BALTIC SEA MIRG
Project 2014-2016

SHIP FIRE INCIDENT ANALYSIS
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1. Overview

A fire on a ship at sea is always serious and dangerous. The crew of the ship and any external help dispatched to assist with the situation must take rapid and appropriate steps to extinguish or limit the fire. In the event of an extensive ship fire, the greatest challenges concern decisions about when to muster any passengers on the ship at its rescue stations, or even evacuate them, and how long firefighting measures are carried out before the ship must be either partly or even completely exited. Taking the ship to a port or place of refuge also involves great challenges.

This report was drafted as part of the Baltic Sea Maritime Incident Response Group (Baltic Sea MIRG) project, which is led by the Finnish Border Guard and financed by the Ministry for Foreign Affairs of Finland in order to develop co-operation in the Baltic Sea, Barents Sea and Arctic region. The Baltic Sea MIRG project seeks to develop joint co-ordination models and operational guidelines (OG) for the use of the authorities, particularly in dealing with ship fires, in order to enhance the efficiency of Maritime Incident Response Groups (MIRG) or similar special teams providing external help during maritime incidents (for more information on the project, see www.rra.fi/MIRG).

MIRG teams are generally the best-known firefighting teams providing external help. Some Fire and rescue services maintain MIRG teams. The purpose of this “Ship Fire Incident Analysis” report is to analyse ship fires that occurred in Europe in the 2000s in order to support the development of the joint co-ordination models and operational guidelines procedures for MIRG operations.

The analysis was carried out in two phases. The first consisted of a brief general overview of ship fires in Europe and their special characteristics. In the second, seven ship fires were examined in greater detail. The geographical coverage of the report is limited to the territorial waters of European countries (Search and Rescue Regions, SRRs). The analysis results are presented in two sections:

- Statistics (Chapter 3)
- Case analysis (Chapter 4)

The “statistics” section reviews incident statistics on ship fires in Europe from 2000–2015. In this context, “ship fire” refers to a fire or an explosion that caused a fire on the ship. The section examines ship fires in terms of 1) vessel type, 2) whether the incident occurred at sea or port, and 3) use of external help, that is, whether external parties assisted with extinguishing the fire.

The report only includes fires at sea or ports involving ships larger than 300 GT (gross tonnage) for which information on the use of any external help was available. This report does not include ship fires at shipyards.

The second section of the report, “case analysis”, takes a closer look at seven ship fires at sea involving different kinds of vessels. In all these cases, the firefighting efforts of the crew were supplemented with external help at some stage of the rescue operation. Accordingly, the case analysis section examines and analyses the significance of external help during the course of the incident with a view to answering the following questions:
1. How was external help used and how did it affect the progress of the situation?
2. What were the “lessons learned” for the future development of MIRG operations?

The analysis draws not only on incident statistics and interviews with experts, but also on incident studies and reports by accident investigation boards and other authorities from different countries.

Due to the limited resources and materials available, some of the observations presented in this report may be based on second-hand information or generally available publications concerning the incident in question.

The report largely focuses on the operating principles of MIRG teams and co-operation between the maritime search and rescue authority, Fire and rescue services and the distress vessel. It is hoped that the report will serve rescue professionals by providing a regionally extensive description of the challenges and operating models involved in ship fires. The report is also intended to clarify the special characteristics of ship fires to those who do not deal with the details of such incidents in their daily work.

2. Key definitions used in the analysis

In the event of a ship fire, the situation can be brought under control with the help of many different actors and functions. The major ship fire related terms used in this report are discussed below: maritime search and rescue, Fire and rescue services at sea, MIRG team, salvage, place of refuge.

2.1. Maritime search and rescue

Maritime search and rescue (SAR) involves saving and safeguarding people in distress and danger at sea. Maritime SAR can be considered to include many kinds of tasks, such as assisting ships and boats in maritime distress, preventing accidents, searching for persons and vessels lost at sea, consultation with physicians and medical transportation from archipelagos and other sea regions. The principles for the performance of these tasks are laid down in international agreements and in some cases also in national laws and decrees. Salvaging assets, such as ships or boats, does not constitute SAR, but a commercial or contractual activity. As a rule, most salvage operations are carried out by commercial companies (see the section entitled “salvage”).

International principles for maritime SAR:

- The minimum requirements for a functional maritime SAR system are set in the International Convention on Maritime Search and Rescue (also known as the Hamburg Convention) and its amendments. It is intended to promote international and national joint operations between actors participating in maritime SAR.
- The International Convention for the Safety of Life at Sea (“SOLAS”) includes the general obligation to organise maritime SAR.
- The International Aeronautical and Maritime Search and Rescue Manual (“IAMSAR manual”) of the International Maritime Organisation (IMO) and the International Civil Aviation Organisation (ICAO) seeks to harmonise maritime SAR organisation, operating models and joint operations between different actors.

2.2. Fire and rescue services at sea

Fire and rescue services engage in maritime operations based on their ordinary day-to-day capabilities to operate on water. For instance, Fire and rescue services in Finland use either their own or a contract-based fleet, in co-operation with their land units. Fire and rescue services as a rule engage in such operations in their own area of operations. If necessary, the Fire and rescue services can use their own fleet to support single missions in the area of operations of neighbouring Fire and rescue services or even participate in maintaining maritime preparedness on a broader scale. The scope of operations depends largely on a risk analysis of the area in question and the available resources. The basics of operations and the co-ordination and command structure are usually determined on the basis of the national rescue legislation when the units do not participate in maritime SAR operations. A fire on an island or rescue diving of a drowning person very close to shore are typical examples of the maritime operations of Fire and rescue services.
2.3. Maritime Incident Response Group

Maritime Incident Response Group, MIRG, is a term used in international seafaring for a special team that is trained and equipped to operate in special maritime SAR situations to support the rescue measures carried out by the crew of a vessel. Typically, these operations focus on ship fires, but may also involve a range of damage-prevention tasks, help with evacuation and first aid. Most MIRG teams are special units maintained by fire and rescue services. Their members are trained to work with support from SAR helicopters.

All members of a professionally skilled MIRG team have been provided with orientation and training for the special characteristics of maritime operations. Not all Baltic and European countries currently have such MIRG teams. It should be noted, however, that most Baltic Sea and European countries provide assistance for firefighting efforts at sea even if they do not have official MIRG teams. External help always supplements the ship’s own organisation, and operations on the vessel at sea are carried out in the manner approved by the master of the vessel.

The composition, equipment and tasks of a MIRG team are explained in greater detail in other sections of the Baltic Sea MIRG project.

2.4. Salvage

In ship fires, it is often difficult to draw a clear line between maritime SAR and salvage. Salvage is the recovery of assets and is as a rule carried out by commercial companies. However, it should be noted that the international maritime law obligates each vessel to help those in maritime distress if this is possible without endangering their own vessel or crew. The maritime law also lays down provisions on the right of the first rescuer to a share of the salvage reward. Furthermore, national laws may also oblige authorities to render assistance over and above maritime SAR, which may partially conflict with the general principles of salvage.

In general, maritime SAR efforts continue until there is no longer any reason to suspect that anyone is in jeopardy at sea and until the Search and Rescue Mission Co-ordinator (SMC) has concluded the maritime SAR operation. All actions taken to save the lives of people and transport them to safety constitute maritime SAR, which may partially overlap with the salvage operation.

Maritime SAR operations are carried out by state authorities under the command of the leading maritime SAR authority, whereas salvage operations are performed at the request with the consent of the master of the vessel under terms governed by contract law. Salvage also intersects, through the recovery of assets, with the prevention of environmental damage. The obligations and measures involved in taking a distress vessel to a place of refuge in Europe may also cloud the boundaries between the operations of the authorities and salvage.

