European Maritime Safety Agency

EMSA study

EMSA/2024/OP/0014

Lessons learned from passenger ship accidents

Rev. 1.0

Date: 2025-03-29

EMSA

About this study:

This report was commissioned by the European Maritime Safety Agency (EMSA) under framework contract 2024/EMSA/2024/OP/0014.

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Recommended citation:

European Maritime Safety Agency (2024), EMSA study EMSA/2024/OP/0014 Task 2: Lessons learned from passenger ship accidents EMSA, Lisbon

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Document History (if needed)

Version	Date	Changes	Prepared	Approved
Inter-mediate	2024-12-20		Aarcha Santosh, Nina Kähler	T. Zorn
1.0	2025-03-29		Aarcha Santosh, Nina Kähler	T. Zorn

Table of Contents

List of Tables

List of Figures

List of Abbreviations

ACO	Aircraft Coordinator
BF	Beaufort
CC	Costa Concordia
CF	Caribbean Fantasy
CG	Coast Guard
DCB	Damage Control Booklet
DCP	Damage Control Plan
DG	Diesel Generator
DPA	Designated Person Ashore
EEBD	Emergency Escape Breathing Device
ER	Engine Room
ECR	Engine Control Room
IACS	International Association of Classification Societies
IMO	International Maritime Organization
ISM	International Safety Management
JRCC	Joint Rescue Coordination Centre
JRCC-SN	Joint Rescue Coordination Centre South Norway
LB	Lifeboat
LSA	Life Saving Appliances
MRCC	Marine Rescue Coordination Centre
MES	Marine Evacuation System
MRO	Mass Rescue Operation
NA	Norman Atlantic
NSIA	Norwegian Safety Investigation Authority
NTSB	National Transportation Safety Board
OSC	On Scene Coordinator
PA	Public Address
Pax	Passenger
QCV	Quick-closing valve
RCU	release control unit
RoPax	Roll-on/roll-off passenger vessel
RSC	Rescue Coordination Centre
SAR	Search and Rescue
SMS	Safety Management System
SOLAS	International Convention for Safety of Life at Sea
SRtP	Safe Return to Port
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
UTC	Universal Time Coordinated
VDR	Voyage Data Recorder
VHF	Very High Frequency
VS	Viking Sky
WTC	Watertight compartment

1. Executive Summary

As part of this study, a comprehensive review of the literature and online sources was conducted to compile accidents between the years 2000 to 2024 that led to evacuation operations on passenger ships. The database collected for this study consists of 86 passenger vessel incidents, including river cruise vessels. These cases were included if the passengers were called to muster stations or if the vessel was evacuated. The identified vessels are mainly cruise and RoPax vessels accounting to 44% and 33% respectively. 8% were river or inland cruise vessels and 15% belonged to other passenger vessel types (casino ships, high speed vessels, other ferries). The number of people on board each vessel ranged between 39 to 5900. Of these accidents, 26% has major fatalities, while 73% had no fatalities and 1% is unaccounted for. In total the 86 accidents have resulted in over 5000 lives lost. “Fire / Explosion” was the leading cause (44%) for passenger ship evacuations in the period under review, followed by “Grounding / Stranding” (31%), “Collision / Contact” (11%), “Capsizing / Listing” (8%), “Loss of control” (4%) and “Others” (2%).

Out of the 86 passenger vessel accidents that have been considered, 14 maritime accidents were shortlisted. These were shortlisted due to their significant impact on the maritime industry. Finally four of them have been selected for an in-depth review: Costa Concordia, Viking Sky, Norman Atlantic and Caribbean Fantasy. These four cases are well suited for further investigations in the context of the study: Detailed accident reports and additional sources or publications are available for them. Two of the cases are cruise ships (Costa Concordia and Viking Sky), two of them are RoPax vessels (Norman Atlantic and Caribbean Fantasy). The selected cases cover different accident categories: 2 x “Fire / Explosion” (Norman Atlantic and Caribbean Fantasy), 1 x “Loss of control” (Viking Sky) and 1 x “Grounding / Stranding” (Costa Concordia) and different ambient conditions (with regard to time of day, weather, distance to the coast, …). The outcome of the accidents ranges from numerous deaths and injuries (Costa Concordia, Norman Atlantic) to successful outcomes without personal injury (Caribbean Fantasy). Furthermore, the four cases differ significantly in terms of the means of evacuation: from helicopters only (Viking Sky) to the use of lifeboats and MES and different failures and problems with the LSA.

The in-depth investigation of the events has been done with focus on root causes and contributing factors, evacuation procedures, decision making processes, response time, crew and passenger behaviour, communication and gaps and lessons learned:

The Costa Concordia accident was marked by a lack of organisational leadership. The Master failed to acknowledge the severity of the accident and delayed giving critical instructions, resulting in panic and chaos. The crew and passengers were not well informed and were on their own. The deployment of the LSA was ordered with delay and made difficult by the vessel’s heeling. Key take- aways: Organisational leadership, timely decision making, and clear communication are critical in managing large scale evacuations.

