore restrict or eliminate the source of fuel and eliminate or reduce the likelihood of the source of ignition being present.

In terms of accommodation sections, the regulations presently in force seek to limit the amount of combustible material used in accommodation sections. The regulations also divide the vessel into main vertical zones with thermal structural boundaries. This precaution restricts the spread of fire should one develop in a particular area. Care must be taken to ensure that penetrations in the structural boundaries are fitted with the appropriate closure devices that must operate correctly in the event of fire. Nevertheless, it must be accepted that some combustible material will be present and care must be taken to eliminate sources of ignition.

In preventing or reducing the likelihood that a source of ignition can be present, care must be taken to ensure that all appliances and associated services are correctly designed, installed and maintained. Furthermore, the crew must be made aware of the hazards involved with particular appliances. For example, the hazards associated with hot work, including welding and flame cutting, must be thoroughly understood by those concerned with this work. Similarly, the hazards of galley equipment must be fully understood by those responsible for the maintenance and operation of such appliances.

There is, of course, always the possibility that a fire may develop due to human agency, either accidental or deliberate. Under these circumstances, the design and construction of the vessel will govern how the fire develops and spreads.

Turning now to engine room fires. As in the case of accommodation fires, crew training is paramount in avoiding unsafe work practices and the accidental spillage or leakage of oil that may become ignited and give rise to a serious engine room fire. In addition, care must be taken to ensure that all machinery is properly installed and maintained. Care must be taken to ensure that only the appropriate components are used in repair of machinery.

4. DETECTION AND EXTINGUISHMENT

The intent of the present regulations governing the construction of vessels is to contain a fire in the area of origin and to restrict the speed of spread by the appropriate choice of constructional materials. The regulations also require that the fire be detected in the zone of origin and finally extinguished. These aims can be accomplished by a variety of detection and extinguishing systems and by the use of regular and effective patrols on the vessel. Once again crew training is of great importance, both in use of the detection and extinguishing systems and in the formation and operation of fire fighting teams.

5. CONCLUSIONS

It must be accepted that the risk of a fire starting on a cruise vessel is always present. Fires may develop in any one of a number of spaces in the accommodation section, service areas, storage areas or engine room. The risk of an outbreak of fire can

be reduced by proper training of the crew and ensuring that correct operational and maintenance procedures are followed.

The installation of an effective, well designed fire detection and extinguishing system coupled with a well trained crew, complements structural fire protection and operational procedures in reducing the extent of likely fire spread and therefore reducing risk of loss of life and damage to property in the event that a fire does occur.