2.5. Place of refuge

A distress vessel is brought to a place of refuge when the vessel is in a situation in which it may be lost or poses a danger to the environment or maritime safety. This requirement is quite broad, as it concerns not only the vessel’s own need for assistance but also the need to protect the environment and general maritime safety.

Legislation on places of refuge is based on UNCLOS (Article 98), the rules of the SOLAS Convention and the articles of the EU Directive on Vessel Traffic Monitoring. The IMO has published a declaration and two recommendations on this issue, obligating coastal nations to take action to provide help to distress vessels. Numerous general agreements on maritime law and, for instance, the Salvage Convention grant coastal nations the right to take steps, on their own initiative, to protect their coast and maritime environment.

The purpose of the “Guidelines on places of refuge for ships,” approved by the IMO in 2003, is to bring a distress vessel to a place of refuge, but it does not directly concern situations in which human lives are in danger. An incident in which human lives are in danger is designated as a SAR situation, and then the SAR Convention applies.

The primary idea behind the IMO guidelines is that the authorities of coastal nations would help to guide ships in need of a place of refuge to a location where rescue or damage-prevention measures can be carried out. Coastal nations should draft plans for guiding ships to places of refuge in their territories.

The European Union has issued a separate directive on places of refuge for distress vessels.
3. Statistics

In 2014, there were 74 ship fires in European maritime waters, of which 10 were serious, leading to one or more injuries or fatalities. During the period from 2004-2014, there were a total of 799 ship fires, of which 10% were serious. 2 A separate analysis of the threat of ship fires to commercial European maritime traffic has been drafted as part of the Baltic Sea MIRG project and published in February 2016: “European Maritime Traffic Risk Assessment on Ship Fires”. The analysis shows that, in terms of the risk of fatalities or serious injuries, ship fires pose the greatest risk to European maritime safety compared to other types of maritime incidents. The greatest threat of ship fires concerns ships that transport both passengers and cargo (Ropax vessels).

The report you are now reading focuses on the significance of external help during firefighting on ships and rescue operations due to explosions in European maritime areas from 2000 to 2015. To draft a general overview, a comprehensive Internet and database search was carried out, drawing on more than 30 national and European incident report databases and Internet media sources. Of the ship fires and explosions that occurred in 2000-2015, 570 were selected for analysis. Table 1 shows the breakdown of these incidents by type of vessel, whether the incident occurred at sea or port, and whether external help was used in firefighting.

The analysis does not include fires on ships smaller than 300 GT or those that occurred at shipyards. In addition, those ship fires for which insufficient information was available regarding the use of external help and/or location were excluded from the analysis. Geographically, the scope of the analysis has been limited to apply to European territorial waters (SRRs).

In about a third of all the 570 incidents analysed, the crew of the vessel did not extinguish the fire independently, but relied on external help with firefighting. Of those incidents in which external help was employed for firefighting, slightly fewer than half occurred at sea, and the remainder at port.

In 2000–2015, the largest percentage of ship fires and explosions occurred on cargo ships. In slightly over a third of fires/explosions on cargo ships, external help was used to extinguish the fire. External help was used more frequently at port than at sea, even though a slightly larger share of incidents occurred at sea.

Overall, fires and explosions on all ships that transport passengers – that is, passenger vessels, cruise ships and ro-pax vessels – accounted for almost a quarter of all fires/explosions on all types of vessels. On the basis of the material used for this analysis, these vessels have better-than-average firefighting preparedness, but they also relied on external firefighting help in the case of almost a quarter of onboard fires.

The use of external help to deal with fires on tankers in 2000-2015 is in line with incidents on all types of vessels; in a third of the incidents, external help was used in firefighting. Correspondingly, slightly fewer than half of the incidents in which tankers utilised external help occurred at sea. Although fires and explosions on tankers do not account for a particularly large share of all ship fires, their consequences can be serious.

Compared to other vessels, relatively few fires/explosions occurred on ro-ro (Roll-on/Roll-off vessels), fishing and support vessels in 2000–2015. In the case of these vessel types, fires were more common at sea, and both ro-ro and support vessels relied on

<table>
<thead>
<tr>
<th>Vessel type</th>
<th>Number of ship fires/explosions 2000-2015</th>
<th>At Sea</th>
<th>At Port</th>
<th>In how many incidents external help was used?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passenger Vessels / Cruise Ships</td>
<td>33</td>
<td>21</td>
<td>12</td>
<td>At Sea 4</td>
</tr>
<tr>
<td>Ropax</td>
<td>99</td>
<td>84</td>
<td>15</td>
<td>At Sea 16</td>
</tr>
<tr>
<td>Ro-ro</td>
<td>30</td>
<td>19</td>
<td>11</td>
<td>At Sea 7</td>
</tr>
<tr>
<td>Cargo</td>
<td>238</td>
<td>130</td>
<td>108</td>
<td>At Sea 33</td>
</tr>
<tr>
<td>Fishing Vessels</td>
<td>40</td>
<td>28</td>
<td>12</td>
<td>At Sea 9</td>
</tr>
<tr>
<td>Tanker</td>
<td>82</td>
<td>48</td>
<td>34</td>
<td>At Sea 10</td>
</tr>
<tr>
<td>Support</td>
<td>41</td>
<td>25</td>
<td>16</td>
<td>At Sea 9</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>At Sea 0</td>
</tr>
<tr>
<td>Total</td>
<td>570</td>
<td>359</td>
<td>211</td>
<td>Total 189</td>
</tr>
</tbody>
</table>

*Total does not include: Incidents involving vessels <300GT, Incidents outside of “European Waters”, Incidents where confirmation of events could not be made, Shipyard Fires or Fires where the vessel was not involved in “Ordinary Service.”
**At Sea includes all those accidents where the vessel was at sea or on the way into port.
***At Port includes all those accidents where the vessel was at Port and stationary.

Table 1: Frequency of ship fires and external help used in Europe, 2000–2015
external help more often than other types of vessels (ro-ro: approx. 43% of cases; support vessels: approx. 41% of cases). On ro-ro vessels, fires are very often caused by electrical short-circuits of equipment on the vehicle decks. This is also a common cause of fires on ropax vessels. Due to the high density of cars on the vehicle decks, firefighting is a challenge. This may increase the need for external help. In addition, ro-ro and ropax vessels most often operate on short scheduled routes, which makes it easier for them to call on external help.

External help was used in firefighting efforts in about a third of the above cases, which shows that external help is a significant resource in managing ship fires. External help is an aspect of ship fire management that the authorities can develop (unilaterally). Other, non-official actors also provide external help to ships, but the purpose of this report is to provide tools for the development of the operations of the authorities. The next chapter focuses on the operations of maritime SAR and Fire and rescue services in ship fire situations.

4. Case analysis

This chapter examines fires on seven vessels at sea in which external firefighting help was utilised at some stage of the rescue operation in addition to the firefighting efforts of the ship’s crew. The examined ship fires represent several types of commercial vessels. Some of these fires were extinguished at sea, some only at port. The available information influenced the selection of incidents; the inclusion of certain recent ship fires was limited because their incident investigations are still ongoing or have not been made public as yet. The incidents analysed are:

1. m/s Calypso (cruise ship), UK, 2006
2. m/v Lemo (cargo ship), Finland, 2008
3. m/s Commodore Clipper (ropax vessel), UK, 2010
4. m/s Pearl of Scandinavia (ropax vessel), Sweden, 2010
5. m/s Nordlys (ropax vessel), Norway, 2011
6. m/v Fernanda (ro-ro vessel), Iceland, 2013
7. m/v Purple Beach (cargo ship), Germany, 2015

The analysis of ship fires focuses particularly on assessing the significance of external help in dealing with the incident, while also taking the actions of the crew into consideration. A ship fire is always a serious and dangerous situation that requires the shipboard organisation to take rapid steps to combat the fire.