The Norman Atlantic incident involved a fire on a passenger ferry in the Adriatic Sea, resulting to at least 11 deaths. Bad weather and other factors worsened the situation, rendering one side of the ship’s life-saving appliances (LSA) unusable. Evacuation efforts were hampered by ineffective LSA, particularly the Marine Evacuation System (MES), due to poor preparation and extreme weather. The crew’s lack of coordination and communication worsened the evacuation. Key take-aways: The need for robust fire safety systems, functional LSA on both sides, and comprehensive crew training is vital.

The evacuation of Caribbean Fantasy was characterized by problems with the vessel’s LSA: The crew struggled with lifeboat deployment, as they were unable to release the hooks properly. MES usage was also unfamiliar. The Master played a key role in managing the situation with Coast Guard assistance. Key take-aways: Crew must be thoroughly trained on LSA systems, including updates. Proximity to shore and timely external support were crucial to the successful outcome.

The Viking Sky accident was characterized by the severe weather conditions that on the one hand caused the lubricating oil deficiency in the diesel generators and on the other hand prevented the deployment of vessel’s LSA. The decision making and the actions of the Master were quick and straight forward. The emergency procedures (Alarm, mustering) have been followed. The internal and external communication was clear, and target orientated. The passengers felt well informed and taken care of. The evacuation by helicopters was time consuming although the distance to be flown was short. Key take-aways: LSAs may be unusable in adverse conditions. Helicopter evacuations are not feasible for full-scale evacuation of large cruise ships within a reasonable timeframe.

Finally, it can be concluded that

- In none of the four accidents the LSA could be used as intended.
- Strong Organisational leadership onboard is essential.
- Communication challenges complicate the coordination.
- Timely and effective external support is vital.
- Lessons learned are often slow and inconsistently translated into regulatory changes.

2. Introduction

The most well-known ship disasters, the sinking of the Titanic in 1912 highlighted the importance of safety regulations, proper safety equipment and procedures and had an enormous impact on the rule development. The accident of Costa Concordia 100 years later has inter alia influenced e.g. the rules for muster drills, bridge access and procedures as well as the need for individual evacuation analyses. Besides these “flagship” disasters many other incidents have impacted the enhancement of rules and regulations.

As part of this study, a comprehensive review of the literature and online sources was conducted to compile accidents between the years 2000 to 2024 that led to evacuation operations on passenger ships. The database collected for this study consists of 86 passenger vessel incidents, including river cruise vessels.

The scope of this task is to select four of these 86 events for an in-depth review. In a first step, 14 accidents with significant impact have been shortlisted and available documentation has been compiled. In a second step, 4 of these have been selected for an in-depth review: Costa Concordia, Norman Atlantic, Caribbean Fantasy and Viking Sky.

These four have been investigated in detail with regard to root causes and contributing factors, adherence to regulations, evacuation procedures and their effectiveness, decision making, response time, crew preparedness and behaviour, passenger behaviour, impact of ship design and layout, role of life-saving appliances, communication and gaps and lessons learned. Finally the impact of these accidents on rules and regulations is analysed.

3. Database and Sources

3.1 Sources Used

In this task a comprehensive literature review and internet search has been conducted to compile evacuation events on passenger ships. Starting points were public webpages like cruisejunkie.com (not available anymore), and cruiseminus.com (in the meantime integrated into cruisemapper.com) which use news media and local police reports in addition to official coast guard reports. Before listing the events in the database each of them has been affirmed by searching for information on the European Marine Casualty Information Platform (EMCIP) (EMSA), in EMSA's Annual Overview of Marine Casualties and Incidents (EMSA, 2000 - 2023 https://www.emsa.europa.eu/publications/reports.html) and on the internet (google.com, Microsoft Copilot, accident investigation bodies of several flag states, scientific publications (e.g. , etc.). Further on publicly available accident investigation reports of the flag states have been scanned (e.g. (EMSA), (Transportation Safety Board of Canada), (Authority), ((NTSB)), (Germany Federal Bureau of Maritime Casualty Investigation), (Greece Hellenic Bureau for Marine Casualties Investigation (HBMCI)), (Norwegian Maritime Directorate), (Netherlands Dutch Safety Board).)

3.2 Database

A total of 86 events were included in the database (see Appendix A). To be eligible, incidents had to meet the following criteria:

- The ship was commercially intended to carry passengers
- The incident happened between year 2000 and October 2024
- Persons were called to assembly / muster stations or
- The order to abandon ship has been given or "should have been given"

In this stage, evacuation incidents on river cruise vessels have been included in order not to miss different / alternative evacuation routes or procedures and the impact of restricted waterways with regard to usability of LSA, the accessibility by external supporters and rescue operations. However, for the selection of events for in-depth review we have focused on seagoing ships.

