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Shaping shipping for people

Photo 1. Fire on board the livestock carrier Ocean Drover [7].

This issue focuses on fire prevention on vessels, including some information on the following key safety factors:

- maintenance of electrical and mechanical systems
- maintenance of fire protection systems
- importance of safety culture.

Fire prevention on vessels

Shipboard fires cause more fatalities than other types of accidents at sea, and they often occur unexpectedly. This makes fire prevention an essential element of maritime safety.

In this issue, Australian Maritime Safety Authority (AMSA) safety data is used to explore safety factors associated with fire, highlighting the risks and ways to mitigate fires at sea.

The Safety of Life at Sea (SOLAS) Convention, Chapter II/2 clearly sets out the requirements to prevent, detect and extinguish fires on vessels. Despite this, fires continue to result in fatality, loss of vessel and environmental pollution [1]. An analysis of 24,301 maritime accidents from Lloyd's worldwide shipping accident database that occurred between 2001 and 2011 shows that fatalities from fire accidents are 1.32 times more likely to occur than from other types of maritime accidents [2].

Case study

Fire broke out in the main engine room of a passenger vessel when fuel spraying from a leaking flange came in contact with a hot surface on the port main propulsion engine[3]. The fire could not be contained and subsequently the vessel was abandoned.

The investigation identified that no maintenance records were available for when the flange blanking plate, gasket material and fasteners were last repaired or replaced. The blanking plate did not meet the manufacturer's specifications and the gasket was composed of silicone rubber—a compound that breaks down when exposed to fuel.

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Based on evidence of smoke rising from the ship's funnel, the report concluded that some fire dampers did not close, or did not seal properly. This allowed oxygen to continue to feed the fire while making the carbon dioxide fixed firefighting system ineffective.

All eight fuel and lube oil quick-closing valves were found to be intentionally blocked open, making it impossible to isolate fuel and lube oil from the main engine room. This contributed to the spread of the fire.

The investigation determined that the probable cause of the fire was the operator's poor safety culture and ineffective implementation of their safety management system, where poor maintenance practices led to an uncontained fuel spray from a blank flange.

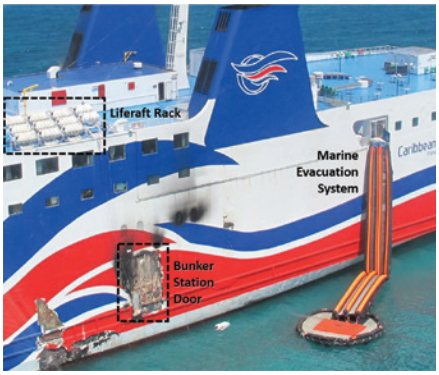

Figure 1. Image of the fire affected vessel and escape route.

Incident and inspection data

Between September 2015 and September 2019, 75 reported maritime incidents in Australian waters involved fire and smoke. The majority (46 per cent), occurred in machinery spaces.

Of the fire-related port state control inspection deficiencies, 22 per cent related to fire ventilation (fire dampers, galley exhausts etc.), 19 per cent to fire equipment, 18 per cent to passive fire protection—including fire doors, and 16 per cent to unsafe practices—including having equipment readily available and doors/hatches/valves gagged open.

A review of investigation reports from national agencies into fire and explosion incidents between 1990 and 2015 concluded that 43 per cent of incidents involved maintenance related activities [4]. AMSA's statistics are consistent with the findings that unsafe maintenance practices, including maintenance of fire protection equipment, significantly contributed to the risk of fire.

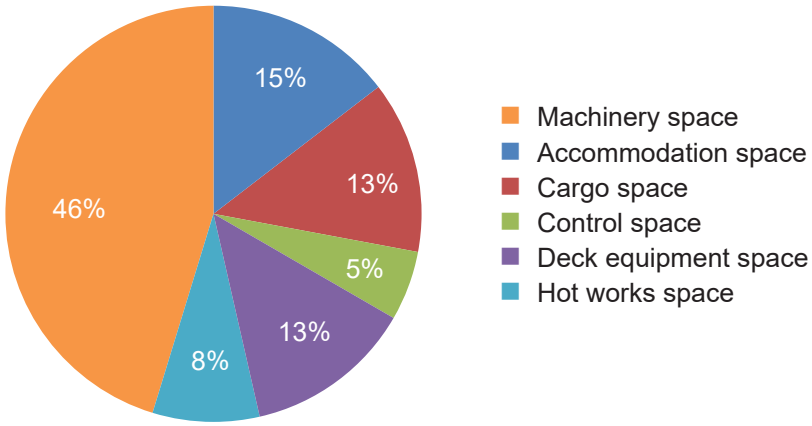

Figure 2. Location of fire (Source: AMSA marine incident data 2015-2019).

Factors influencing fire risk

The risk of fire at sea is likely to be affected by maintenance, maintenance of fire equipment and safety culture.

A review of the marine incident and inspection data and case studies highlight the following factors as influencing fire risk:

- maintenance of electrical and mechanical systems
- maintenance of fire prevention equipment
- poor safety culture.

Maintenance of electrical and mechanical systems

Regular engine, equipment and machinery maintenance will help minimise the risk of fire as well as mitigate the spread and consequences of fire [4].

The lack of effective maintenance practices and procedures increases the risk of technical deficiencies going unnoticed and unreported. Deficient maintenance work can create new hazards generated by short cuts and invalid procedures [5].