The primary research method consisted of interviews with experts carried out by a working group of Finnish seafaring, SAR and Fire and rescue services experts in autumn 2015. The working group interviewed experts familiar with the incident in question in the country whose responsibility it was to deal with the incident. The interviewees were SAR, rescue and accident investigation officials appointed to the task by the country in question. The working group could not interview all the parties involved in dealing with the incidents and thus some of the information is second-hand.

The analysis also draws on incident studies and reports by accident investigation boards and other authorities from different countries. In all of the EU countries, all serious maritime incidents are to be investigated by the national accident investigation authority, unless stated otherwise in national legislation. The accident investigation authority always works fully independently with the sole aim of assessing the cause of the incident.

4.1. Incidents analysed

The ship fires selected for analysis are presented below. The presentations include a short description of the incident, the measures taken by providers of external help in the incident and the key safety recommendations made during the investigation. The following chapter focuses on incident observations to develop MIRG operations.
4.1.1. M/s The Calypso

**Accident description**

A fire broke out in the engine room of the 135-metre cruise ship on 6 May 2006. The ship was carrying 708 people from Tilbury to Guernsey, UK, at the time of the incident.

Initial action by the watch keeping engineer officer was effective in eventually extinguishing the fire although the vessel lost all but emergency electrical power and was left drifting in the Dover Straits, 16 miles south of Beachy Head in East Sussex. The vessel’s starboard main engine had been very seriously damaged and she was towed to the port of Southampton by the Maritime and Coastguard Agency’s (MCA) emergency towing vessel Anglian Monarch.

The subsequent investigation discovered that the fire had been caused by a failed low pressure fuel pipe flange on the starboard main engine. The fire was intense, and the subsequent firefighting response highlighted flaws in the knowledge, experience and training of some of the senior ship’s officers. Those on board believed that the fire had been successfully extinguished by the quick use of the fixed CO2 fire smothering system. The fire had, in fact, died down mainly as a result of fuel starvation due to the quick action of the watch keeping engineer officer. Those in charge of the firefighting response did not appear to follow recognised good practice.

During the firefighting efforts, the passengers were kept well informed, were quickly accounted for and, wearing life jackets, mustered on the boat deck. The boats were brought to the embarkation deck without incident. Despite most passengers being elderly, and the cold temperatures experienced out on deck at night, nobody suffered anything more than discomfort. They were eventually allowed back into the accommodation only when the master was sure that the fire was out and it was therefore safe.

**External help measures**

The Maritime Search and Rescue Co-ordination Centre (MRCC) of Dover dispatched two MIRG teams from New Haven in accordance with plans. As helicopter capacity was limited, the nine-member MIRG teams had to airlift to the distress vessel on four separate flights. Once the MIRG team reached the site, it became clear that, contrary to the initial information, the situation on the ship was under control. The primary task of the external help was thus to communicate situation reports to the MRCC, support the crew of the vessel and provide advice.

The incident was the first one of its kind to provide an opportunity to test the operation of the newly formed MIRG teams in the UK. Although the ship’s crew had already got the fire mostly under control, the MIRG team was able to provide valuable assistance both to the ship’s master in decision-making and to rescue services.

**Safety recommendations**

After the incident, the accident investigation authorities issued security recommendations, especially with respect to the CO2 system on the vessel. The accident investigation report (with safety recommendations) is available in full at: https://assets.digital.cabinet-office.gov.uk/media/547c7065ed915d4c0d000097/TheCalypsoReport.pdf

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* UK-MAIB-reports, Accident Investigation Report 8/2007

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General information: M/s Calypso was a cruise ship owned by Louis Cruises. It was built in 1994 at the Fincantieri shipyards in Italy and scrapped in 2013.

- **Length:** 135.4 m.
- **Width:** 19.2 m.
- **Draught:** 6.3 m.
- **Crew on board at the time of the incident:** 246
- **Passengers on board at the time of the incident:** 462
- **Injuries / fatalities:** None

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**Picture 1:** M/s Calypso. Copyright: MAIB.

**Picture 2:** After the fire in the engine room of M/s Calypso. Copyright: MAIB.
4.1.2. M/v Lemo

Accident description

M/v Lemo, sailing under the flag of St Vincent and Grenadines, approached the Mussalo port in Kotka on the morning of 22 November 2008. It was carrying a load of lime from Poland. Three nautical miles from the port, the fire alarm of the ship indicated that a fire had broken out in the galley.

A short while after the fire was noticed, the pilot informed the VTS centre about the fire, which in turn notified the Maritime Search and Rescue Sub-Centre (MRSC) in Helsinki. Before the fire alarm went off, the crew had been woken up to prepare for docking at port, which meant that a recon team could be sent immediately to verify the location of the fire. Once it had been confirmed that a fire had broken out in the galley, a firefighting team started initial extinguishing measures using portable fire extinguishers through a broken galley window. At that time, a decision was taken to anchor the ship due to strong smoke formation. Upon being informed of the fire, the MRSC had requested a firefighting team to be dispatched from Kotka to the ship.

A firefighting team from the Kotka Fire and rescue services was transported to the ship on a Coast Guard patrol boat. After this, the fire on the ship was brought under control in just under an hour, and the damping down and clearing phases began at the scene of the fire. A three-man MIRG team airlifted from Helsinki by helicopter also participated in this task.

Serious injuries were avoided. Only the chief engineer of the vessel had breathed in smoke gases when he left his cabin, located above the galley, after the fire had started. He was taken to hospital for examination.

External help measures

MRSC Helsinki alerted the Helsinki MIRG team and Kotka Fire and rescue services to respond to the situation in line with the agreed operating model. The Kotka Fire and rescue services unit arrived on scene by boat and the Helsinki MIRG team by helicopter. Although the crew of the distress vessel had started fire control measures onboard, sufficiently extensive firefighting measures could only be initiated once the external help had arrived. It is unlikely that the crew of the ship could have brought the fire under control on their own.

Safety recommendations

The accident investigation board did not issue safety recommendations, but wanted to pay attention to issues such as:

- The vessel must have functional firefighting equipment that must comply with the requirements set in SOLAS, at the minimum, and the crew must be able to use it correctly.

- When using water for firefighting, the pump must be able to produce enough pressure so that the water mist from the nozzle provides sufficient protection for the firefighter and also efficiently and extensively cools the area being extinguished.

- The owner of the vessel must ensure that all members of the crew participate in statutory firefighting drills with the seriousness required and that the drills are planned so that the situations feel as realistic as possible.

1 OTKES, B3/2008M M/s LEMO, 22 NOV 2008
4.1.3 M/s Commodore Clipper

**Accident description**

As a result of an electrical fault a fire broke out on the vehicle deck of the 118-metre ro-ro ferry on its way from Jersey to Portsmouth, UK, on 16 June 2010. The crew contained the fire using the vehicle deck water drenching system and boundary cooling from above, but were not able to extinguish it. Fire damage to unprotected cables and pipework in the main vehicle deck caused extensive disruption to systems, affecting the vessel’s ability to manoeuvre and contain the fire. Firefighting efforts had to be suspended as cargo debris blocked vehicle deck drains, causing water from the firefighting effort to accumulate and reduce the vessel’s stability.

Although Commodore Clipper was close to Portsmouth harbour, berthing was significantly delayed through ineffective co-ordination between shore agencies and because of equipment defects. Once alongside, the high density of cargo and constraints in the design of the vessel limited access to both fight the fire and to disembark the passengers. As a consequence, freight trailers had to be towed off the vessel before the fire could be extinguished. The last of the 62 passengers disembarked from the vessel nearly 20 hours after the fire started.