3.3 Statistics

The analysis of passenger vessel accidents is essential for improving the maritime safety and preventing future casualties. The database collected for this study consist of 86 passenger vessel incidents, including river cruise vessels, from the year 2000 up to 2024. These cases were included if the passengers were called to muster stations or if the vessel was evacuated. The identified vessels are mainly cruise and RoPax vessels accounting to 44% and 33% respectively. 8% were river or inland cruise vessels and 15% other passenger vessel types (casino ships, high speed vessels, other ferries). The number of people on board each vessel ranged between 39 to 5900.

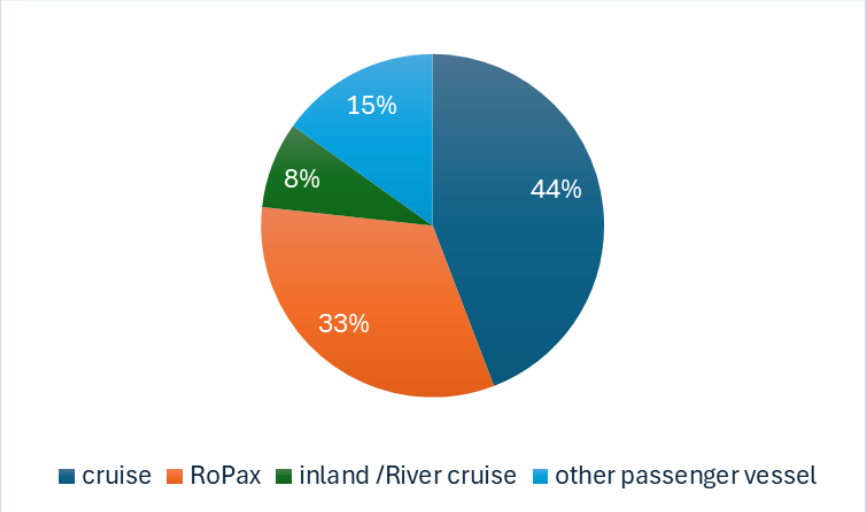

Figure 3-1 Ship types involved in the 86 accidents

The 86 accidents have resulted in over 5000 lives lost[2], highlighting the critical nature of the work at hand. Of these accidents, 26% has major fatalities, while 73% had no fatalities and 1% is unaccounted for.

Maritime Accidents can be categorized as follows (EMSA, 2000 - 2023 https://www.emsa.europa.eu/publications/reports.html):

- Capsizing / Listing
- Collision / Contact
- Fire / Explosion
- Grounding / Stranding
- Loss of control (directional control, propulsion power, electrical power)

The 86 accidents found have been assigned to these categories:

A.	Fire /Explosion:	38 out of 86 cases	(44.2 %)
B.	Grounding /Stranding:	27 of the 86 cases	(31.4 %)
C.	Collision / Contact:	9 of the 86 cases	(10.5 %)
D.	Capsizing / Listing:	7 out of the 86 cases	(8.1 %)
E.	Loss of control:	3 out of the 86 cases	(3.5 %)
F.	Others:	2 out of the 86	(2.3 %) were bomb scares.

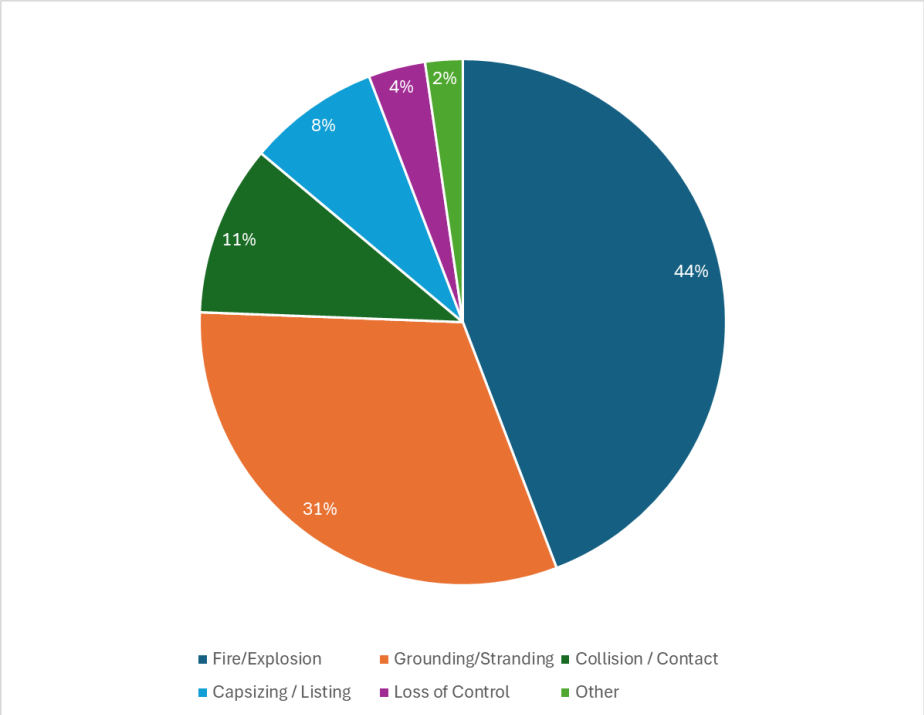

Figure 3-2 Assignment to accident categories

[2] This high number is mainly driven by three accidents with a high number of fatalities (Joola in 2002, Al-Salam Boccaccio98 in 2006 and Princess of the Stars in 2008, see Appendix A.