Adopting a systemic approach to maintenance can help to identify issues early, and ensure corrective actions are put in place.

- Plan maintenance to include regular inspections, preventative, functional and operational checks.
- Maintenance-related risks must be included within the safety management system to ensure appropriate risk controls are in place.
- Capture design-related hazards or limitations and ensure all affected parties are aware.
- Investigate technical failures and make improvements to minimise the risk of fires.
- Additionally, Infra-Red Thermography can be used.
- Ensure procedures and training are relevant and up-to-date. Be vigilant in addressing short cuts and workarounds, as these may become a norm resulting in unintended consequences.
- Regularly review maintenance actions and processes for effectiveness. See figure 3—order of effectiveness of risk controls in maintenance.

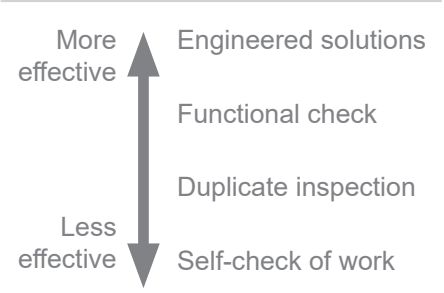

Figure 3. Order of effectiveness of risk controls in maintenance [6].

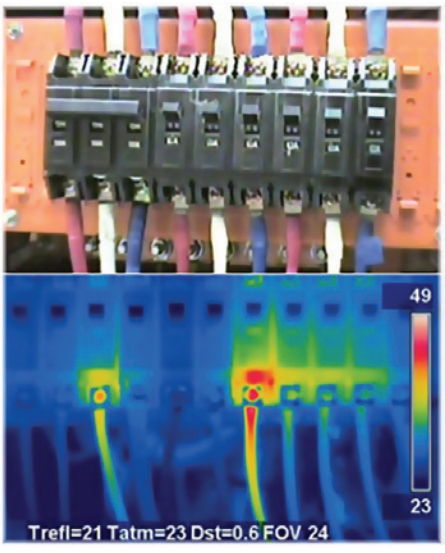

Photo 2. Infra-red thermography illustrates hotspots on a circuit breaker.

Maintenance of fire protection systems

SOLAS Chapter II/2 Regulation 14 (operational readiness) requires that fire protection systems be kept in good order to ensure their effective performance if a fire occurs. This includes firefighting appliances being readily available for immediate use.

Deficiencies in fire protection equipment are also frequently found during port State control inspections, including:

- fire dampers
- quick closing valves
- fire doors

Fire dampers

The purpose of a fire damper is to stop the flow of air into a space to help prevent the spread of a fire in an emergency. Common fire damper issues include:

- holes caused by corrosion
- not closing completely, or at all
- excessive effort required to open and close the damper.

Photo 3. Fire damper unable to close.

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Routine checks and maintenance must be done to make sure fire dampers and their control mechanisms operate effectively.

Quick closing valves

Quick closing valves are positive shutoff valves on fuel oil systems serving to isolate fuel and lube oil tanks in the event of a fire. These valves are designed to be remotely operated and play a key role in fire prevention.

It is crucial that quick closing valves operate correctly, are maintained and ready for use at all times. Proper routine maintenance is necessary to ensure remote operation and closure of the valve.

Blocking or disabling these valves is an unacceptable safety risk under any circumstance.

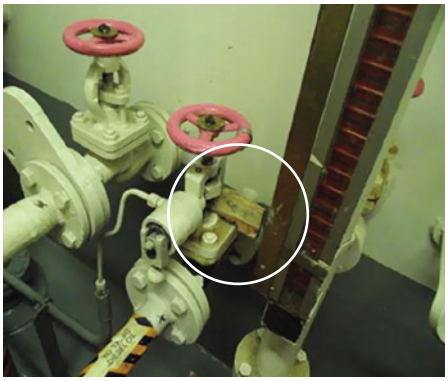

Photo 4. Quick closing valve held open using a block of wood.

Fire doors

Fire doors should be inspected for effective operation and for modifications or evidence they are being intentionally kept open, enabling the spread of potential fire.

For example, a fire started in the crew cabin of a livestock ship [7]. A bridge-deck stairwell fire door was hooked open which allowed the fire to spread rapidly and engulf the accommodation spaces, and the upper and bridge decks.

Effective containment relies on maintaining the integrity of fire divisions, including bulkheads, decks and doors.

Photo 5. Fire door lashed open.

Safety culture

The case referred to in this bulletin highlight poor safety culture as a contributing factor in ship fires.

Poor practices repeated over time gradually become the norm. If the vessel owner, master, chief engineer and crew do not effectively address unsafe practices or shortcuts, these practices will be seen as acceptable behaviour, creating a shared mindset that safety is not a priority.

A good safety culture can be achieved through a combination of genuine commitment from management and supported by a successfully implemented safety management system that encourages seafarers to apply safe practices at all times [8].

Key messages

- Fires are more likely to result in fatalities, loss of vessel, and environmental pollution than other incident types.
- Include maintenance related risks in the vessel's safety management system.
- Poor maintenance processes and ineffective maintenance of fire protection equipment are major contributors to ship fires.
- Fire preventative equipment must be incorporated into planned maintenance systems.
- A ship's safety culture will influence the effectiveness of maintenance (including fire related systems), safety behaviour on the vessel, as well as the operational readiness of the crew in fighting the fire.

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