**External help measures**

The MRCC (Solent Coast Guard) alerted a MIRG team to the task in accordance with operational guidelines and called a FIRE Liaison Officer to the centre. Due to communication problems and ambiguity, the MIRG team was never dispatched. The vessel was taken to port, where the Fire and rescue services and firefighting teams were waiting. The rescue task was difficult and raised many questions related to issues such as the high density of cargo on the vehicle decks and evacuation possibilities on ro-ro vessels.

**Safety recommendations**

The accident investigation authorities issued a total of five safety recommendations after the accident. One of them concerned SAR in particular:

- The Maritime and Coastguard Agency is recommended to:
  - Work with its stakeholders to produce industry guidelines for maritime emergency responders to consider when providing firefighting or other emergency support to ships in UK waters. The guidelines should include, inter alia:
    - Best practice command and control principles
    - Information gathering and liaison on scene
    - Safety of passengers and crew
    - Ship specific risks and considerations with particular emphasis on issues associated with passenger ro-ro vessels and vessels carrying hazardous cargoes
    - Factors to be considered in deciding whether to bring a vessel into port/alongside
    - Specialised equipment and other resources

The accident investigation report (with safety recommendations) is available in full at: [https://assets.digital.cabinet-office.gov.uk/media/547c6fb0e5274a428d000037/CommodoreClipperReport.pdf](https://assets.digital.cabinet-office.gov.uk/media/547c6fb0e5274a428d000037/CommodoreClipperReport.pdf)

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8 UK-MAIB-reports, Accident Investigation Report 24/2011
4.1.4. M/s Pearl of Scandinavia

Accident description

The Ro-pax vessel Pearl of Scandinavia was on its way from Oslo, Norway, to Copenhagen, Denmark, on 16 November 2010, when a fire broke out on the ship’s car deck. The cause of the fire was an electric car that was being charged during the voyage.

The fire was extinguished by the ship’s sprinkler system, the ship’s firefighting team, and Swedish firefighters who were flown to the scene. After having recognised the fire, all passengers were evacuated to safe areas in the ship. Neither the passengers nor the crew were injured.

External help measures

Joint Rescue Co-ordination Centre (JRCC) Gothenburg alerted external help immediately and in the manner previously agreed by the authorities. In addition, the liaison officer immediately went to the JRCC following the agreed procedure. The Gothenburg Fire and rescue services dispatched a full-strength team of first responders (1+1+5) to the ship. The team was airlifted by helicopter. The crew of the distress vessel acted in exemplary fashion using the onboard fixed extinguisher systems. The task of the MIRG team was thus to carry out smoke diving and the damping down operation. With external help, the overall outcome of the operation was highly successful in terms of both firefighting and rescue operations.

Safety recommendations

The accident investigation board did not issue safety recommendations concerning SAR, firefighting or the vessel’s own procedures in the event of a fire.

The accident investigation report is available in full at: http://www.dmaib.dk/Ulykkesrapporter/Final%20report%20-%20PEARL%20OF%20SCANDINAVIA.pdf

General information: M/s Pearl of Scandinavia is a passenger ship (ropax) owned by DFDS Seaways. It was built at the Wärtsilä shipyards in Finland for Viking Line in 1989. It has a capacity of around 2400 passengers and 450 vehicles.

Length: 126.6 m.
Width: 29 m.
Crew on board at the time of the incident: 161
Passengers on board at the time of the incident: 490
Injuries / fatalities: None

Picture 7: Pearl of Scandinavia. Copyright: Lasse Kaila.

Picture 8: Firefighters on the car deck of Pearl of Scandinavia at the end of the firefighting mission. Copyright: Räddningsjärnsten StorGöteborg.
4.1.5. M/s Nordlys

Accident description

A fire broke out in the engine room of the 122-metre cruise ship Nordlys operated by Hurtigruten ASA, on its way from Bergen to Ålesund, Norway, on 15 September 2011. The investigation concluded that the fire probably started when a diesel leakage was ignited coming into contact with an un-insulated indicator valve on the starboard main engine. Nordlys lost all engine power as both the main and auxiliary engines stopped as a consequence of the fire. The ship was towed to Ålesund harbour, and as Nordlys was being berthed, the starboard stabiliser fin was pressed through the hull’s side so that the cargo holds became flooded with water. As a result of the flooding, Nordlys developed a 20 degrees list. The situation was clarified during the next day when the leakage in the hull had been located and temporarily sealed.

The incident claimed two lives, and 12 people were injured. The passengers were evacuated off the ship, but 55 crew members stayed on the vessel to assist with firefighting operations.

External help measures

The accident occurred just outside the port (only 500 metres away). For this reason, external firefighting assistance was not dispatched to the vessel while it was at sea. Instead, the vessel was towed to shore where the Ålesund Fire and rescue services and its MIRG teams were waiting. All alerts and preparations were carried out in accordance with the large-scale accident plan. Actual firefighting efforts on board the vessel were initiated only once the vessel had been berthed and external responders came on board.

The situation was led systematically throughout the entire firefighting operation. During this extremely difficult operation, the MIRG system’s expertise and knowledge of the vessel were successfully utilised. External help played a decisive role in ensuring the success of the rescue operation.

Safety recommendations

The accident investigation authorities of Norway issued a total of nine safety recommendations after the accident. Most of them concerned technical solutions, such as the use of CO2 in shipboard engine room fires and the manual triggering of the automated fire extinguisher system. The accident investigation board did not issue safety recommendations concerning maritime SAR or firefighting.

Regarding the vessel’s own procedures in the event of a fire, the board states that:

“When the fire on board Nordlys started, crew members with key functions were put out of action. Stand-ins had been appointed, but no drills had been organised simulating loss of personnel and the assumption of new roles. As a consequence, several safety-critical tasks were not attended to in connection with the fire.

The AIBN recommends that Hurtigruten ASA prepare procedures for training in the loss of key personnel and implement training in this area on board its ships.”

Accident investigation report: http://www.aibn.no/Marine/Reports/2013-02-eng

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General information: M/s Nordlys is a ropax vessel sailing on the Norwegian Hurtigruten route from Kirkenes to Bergen. It is owned by Hurtigruten Group ASA and was built in 1994.

Length: 122 m
Width: 19 m
Draught: 4.7 m
Crew on board at the time of the incident: 55
Passengers on board at the time of the incident: 207
Number of fatalities: 2 dead crewmembers
Number of injured persons: 2 seriously injured and 7 less seriously injured.

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Picture 9: M/s Nordlys on fire outside the harbour of Ålesund. Copyright: Ålesund Brannvesen.
4.1.6. M/v Fernanda

Accident description\textsuperscript{11}

On 30 October 2013 the Dominica registered refrigerated ro-ro cargo ship Fernanda suffered a fire in the engine room while off the coast of Iceland. Efforts were made to enter the machinery spaces to determine the location of the fire but they were unsuccessful due to the presence of heavy smoke. Flames were seen on the starboard side of the engine room. The main engine stopped resulting in a blackout as electrical power was being supplied by the shaft generator. It soon became apparent to the master that the fire was gaining ground and the crew mustered on the navigation bridge and later on the boatdeck. Two inflatable liferafts were launched. The Icelandic coastguard had though launched a rescue helicopter to assist the vessel and all eleven crew members were successfully airlifted from the vessel approximately two hours after the detection.

The fire was extinguished with the help of a patrol vessel of the Icelandic Coastguard and firefighters from Reykjavik. The firefighting operation continued for several days.

External help measures

JRCC alerted external rescue units in the agreed manner. After the situational assessment was updated, the team was not sent to the vessel on a helicopter. Instead, the same team (1+3) was later transported to the vessel on a boat to provide updates on the situation and to assist with towing. By this point, the crew of the vessel had already been evacuated. The vessel was towed to port with the intention of completing firefighting operations there. However, due to heavy smoke formation, it was decided to tow the vessel to sea again. Firefighting operations at sea took several days and the fire was only extinguished when all flammable materials onboard had been consumed.