"Fire / Explosion" was the leading cause (44%) for passenger ship evacuations in the period under review, followed by "Grounding / Stranding" (31%).

3.4 Frequency of Evacuation Events in Relation to Passenger Exposure

To assess the risk associated with evacuation or mustering events on passenger ships, a normalized analysis was carried out using the ratio of such events to total passenger exposure. This includes both:

- Cruise ships, primarily operating on international leisure routes with longer durations and lower frequency of port calls.
- RoRo passenger ships (ferries), operating on domestic and intra-EU short sea routes, often with high frequency and shorter onboard duration.

Two metrics were used to express evacuation frequency:

- Evacuation events per passenger-hour onboard (Evac/Pax·hours)
- Evacuation events per passenger-nautical-mile travelled (Evac/Pax·NM)

3.4.1 Methodology

For both ship types:

The incident database includes both **full evacuations** and **muster/assembly events** between **2000 and 2024**.
For the RoRo passenger ships only ships **operating in the EU** and **within EU waters** were included.
Passenger exposure was estimated as follows:

Table 3-1 Average trip duration and the average distance travelled

Ship Type	Average Trip Duration	Average Distance Travelled
Cruise Ships	7 days (≈168 hours)	2100 nm (300 nm/day)
RoRo Ships (EU)	8 hours	200 nm

3.4.2 Results for Cruise Ships

As illustrated in the Evacuations per billion Passenger Hours chart Figure 3-3, Cruise ships show an evacuation frequency, typically around 0.2 to 1 event per billion passenger hour. Notable spikes occur in years of major accidents:

- 2012: Costa Concordia (Italy)
- 2014: Norman Atlantic (Italy)
- 2019: Viking Sky (Norway)

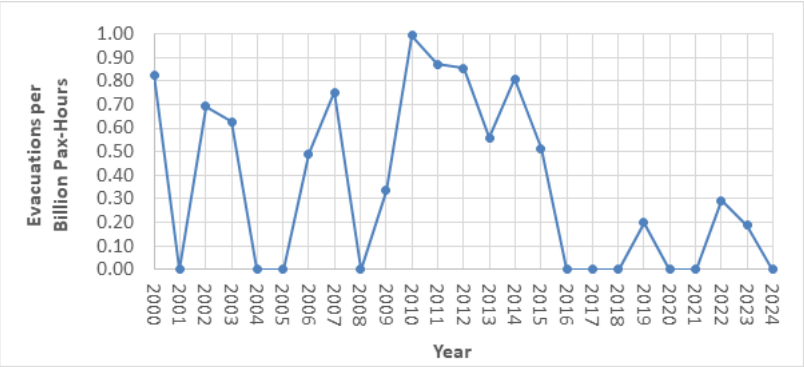

Figure 3 3: Evacuations per one billion Passenger Hours.

Between 2000 and 2009, the frequency of cruise ship evacuations remained low and sporadic. Most years recorded either no incidents or isolated events, with values generally fluctuating between 0.2 and 1 evacuations per billion passenger-hours. There was no consistent upward or downward trend during this period, and the evacuations appeared to be largely event-driven, with no indication of widespread systemic deficiencies. This pattern reinforces the understanding that large-scale cruise ship evacuations remain, exceptional occurrences.

From 2010 up to 2015 evacuation incidences occurred annually, with a notable peak around 2012, which corresponds with the Costa Concordia disaster one of the most significant cruise ship accidents in recent history. This incident served as a major inflection point for international maritime safety policy, triggering a wave of regulatory attention within the International Maritime Organization (IMO), particularly through the work of the Maritime Safety Committee (MSC).

Although the evacuation frequency remained relatively low after 2012, the period that followed reflects more consistent regulatory efforts to strengthen evacuation preparedness and Life-Saving Appliances (LSA) requirements. These developments were aimed at addressing the lessons learned from Costa Concordia and other incidents involving evacuation or mustering challenges. After 2016, a decline in evacuation frequency is visible, which may be partially attributed to enhanced safety procedures, updated SOLAS provisions, improved crew training, and better voyage planning. However, it should be noted that a decline in cruise activity during the COVID-19 pandemic (2020–2021) also contributed to fewer operational hours and may have affected overall trends.

When the same data is normalized by distance travelled rather than time on board, a similar pattern is evident. Cruise ships again show a very low evacuation frequency, typically below 1 event per 10 billion passenger-nautical-miles (Figure 3-4)**.** The long voyage distances characteristic of cruise travel distribute risk over a larger denominator, further reducing the frequency when expressed per nautical mile. This supports the that the risk of evacuation remains small across the sector, even when exposure is viewed in terms of distance travelled.