Safety recommendations

The accident investigation authorities issued numerous safety recommendations after the accident. None of these concerned SAR. The recommendations on firefighting and the ship’s own procedures in the event of a fire include:

*Dominica Maritime Administration is recommended to issue a Safety Circular:
  - publishing the details of this fire, highlighting the need to maintain high housekeeping standards in machinery spaces, particularly in the engine room;
  - recommending that statutory drills are planned to achieve specific objectives such as closing down all accesses to the engine room or removing a casualty from the engine room;
  - recommending that at the conclusion of each drill its progress should be reviewed to highlight what went well and identify what could have been improved.

The accident investigation report (with safety recommendations) is available in full at: Accident investigation report: [http://rns.is/pdfs/fernanda_final_report.pdf](http://rns.is/pdfs/fernanda_final_report.pdf)

\textsuperscript{11} Commonwealth of Dominica Maritime Administration - report on FERNANDA - 30 October 2013

General information: M/v Fernanda was a Dominica registered refrigerated ro-ro cargo ship built in 1982 in Spain. After the accident, the vessel was scrapped.

Length: 74.7 m
Width: 14 m
Draught: 4.2 m
Crew on board at the time of the incident: 11
Injuries / fatalities: None
4.1.7. M/v Purple Beach

Accident description

The 192 m long cargo vessel Purple Beach was on its way from Immingham, UK, to Brake, Germany, on 25 May 2015. A fire/smoke formation started in one of the cargo holds that was loaded with fertilisers. The crew extinguished the blaze that evening, but the fire re-ignited and smoke started to form again the following day while the vessel was off Helgoland, Germany. The crew requested assistance with rescue boats, helicopters and salvage vessels arriving on scene.

The situation on the vessel remained unclear for a long time and the accident investigation is still in progress, but it seems that the situation began due to a chemical reaction involving substances carried as cargo. In the early phase of the incident, before additional information became available, it was feared that there might be the risk of an explosion. One of the 25 persons on board suffered injuries from the toxic gas released and was airlifted for treatment.

Water was pumped into the cargo hold to stop smoke from forming. The multipurpose vessels’ water cannons were employed in an effort to prevent smoke cloud formation. Thanks to the massive firefighting operation and work by firefighting units over a period of several days, smoke formation was eventually stopped.

External help measures

The Central Command for Maritime Emergencies (CCME) in Germany, which attends to co-ordinating large-scale dangerous maritime situations, alerted Fire and rescue service units as agreed. The BBE firefighting unit (Brandbekämpfungseinheit) of the Cuxhaven Fire and rescue services was airlifted by helicopter to the vessel. The unit had light equipment and was the first on scene. Later, a more heavily equipped unit from Bremen was transported to the vessel by a surface craft. In addition to the BBE firefighting units, the Analytical Task Force participated in the response to the incident; a special unit, it can conduct rapid on-scene analyses of chemical-related incidents.

Safety recommendations

At the time of writing, the official accident investigation report had not been completed, and thus no safety recommendations were as yet available.

General information: M/v Purple Beach is a multi-purpose cargo vessel registered in the Marshall Islands. It was built in 1988.

Length: 181 m.
Width: 27 m.
Crew on board at the time of the incident: 22
Injuries / fatalities: 1 injured crew member, total 36 persons to hospital for checkout.

12Havariekommando, Central Command for Maritime Emergencies Germany, Pressemitteilung 26.5.2015

Pictures 11 and 12: M/v Purple Beach. Copyright: Havariekommando.
4.2. Analysis observations

This section analyses the ship fire incidents presented above as a whole, with a particular focus on evaluating whether external help was useful in minimising the consequences of these incidents and how MIRG operations could be developed in the future.

The analysed incidents and the rescue measures employed have been divided into three phases: 1) “start and alert phase”, 2) “MIRG team on the way” and 3) “operations on scene”. Furthermore, these three phases have been examined from the perspectives of three actors: the distress vessel, the Rescue Co-ordination Centre (incl. JRCC, MRCC, MRSC) and Fire and rescue services (incl. MIRG or equivalent). The figure below illustrates the roles of the different actors in each phase of the incident.

Figure 1: The analysed incident phases and measures

Not all of the analysed incidents precisely followed the different phases shown in the figure. Therefore, the observations presented below are based on the incidents for which information on the phase in question was available. Likewise, a MIRG team was not used at sea in all of the incidents. Observations concerning the operations of MIRG teams at sea are thus based on the incidents in which such teams were used at sea.

4.2.1. Start and alert phase

Operations of the vessel in the start and alert phase

The number of crew on the analysed vessels and their qualifications complied with the STCW Convention.

The IMO’s STCW Convention is an international agreement on the minimum standards of training, certification and watchkeeping for seafarers. Although the qualifications of the crews were in line with STCW, there were great differences in the actual competences of the crews. As a general observation, it can be noted that crew readiness and competence to deal with more severe incidents were higher on passenger and ropax vessels.

All of the distress vessels had STCW-compliant operating models for dealing with fires. In two of the cases, the operating models did not work in practice, as some of the key firefighting personnel were absent, injured or trapped by the fire. Key personnel in this context refers to the master of the vessel, chief engineer and other senior officers who play a central role in firefighting.

The fire control plans of a vessel designate a separate person or persons to be responsible for tasks such as the use of the CO2 fire smothering system in the engine room, the closing of ventilation hatches and smoke diving. These crew members may be both engineers and mates. Other crew members usually also participate in operations. On the basis of the analysed ship fires, it can be noted that operations and drills on ships should be planned so that the absence of a single person does not paralyse operations in the event of a fire.

On all of the analysed distress vessels, the fire alarm systems functioned, but in some cases provided erroneous information about the location of the fire in the ship. For this reason, the necessary initial measures on these vessels could not be immediately targeted at the right locations.

Human factors, the training completed by crew and drills play a decisive role in the success of the initial measures. Due to these factors, the initial firefighting measures were sometimes delayed, and consequently the fire spread and the situation became more severe. On the other hand, in several of the cases rapid and correct initial measures led to excellent results and the fire, in spite of the threatening situation, did not spread.

These cases highlighted the importance of rapid action. In one case, an engineer reacted immediately to the fire alarm and carried out initial firefighting measures, which the accident investigation indicated had a major role in minimising the consequences. In another case, the alarm was not taken seriously and when the crew finally reacted to it, the fire had already become so severe that the crew could no longer extinguish it with their own resources. A vessel must be aware that it has to request external help early enough if it cannot get the fire under control immediately or if there is a delay before the fire is detected. Situational awareness is particularly significant when requesting external help; if the extent of the fire is not accurately known, it is best to err on the side of caution.
**Operations of the Rescue Co-ordination Centre in the alert phase**

In only one of the analysed cases did the vessel send a distress message in accordance with the Global Maritime Distress and Safety System (GMDSS). In the other cases, the distress message was relayed to RCC via a coastal radio station, VTS centre or the agent/representative of the vessel/shipping company.

According to GMDSS, a vessel should first send out a digital distress message on Channel 70 using VHF-DSC. After this, the distress vessel should tune to VHF Channel 16 to report on the situation onboard and request assistance. VHF distress communications are then automatically carried out on Channel 16. This was done in only one of the incidents.

In several cases, the distress messages sent by the vessels were delayed. However, these delays were relatively short and did not have a decisive impact on the development of the incident or its final outcome. In the analysed cases, the delay between the time when the fire was detected on the vessel and the sending of the distress message (alert) to RCC ranged from a few minutes to 20. Delays between the triggering of the fire alarm and the verification of the fire also varied on the vessels.