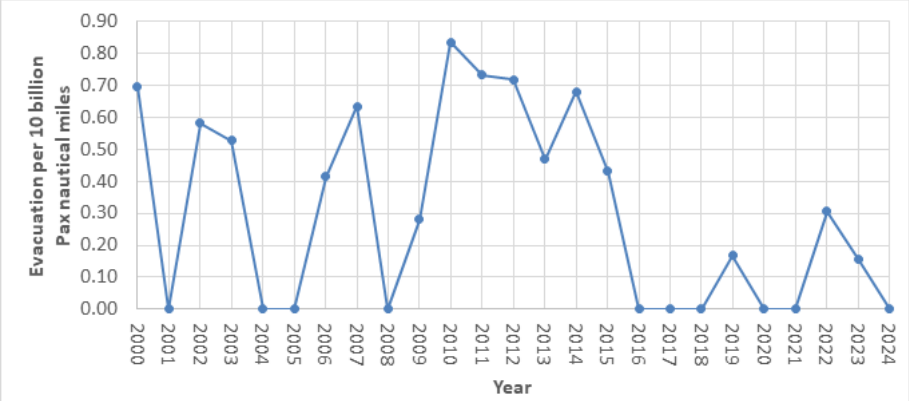

Figure 3-4: Evacuation per 10 billion passenger nautical miles

3.4.3 RO-RO Passenger Ships

The evacuation frequency for Ro-Ro passenger ships, including RoPax vessels and ferries, has been analysed over the period from 2000 to 2024 using two key indicators: evacuations per billion passenger-hours and evacuations per 10 billion passenger-nautical-miles. Figure 3-5 and Figure 3-6 illustrate these two metrics, respectively, and reveal important operational patterns.

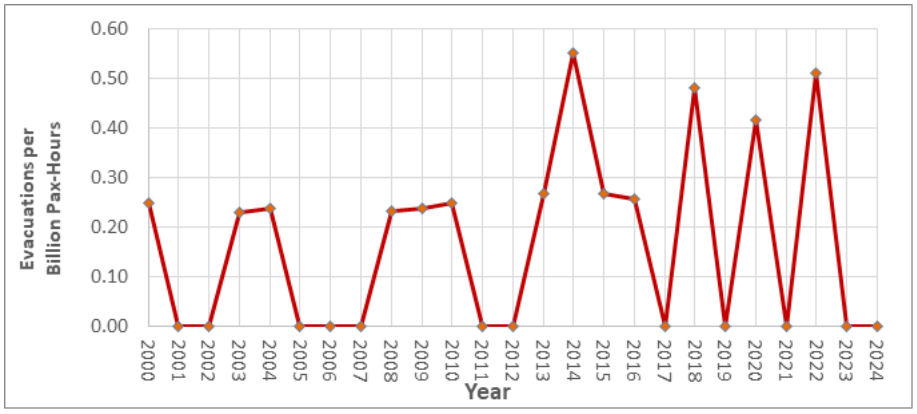

Figure 3-5: Evacuations per one billion Passenger Hours (RO-RO pax in EU)

Between 2000 and 2010, the evacuation frequency remained relatively stable, typically in the range of 0.2 to 0.25 evacuations per billion passenger-hours. This period was characterised by isolated events with no apparent trend or systemic increase. The nature of the incidents recorded during these years suggests that most evacuations were the result of discrete operational failures.

A significant increase in evacuation frequency was observed in 2014, corresponding with the Norman Atlantic incident. This event, involving a major fire on the car deck of a RoPax vessel operating in the Adriatic Sea, had considerable impact in terms of public perception and policy attention. It highlighted the complexity of evacuating RoPax ships under adverse conditions, particularly when fires break out in enclosed vehicle spaces and evacuation is hindered by weather and congestion. The Norman Atlantic incident marked a turning point in terms of awareness and likely prompted enhanced discussions within IMO and among Member States on improving fire safety and life-saving arrangements for this category of ships.

Following 2014, the frequency of evacuations for Ro-Ro passenger ships exhibits a more noticeable and sustained increase. While the years leading up to 2014 showed relatively isolated evacuation events, the post-2014 period includes several years with consistently elevated frequencies, such as 2014, 2018, 2020, and 2022. This suggests not just a return to pre-incident levels but a potential shift toward a higher underlying rate of evacuation events. The incidents during this period are frequently associated with operational challenges such as fires, machinery failures, and groundings typical of high-frequency, short-distance RoPax operations where vessels face intensive docking schedules, vehicle handling risks, and coastal navigational hazards. While no exponential growth is evident, the pattern reflects a persistent risk environment that may indicate underlying design or procedural issues that deserves a continuous regulatory and operational attention.

Since 2014, evacuation rates per passenger-hour have remained relatively stable, without a clear downward trend. Although it is possible that enhanced regulations, crew training, and procedural upgrades have reduced the severity or escalation of more recent incidents, the underlying frequency of events appears unaffected.

A similar pattern is observed when analysing evacuation frequency per 10 billion passenger-nautical-miles. RoPax services characterised by short routes and high turnaround frequency continue to demonstrate higher exposure per mile travelled compared to cruise ships. Nevertheless, the overall risk remains low, with most years recording fewer than 0.5 evacuations per 10 billion passenger-nautical-miles.

Unlike the cruise sector, which faced an almost complete suspension of operations during the COVID-19 pandemic, RoPax services particularly on domestic and intra-EU routes continued to operate in a more limited capacity, often to maintain essential transport links. However, these services were not unaffected. Passenger volumes dropped significantly due to travel restrictions, and some routes saw reduced frequency or temporary suspensions. As a result, the observed evacuation rates for 2020–2021 should be interpreted with caution, as they reflect a period of not typical operational patterns. While the continuity of some services during the pandemic does allow for year-on-year comparisons, these years cannot be assumed to represent normal risk exposure across the entire RoPax sector.

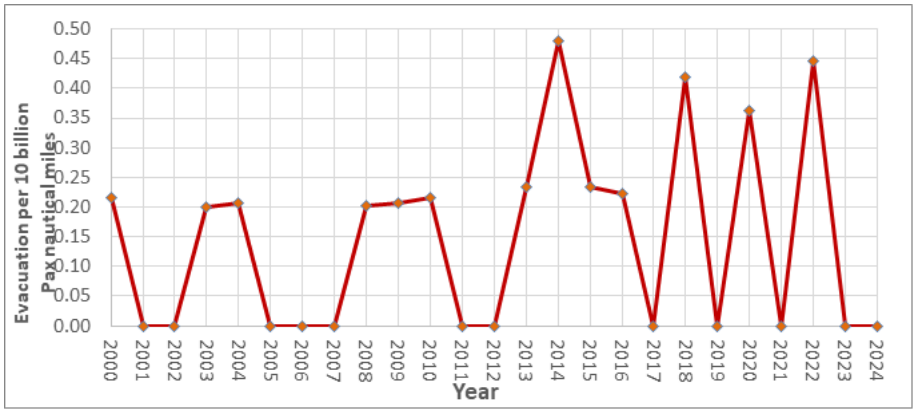

Figure 3-6: Evacuation per 10 billion passenger nautical miles (RO-RO pax in EU)

3.4.4 Conclusion

This chapter provided a quantitative assessment of evacuation-related incidents on passenger ships, with a specific focus on cruise ships and Ro-Ro passenger vessels (RoPax), covering the period from 2000 to 2024. By analysing the frequency of full or partial evacuations and mustering events in relation to passenger-hours onboard and passenger-nautical-miles travelled, the study introduces a risk-normalised understanding of evacuation occurrences across two major passenger ship categories.

Cruise ships exhibit an exceptionally low evacuation frequency, generally between 0.2 and 1.0 events per billion passenger-hours. This trend is true even when normalised by nautical distance travelled, with rates typically remaining below 1.0 evacuation per 10 billion passenger-nautical-miles. Notable peaks in the dataset align with high-profile accidents such as Costa Concordia (2012), Norman Atlantic (2014), and Viking Sky (2019), each of which prompted a regulatory and operational scrutiny. Although the post-2012 period did not show a sharp decline in the number of incidents, there is evidence of a gradual downward trend after 2016. This may reflect the cumulative effect of regulatory reforms, including enhancements to SOLAS provisions, crew training requirements, muster procedures, and Life-Saving Appliance (LSA) maintenance standards. It is also important to note that the COVID-19 pandemic (2020–2021) temporarily reduced cruise activity, which is likely to have contributed to the low exposure hours recorded during those years.

In contrast, Ro-Ro passenger ships present a more complex risk profile. While the early 2000s show relatively low and sporadic activity, the period after 2014 is marked by a visible increase in evacuation events. The Norman Atlantic incident that year highlighted key vulnerabilities related to fire safety, LSA accessibility, and evacuation coordination under adverse conditions. Despite ongoing regulatory attention, the frequency of RoPax evacuations has remained elevated in the years that followed, with incidents in 2018, 2020, and 2022 reinforcing the operational challenges of this ship type. RoPax vessels often operate on high-frequency, short-distance routes, with intensive docking cycles and high passenger turnover, exposing them to a different set of operational hazards than cruise ships. While the overall risk per nautical mile remains low, the data suggests that systemic issues such as car deck fire safety, crew coordination under pressure, and LSA deployment continue to warrant attention.

The comparative analysis between the two ship types confirms that large-scale evacuations remain rare events across the passenger shipping domain. However, the nature, recurrence, and causes of these events differ significantly between cruise ships and RoPax vessels. Cruise ship evacuations are infrequent, often high-profile, and more likely to lead to regulatory change. The findings support the continued need for differentiated regulatory approaches and targeted safety measures that reflect the specific operational realities of each sector.