On the basis of the analysed cases, it can be stated that all of the RCCs that participated in responding to these incidents have operating models in place for dealing with maritime fires/explosions. These operating models and plans were also used with good success in the analysed cases. Inadequate guidelines did not lead to a failure to alert Fire and rescue services/MIRG team in any of the cases. At RCCs, decisions to alert the Fire and rescue services were for the most part done rapidly and clearly.

In one case, the RCC encountered problems with finding basic and safety information on the vessel from the international SAR data provider system. For this reason, the leading RCC did not have information at its disposal on the safety systems and equipment of the ship. Without this information, the RCC could not contact the owner or shipping agent of the vessel, which hindered decision-making concerning the incident.

In two cases, the limited personnel resources of the RCCs constrained their ability to deal with and co-ordinate larger-scale challenging incidents. However, even in these cases, the situation could be rectified relatively fast by alerting additional personnel. At the time of the alerts, the average number of staff at the RCCs was three, with one to two persons classified as operators and one as a Search and Rescue Mission Co-ordinator (SMC).

In many cases, the personnel strength of the RCCs was increased with people from both their own organisation and co-operating actors. Adding personnel from their own organisation enabled the RCCs to divide tasks efficiently, which in turn lightened the workload of the SMC and the core staff at the centre while dealing with the situation. The representatives of co-operation parties provide the centre with specialist expertise in their own fields, thanks to which the basic operational concept and rescue plan can be specified better, thereby improving the efficiency and appropriateness of rescue operations.

The operations of the RCCs are also supported by management boards, as set out in the preparedness plans; their composition varies from country to country. The management boards typically consist of key representatives of different authorities. Their operations and roles (responsibilities, obligations, role in operational management) vary in different countries. These management boards do not necessarily always operate out of an RCC in all countries. In certain situations they may be stationed in their own command premises, which hinders co-operation with the Search and Rescue Mission Co-ordinator. That said, such a management board was not convened at the RCC in any of the analysed cases.

In all of these cases, the RCCs had sufficient rescue units (external resources providing firefighting and other assistance) to call upon. In cases where it was decided to dispatch external help, it took 30-60 minutes for the help to arrive at the distress vessel, depending on its location. With respect to delays, it should be noted that in some cases external units were alerted immediately, but their transportation to the scene was delayed or they were not transported at all.

There were also country-specific differences in how rescue units were alerted and used. Differences in such alerts were largely due to differences in the organisations (for instance, who operates the rescue helicopters), their operating models and divergent on-call arrangements. The principles of using external help were affected primarily by the availability of resources as well as the location of the distress vessel and the distance to it. In the analysed cases, enough aircraft resources were available to make it possible to airlift external help (MIRG) to the vessel while preparing for the evacuation of the people on board. Due to scarce resources, long response times and transport to the distress vessel, RCCs have to critically assess, among other things, the usage purpose and stationing of helicopters. In such situations, a decision must be made whether to dispatch external help to the vessel or prepare to evacuate those on board.

Conditions such as heavy winds or winter weather hindered and complicated, but did not prevent, operations in some of these cases. For instance, poor visibility or icy conditions can prevent airlifting MIRG teams to the target by helicopter, while excessive winds and high waves can make it more difficult to transport other help on boats. Heavy seas and high winds also hinder the joint operations of surface craft and the distress vessel. In two of the cases, difficult conditions significantly hindered transportation of help to the distress vessel.

Conditions also have a considerable impact on the on-scene operations of an external unit. In two of the examined cases, conditions at the distress vessel had a detrimental impact on the operational capability, effectiveness and occupational safety of the unit. In those analysed incidents where MIRG teams were used, the MIRG teams were in operational readiness after being alerted by the RCC without delay and in line with plans and agreed operating models. The MIRG teams were ready for deployment in 10-60 minutes after receiving the alert. This great variation is due to differences in the setup and agreed operating models of the MIRG teams.

In one of the analysed cases, there were uncertainties concerning whether to dispatch an alerted and ready-to-go MIRG team to the distress vessel. This was because different actors interpreted the distress message in divergent ways, which was reflected in communications between the RCC and the distress vessel as well as in the use of units.
Operations of the Fire and rescue services in the alert phase

In most of the analysed accidents, an Fire and rescue services liaison was used at the RCC. The general operational principles of a Fire Liaison Officer are:

The Fire liaison Officer serves as the Fire and rescue services’ expert at the RCC under the Search and Rescue Mission Co-ordinator or supports him.

The liaison Officer can be invited to the RCC solely to consult and assess the situation without alerting MIRG teams or other Fire and rescue services units to the task or even if there is no intention to use such teams and units. In certain cases, while the Fire Liaison Officer is at the RCC, he may be alerted to handle other Fire and rescue services tasks. This may pose great challenges to the appropriate co-ordination of the SAR situation.

When necessary, the Fire Liaison Officer in RCC serves as a link with the MIRG teams and MIRG Operation Commander aboard the distress vessel. He also maintains contact with other Fire and rescue services participating in the task and provides information to his own organisation as instructed. The Fire Liaison Officer plans the continuity of MIRG operations and secures any necessary additional SAR resources from the Fire and rescue services.

In addition to RCCs, a Fire Liaison Officer can also be used on the distress vessel. In the cases analysed, transferring a Liaison Officer onto the vessel was considered to be useful. Having a MIRG Operational Commander on board facilitated messaging and communications between the vessel and RCC, thereby improving situational awareness. Establishing accurate situational awareness helps the RCC to make the right decisions and operating plans. At the same time, the Liaison Officer on board can support the master of the vessel in decision-making concerning rescue operations on the vessel and inform him of the official obligations and practices of the country in question. In addition to the Fire Liaison Officer at the RCC, appointing a separate MIRG Operational Commander to the task enables the master of the vessel, RCC and MIRG units to make joint risk assessments and also enables the efficient co-ordination and appropriate use of MIRG teams.

There are differences in how MIRG teams are assembled in different countries and Fire and rescue services. In analysing these cases, it was observed that in certain countries and Fire and rescue services all personnel receive special training for maritime operations, whereas in other countries only a small share of personnel have been trained for such tasks. When incidents occurred, teams were assembled by alerting pre-assigned personnel to the task. That said, there were differences in alerting and assembling MIRG teams: in some cases, team members were on shift when the alert came, while others were off duty.

The operating methods of MIRG teams also vary from country to country. On the basis of the analysed incidents, it cannot be unambiguously determined which is the most appropriate and cost-effective method. However, in general terms it can be stated that, as a rule, a team that is on duty can be mobilised faster than a team that has to be called in from home. Another great difference concerns the equipment of the teams. A team with light equipment can be transported to the site faster than a team equipped with a variety of heavy gear. However, the operational capabilities of a lightly equipped team are more limited. Still, a rapid and professional response can often provide sufficient additional support, in accordance with the basic concept of MIRG operations, to the crew of a distress vessel dealing with a ship fire.

4.2.2. MIRG team on the way

SAR operations during the transportation phase

In cases where a MIRG or equivalent team was dispatched to the distress vessel at sea, the RCC gathered additional information and often also updated the threat assessment of the distress vessel. At that stage, a second updated operating plan may also be drafted. The RCC’s situational awareness improved decisively in many of the analysed cases when the first unit arrived on scene or the MIRG unit boarded the distress vessel. These units were able to provide additional information and a separate situation report to the RCC. In particular, more detailed information is required on the general situation and its escalation, and also on how ship evacuation is progressing: is the ship being evacuated in a controlled manner?

When MIRG teams were airlifted to the distress vessel by helicopter, a particular challenge in several of these cases involved keeping the MIRG team aware of the development of the situation. During helicopter transport, MIRG teams cannot use normal means of communication. It might not even be possible for team members on the helicopter to use headset radios to be in contact with the MIRG Team Leader. However, communication between the MIRG Team Leader and the helicopter captain is critically important, as they together decide whether to board the ship once the scene has been examined from the air.