The analysis highlights the importance of sustaining efforts in crew training, evacuation planning, LSA system design and testing, and regulatory adaptation particularly for RoPax operations where the risk landscape appears more persistent. Furthermore, improving the systematic reporting and classification of mustering and evacuation events including near misses will be essential to strengthening data quality and enabling more robust risk-based oversight.

4. Selection of Cases for in-depth Review

The aim of the report is to have enhanced the understanding of past maritime accidents so as to use the knowledge to contribute to ongoing improvements in safety practices and standards in the maritime evacuation procedures. In order to achieve this goal, there is a need to identify as many significant ship evacuations incidents as possible, followed by an analysis of the high-profile incidents, extract the lessons learned and assess their implementations in the maritime industry at present. As a result of an extensive list and record of such incidents over the past 20 years, the study selects four specific cases that are most significant in terms of their impact and potential learning on evacuation procedures. The focus of the study is on life-saving appliances, evacuation procedures, emergency decision-making, and life safety lessons learned, and an objective is to understand the factors that contributed to the tragedy and to identify regulatory points related to life safety.

This section of the report explains the selection of the cases to be reviewed in depth.

Out of the 86 passenger vessel accidents that have been considered, 14 maritime accidents were shortlisted. These were chosen either due to a significant impact and impression of said incident on the maritime world. These 14 candidates and the years of the accidents are stated below:

Table 4-1 14 candidates for in-depth review

Ship name	Year of accident	Ship type	Accident category
Lady Mary Joy 3 (Wikipedia)	2023	Passenger ferry	Fire / Explosion
Euroferry Olympia (HELLENIC BUREAU FOR MARINE CASUALTIES INVESTIGATION, June 2023)	2022	RoPax	Fire / Explosion
Mercraft 2 (https://portcalls.com/mercraft-2-carried-157-but-not-overloaded-pcg/)	2022	High-speed ferry	Fire / Explosion
Stena Scandica (DMAIB Danish Maritime Accident Investigation Board, Sept 2023)	2022	RoPax	Fire / Explosion
Viking Sky (Norwegian Safety Investigation Authority, March 2024)	2019	Cruise	Loss of control
Caribbean Fantasy (National Transportation Safety Board, June 2018)	2016	RoPax	Fire / Explosion
Freedom of the Seas (The Bahamas Maritime Authority, Feb 2017)	2015	Cruise	Fire / Explosion
Le Boreal Ponant (BEA mer, Jul 2016)	2015	Cruise	Fire / Explosion
Sorrento (MINISTRY OF INFRASTRUCTURE AND TRASPORT)	2015	RoPax	Fire / Explosion
Norman Atlantic (Ministry of Infrastructure and Transport, Final Report)	2014	RoPax	Fire / Explosion

Sewol (Kwon, February 2016)	2014	RoPax	Capsizing / Listing
Costa Concordia (Ministry of Infrastructures and Transports Marine Casualities Investigative Body)	2012	Cruise	Grounding / Stranding
Mecklenburg Vorpommern (Bundesstelle für Seeunfalluntersuchung, Nov 2012)	2012	RoPax	Fire / Explosion
Rabaul Queen (COMMISSION OF INQUIRY INTO THE SINKING OF RABAUL QUEEN, June 2012)	2012	RoPax	Capsizing / Listing

In the above mentioned the most recent incidents of “Euroferry Olympia”, “Mercraft 2” and “Lady Mary Joy 3” were unable to be considered in the further steps due to a lack of sufficient reliable resources and investigation reports as the investigations have not yet been finalised at the time of selection of the cases.

Out of the rest of the 11 major maritime passenger vessel accidents over the last 20 years, finally four individual accidents were narrowed out with regard to significant impact on the maritime industry and its safety regulations:

1. In 2012 the **Costa Concordia**, a luxury cruise vessel, struck a reef off the coast of Italy due to reckless navigation. It capsized, resulting in 32 deaths. The incident highlights the critical role of the Master in safe navigation, effective communication, timely management, deployment of safety procedures, general accountability and the catastrophic result of poor decision-making. There was a clear lack of instructions for crew and passengers, this along with poor proficiency of the crew resulting in significant delays in evacuation and rescue. The lifeboats could not be deployed on one side due to the ships list, leaving passengers stranded. The incident sparked changes in evacuation drills, mandating that all passengers must receive safety briefings prior to departure. The unfortunate event also resulted in SOLAS amendments around regulations towards improving stability requirements and quick evacuation readiness.

   Safety recommendations given in the investigation report (Ministry of Infrastructures and Transports Marine Casualities Investigative Body) relate to: Stability, Electric distribution /location of switchboard rooms, emergency power generation, bridge management, evacuation analysis, embarkation ladders and SAR boat design. The details and the impact on rules and regulations is described in chapter 9.