Operations of the MIRG team during the transportation phase

In every incident where a MIRG or equivalent team was dispatched to handle the mission, the amount of time required for transportation was within normal boundaries. The amount of time was largely determined by the geographical location of the incident and the means of transportation used by the team. With the current response times, the target for reaching all fires in the Baltic Sea and English Channel is less than two hours, but often the scene of the incident can be reached considerably faster. However, the weather can hinder or even prevent external help from reaching the scene, such as due to poor visibility or icy flying conditions.

In the case of the analysed ship fires, the MIRG base and designated transport unit (helicopter/boat) were often located very close to each other, or alternatively there was a separate landing zone next to the rescue station, where the MIRG team could easily and quickly board the helicopter. However, there were exceptions both between the countries and within them. In order to ensure rapid and appropriate response times, transport and on-call arrangements should be examined as a whole, so that both the MIRG team and helicopter do not have to wait unnecessarily in alert situations. This will also ensure that external help will reach the distress vessel faster.

At the beginning of the 2000s, rescue helicopters in certain countries frequently did not have sufficient transport capacity to airlift a MIRG team and its equipment to the distress vessel on a single flight. In one of the analysed cases, the MIRG team had to be airlifted in two runs due to its large size. Nowadays, efforts are made to dimension MIRG teams in accordance with the capacity of the SAR helicopters that are in use. This is one of the factors behind the decreasing size of MIRG teams over the years. Nowadays, depending on the country in question, the size of MIRG teams varies from four to nine people. Even now, smaller SAR helicopters are not large enough to airlift an entire MIRG team to the distress vessel, and two flights are often required. The use of aircraft must always be efficient. For this reason, transporting a MIRG team to the scene is not the only mission assigned to the helicopter; it can also evacuate people from the vessel or save people from the sea.
4.2.3. Operations on scene

Operations of the distress vessel

Great differences were observed in the operating models of the distress vessels, the operations of the crew and their firefighting skills, even though the crews had been trained in accordance with STCW requirements. In many cases, the crew of the vessel operated in an exemplary manner and carried out initial firefighting measures on their own – and even managed to control or extinguish the fire. In some cases, the resources of the vessel were limited, such as with regard to smoke diving; the crew had little experience in smoke diving and alternates were not available when required. The analysed cases also included vessels whose crew was, for one reason or another, entirely paralysed and unable to engage in any firefighting.

When examining the incidents, particular problems that came to light were the crew’s lack of skill in using a CO2 extinguisher system and lack of knowledge about the features of this system.

Operating models for receiving and using external help were also deficient on several vessels. In some of the cases, this meant that they did not know how to make efficient use of external help in firefighting.

SAR operations

According to the maritime law, the master of the vessel has absolute authority on the vessel while it is at sea – provided, of course, that the master is on the vessel and legally competent. After the crew and passengers have left the vessel, the SMC has the highest power of command and decision concerning efforts to save them. The SMC co-ordinates the rescue of human lives at sea and the operations of other authorities and parties participating in the rescue operations as agreed nationally.

Accordingly, when the vessel is at sea, the most important task of the RCC co-ordinating the situation is to prepare for the continuity of operations and the possible evacuation of those on board in accordance with the decisions of the master of the vessel. Planning the continuity of operations must take into consideration the need for additional resources and any sudden and decisive changes in the status of the distress vessel. Continuous monitoring of the status of the distress vessel lays a solid foundation for working safely and making the right decisions.

In a few of the analysed cases, a decision was made to tow the vessel to a place of refuge to facilitate firefighting. In these cases, firefighting continued in a place of refuge, which in these cases was a port but could also be a sheltered anchorage. Generally, bringing a vessel to a place of refuge does not mean anchoring at some beach (such as an uninhabited distant islet) but requires the vessel to be securely berthed at a dock where the situation can be co-ordinated by Fire and rescue services. Once the vessel has reached port, the situation is no longer considered a SAR or actual MIRG mission, but a Fire and rescue services or salvage operation.

The maritime law does not apply to saving human lives from a vessel docked at a port. For instance, in some of the countries examined, the port authority played a greater role in managing the incident than in other countries. When command is transferred to another party, the importance of co-ordinated, controlled and situationally appropriate handover of responsibility is emphasised. Changes in command should be communicated sufficiently clearly to all the units involved in the rescue operations.

Fire and rescue services’ operations on the distress vessel

Co-operation between Fire and rescue services teams and vessel crew was generally at a good level in the analysed cases. In addition, the co-ordination and command structure and both the role and duties of the MIRG or equivalent team on the vessel were clear in the analysed cases: the task was to assist the vessel crew and master, not to co-ordinate the rescue operations on the vessel. Such operations are always co-ordinated by the master of vessel, supported by the firemaster of the Fire and rescue services team dispatched onto the vessel. The Fire and rescue services team works under the leadership of the Team Leader and on the vessel under its master. The team supervisors are responsible for the safety of their team.

The operations and tasks of the MIRG teams varied greatly in the analysed incidents. In certain situations, the task was to only provide guidance and support the master of the vessel. On the other hand, when MIRG teams participated in firefighting work, in certain cases they even played a decisive role. In one of the analysed cases, the main task of the MIRG team was to communicate situation reports to the RCC in charge.

The MIRG teams proved to have sufficient equipment to deal with the analysed incidents. No clear shortcomings were noted in any of the cases. In all of the analysed cases the MIRG team relied on the fire extinguisher systems of the vessel. The firefighting equipment of the vessel was inadequate in only one of the cases, and the fire pumps of another vessel had to be used. In several cases, thermal cameras were found to be particularly effective as tools for locating fire pockets and monitoring the fire.

Communications connections posed their own challenges in several of the analysed cases. The greatest challenge was to ensure sufficient radio coverage within the ship’s interior. On the largest ships, UHF radios or even separate transponders are used for internal communications. However, as a rule these cannot be used to communicate with the SMC. MIRG teams generally cannot use the GMDSS radio system to communicate, either. However, in the analysed cases, the MIRG teams had several communications tools at their disposal, enabling them to solve their communications problems.

If the RCC designates the firemaster of the Fire and rescue services to serve as the On Scene Co-ordinator (OSC), he or she also assumes command and responsibility for other units in accordance with the task requirements. In the analysed cases, not a single firemaster was designated as OSC. In a critical situation, such additional responsibilities should not be assigned to a MIRG firemaster (MIRG Operation Commander), as he has enough work to attend to during a ship fire as it is. In addition, it is probable that the MIRG Operation Commander has very limited opportunities effectively co-ordinate other rescue units on scene. Therefore, it is often better that the RCC handles the co-ordination of surface units and aircraft or that the task is separately assigned to an OSC on a surface vessel.
On the basis of the analysed cases it is clear that external help often plays a decisive role in assessing the situation and ensuring that the correct follow-up measures are taken. In several cases, the crew could not have brought a large-scale fire under control without the Fire and rescue services team. In general terms, MIRG yields significantly greater benefits if the team can be transported to the distress vessel as soon as possible once the fire has started, while the ship is still at sea, rather than waiting for hours for the ship to reach port and only then starting large-scale firefighting measures.

Even just sending a contact person (MIRG Operational Commander on board) to the distress vessel in the early stage Fire and rescue services of the incident supported the decision-making of the master and firemaster of the vessel. It also facilitated co-operation between the vessel and the authorities, as the contact person could provide situation reports to the RCC and thereby to other authorities on land.

In the analysed cases, deploying a MIRG or equivalent team to the distress vessel led to a good outcome, without exception. Some of the analysed cases could have ended very badly indeed, maybe even in the total loss of the distress vessel and extensive environmental damage, if external professional help could not have been dispatched rapidly to the vessel.

5. Key conclusions and recommendations

On the basis of the analysed incidents, it can be stated that the special teams participating in MIRG operations were very well trained and carried out their tasks to a high standard. For this reason, most of the observations on MIRG operations are positive.

RCCs prepare for ship fires and their threats before they happen and draw up separate operating plans for such eventualities. For this reason, their responses to ship fires were efficient and appropriate. The actual firefighting mission did not fail in any of these cases due to inadequacies in planning or capabilities. External on-scene help led to a good outcome in all the analysed cases, without exception. The greatest challenge is the response time of MIRG teams in their deployment to the scene of the incident, which is heavily linked not only to the location of the incident but also to where the MIRG teams and SAR helicopters are stationed, and the co-operation between them and the RCCs.

The level of skills and operational capabilities of the crews of commercial vessels varied greatly in the incidents, even though in all cases the crews and their training were in line with STCW requirements. On smaller cargo ships, in particular, there were clear shortcomings in operations, whereas the crews of larger passenger vessels were more efficient. This is largely due to the fact that passenger vessel crews are generally better trained, their turnover is lower and they hold more fire drills.

On the basis of the analysis, the working group recommends that the following issues be taken into consideration in developing co-operation between MIRG operations and the vessel:

1) Each coastal nation should have the ability and readiness to dispatch a specially trained team to provide external help to support vessel crews in firefighting operations

   It should be possible to use MIRG teams, or parts thereof, flexibly in responding to incidents.

   In the case of ship fires, the rapid arrival of external help to support crew in limiting damage is particularly important. It should be possible to rapidly deploy a special group (MIRG team) and it should have the ability to initiate firefighting and damage control measures as soon as possible after its arrival on scene. This requires a team with light equipment that can be mobilised rapidly, and whose primary task is to take initial steps to bring the situation under control or slow down the spread of damage to the extent that the ship can be brought to a port of refuge to save the people on board or evacuated in a controlled manner.

   If the situation is prolonged, this team can serve as the backbone for a longer operation focusing on not only damage limitation but also national interests, which are often related to preventing or limiting environmental damage. The place of refuge process for the vessel is an integral part of these operations.

   There is no doubt that the use of professionally skilled and properly equipped external help in dealing with ship fires is advantageous if they can be transported to the scene fast enough. However, it should also be noted that even merely sending a MIRG Fire Liaison Officer on Board to the distress vessel facilitates both assessing the safety of the distress vessel and communications between the distress vessel and the RCC. Thanks to more effective communications, SAR and other
participating authorities share the same situational awareness as the distress vessel. A consistent and accurate picture of the situation significantly facilitates making the right decisions and viable operating plans at the RCC. At the same time, the MIRG Fire Liaison Officer on Board can support the master of the vessel with decision-making concerning rescue operations on board the vessel.

The threshold for using the MIRG teams of neighbouring countries in assisting with ship fires should be lowered. Joint co-ordination models and standard operating procedures or operational guidelines should be created to ensure safety and efficiency in joint operations, as has been noted in numerous projects (Baltic Sea MIRG, MIRG EU).

2) The RCC and Fire and rescue services should have a joint operating model and co-operation agreement (or equivalent) for how to quickly deploy a MIRG expert/Fire Liaison Officer specialised in ship fires to the RCC

All of the analysed incidents used an (Fire and rescue services) Fire Liaison Officer (expert) at the RCC.

The Fire Liaison Officer serves as an Fire and rescue services expert at the RCC, supporting and under the command of the Search and Rescue Mission Co-ordinator. He or she is in contact with the MIRG teams involved in the mission and other participating Fire and rescue services, plans the continuity of MIRG operations, and keeps the Fire and rescue services that dispatched MIRG units up to date on the development of the situation.

3) The co-ordination and command structure of external help used in ship fires should be clarified

The greatest challenges in the management and control of MIRG teams concern situations in which the responsibility for co-ordinating and commanding firefighting operations is transferred to an on-shore organisation, for instance after people have been rescued or the distress vessel has been towed/brought to shore. In this, the importance of co-ordinated, controlled and situationally appropriate handover of responsibilities is emphasised.

When a decision is made to tow/bring a vessel to port, co-ordination and command is transferred and divided among different parties, depending on the country in question (note, for instance, the role of the port in different countries). As firefighting efforts continue at port, general command over the situation is as a rule transferred from SAR to Fire and rescue services. The situation is then most commonly co-ordinated by the firemaster of the local Fire and rescue services together with the master of the vessel and any other authorities at the port.

In the analysed cases, there was no ambiguity among the leadership regarding command roles, but there was occasional uncertainty at the rescue unit level. In cases where firefighting at sea using MIRG teams is unsuccessful and a decision is made to move the vessel to port to extinguish the fire, the position of the on-board MIRG team with respect to the Fire and rescue services leading the firefighting efforts at port may cause uncertainty. This is particularly the case in situations where the MIRG team is from the area of operations of other Fire and rescue services or even from abroad.

4) Base locations, transport logistics and on-call arrangements of MIRG units and SAR helicopters should be developed as a whole

In order to ensure appropriate and rapid response to distress vessels in ship fire situations, the on-call arrangements and logistics chain of MIRG bases and units transporting MIRG teams (helicopters, boats) should be examined as a single whole, so that both the MIRG team and helicopter used to transport it do not have to wait unnecessarily in alert situations.

This is particularly important when very few helicopters are available and the Search and Rescue Mission Co-ordinator must prioritise the tasks of units. If a SAR helicopter must wait for a MIRG team, the SMC may order the helicopter to proceed directly to the scene of the incident to safeguard the evacuation of those on board the vessel; this will complicate and in some cases even completely prevent the transportation of the MIRG team to the vessel.

An efficiently integrated logistics chain enables transporting external help faster to the distress vessel and the more efficient use of SAR helicopters.

5) Joint ship fire drills between vessels and MIRG teams should be developed in co-operation with the responsible SAR authority

Chapter V.4 of the SOLAS Convention requires that passenger ships to which Chapter I of the Convention applies must have on board a plan for co-operation with appropriate SAR services in the event of an emergency. The plan must be developed in co-operation between the vessel, the company, as defined in Regulation IX/1 (owner of the ship), and the SAR services. The plan must include provisions for periodic exercises to be undertaken to test its effectiveness. The plan must be developed based on the guidelines developed by the Organisation (IMO). The contents of said plan have been further specified in IMO circular MSC/Circ.1079.

Although this obligation only concerns passenger vessels in international traffic, it is recommended that other vessels would draft similar plans for use in accident situations. Cargo ships should also carry out drills of joint operations with SAR authorities covering different kinds of incidents.

Drills can serve to lower the vessel’s threshold for requesting external help to deal with incidents. Communications between the vessel, SAR authorities and MIRG teams to maintain situational awareness would also be facilitated by using a shared method to assess the safety risks of the vessel. This method would be incorporated into joint drills. One suitable method is “Vessel Triage,” in which the vessel status is assessed using a four-step scale on the basis of threat factors (for additional information on Vessel Triage, see: www.rrafis/vesseltriage).

6) Redundancy in division of work related to emergencies on ships should be developed to withstand the absence of individual key persons

On the basis of the analysed ship fires, it can be stated that the operating models of the vessels had not sufficiently prepared for eventualities in which individual key persons (for instance, the firemaster of the ship) became suddenly unable to perform their duties (such as due to an accident or illness). The unexpected
absence of a key person leads to the greatest shortcomings particularly in terms of co-ordinating operations and achieving situational awareness.

For this reason, the emergency operating models and division of work on ships should be developed to ensure that the unexpected absence of any individual will not paralyse operations in the event of a fire or other such incident. Problems caused by the absence of key people can also be easily reflected in the use of external help, as very few senior officers on vessels know how to use external help efficiently.