2. In 2014 RoPax vessel **Norman Atlantic** caught fire in the car deck and it spread quiet rapidly. Rescue efforts were hindered by extreme weather conditions and it resulted in 11 confirmed death and over 18 missing. The unfortunate event, due attention to deficiencies in fire detection and suppression systems, resulting in stricter fires and safety protocols on passenger vessels. The smoke and heat made it difficult to access muster stations and lifeboats. It also emphasised the need for robust safety measures to ensure effective evacuation in rough seas. Another key outcome of the event was the need to improve crew training on managing fires and assisting passengers.

   Safety recommendations given in the investigation report (Ministry of Infrastructure and Transport, Final Report) relate to: coordination between port and ship security, internal audits, working language, registration of passengers and cargo, fire detection systems, structural fire protection, lashing, VDR and operational instructions. The details and the impact on rules and regulations is described in section 6.3.13.

3. In 2019 the cruise ship **Viking Sky** left the port with one out of four diesel generators unavailable and therefore without the redundancy required under Safe Return to Port (SRtP) regulations. She experienced a blackout, causing loss of propulsion and steering, during a storm off the Norwegian coast, with narrowly avoiding grounding. A major evacuation was carried out with over 470 passengers being airlifted to safety. The lifeboats could not be launched due to heavy listing and sea state. The passengers relied in PFD during the airlift process.

This raised awareness about the importance of reliable engine redundancy and underlined the necessity of better risk assessment when navigating through storm-prone regions.

Safety recommendations given in the investigation report (Norwegian Safety Investigation Authority, March 2024) relate to: lube oil tank design, lube oil monitoring and management, VDR, and engine room alarm system and management. The details and the impact on rules and regulations is described in chapters 8 and 9.

4. In 2016 RoPax vessel **Caribbean Fantasy** caught fire near Puerto Rico leading to a complete evacuation of over 500 passengers and crew. The fire originated in the Engine room and quickly spread, forcing passengers to abandon ship. It resulted in a focused attention on the logistical challenges of evacuating a large passenger vessel in emergencies and demonstrated gaps in ensuring ship compliance with safety certifications and prompted more inspections. A major lesson learnt also exposed the vulnerabilities in engine maintenance and fire safety.

   Safety recommendations given in the investigation report (National Transportation Safety Board, June 2018) relate to: quick closing valve testing, fire suppression systems, SAR and LSA and ISM Code training programs. The details and the impact on rules and regulations is described in chapters 7 and 9

These four cases are well suited for further investigations in the context of the study: Detailed accident reports ((Norwegian Safety Investigation Authority, March 2024), (National Transportation Safety Board, June 2018), (Ministry of Infrastructure and Transport, Final Report), (Ministry of Infrastructures and Transports Marine Casualities Investigative Body),) and additional sources or publications are available for them. Two of the cases are cruise ships (Costa Concordia and Viking Sky), two of them are RoPax vessels (Norman Atlantic and Caribbean Fantasy). The selected cases cover different accident categories: 2 x “Fire / Explosion”

(Norman Atlantic and Caribbean Fantasy), 1 x “Loss of control” (Viking Sky) and 1 x “Grounding / Stranding” (Costa Concordia) and different ambient conditions (with regard to time of day, weather, distance to the coast, …). The outcome of the accidents ranges from numerous deaths and injuries (Costa Concordia, Norman Atlantic) to successful outcomes without personal injury (Caribbean Fantasy). Furthermore, the four cases differ significantly in terms of the means of evacuation: from helicopters only (Viking Sky) to the use of lifeboats and MES and different failures and problems with the LSA (see Table 4-2).

Table 4-2 Comparison of some key facts

	Costa Concordia	Norman Atlantic	Viking Sky	Caribbean Fantasy
Accident category	Grounding / Stranding	Fire / Explosion	Loss of control	Fire / Explosion
Ship type	Cruise	RoPax	Cruise	RoPax
Time of day	night	night	afternoon	morning
Weather	moderate	rough	rough	good
Persons on board (pax + crew)	3206+1023	420+55	915 + 458	387+124
Evacuation by	Lifeboats, liferafts, helicopters	Lifeboats, MES helicopters	helicopters	MES, lifeboats
Problems with LSA	Not possible to deploy all LSA due to extreme list of the vessel	LSA on starboard side destroyed by fire Liferafts detached from the vessel; persons blocked inside chute	LSA considered unusable due to weather conditions and proximity to the coast On starboard side LB3, rescue boat, all control stations for LB davits and	Big gap between LB2 and embarkation deck Hooks of LB1 and 2 did open only with delay, hooks of LB3 did not open

			lifejacket boxes damaged by wave impact	LB1 without thrust Portside MES slide angle too steep
Outcome	32 fatalities, vessel scrapped after extensive salvage operations	27+ fatalities, vessel scrapped	No fatalities, 19 injuries (1 serious), vessel back in service	No fatalities, 50+ injuries (6 serious), vessel scrapped

The incidents collectively emphasis the critical need for:

- Improved evacuation systems and procedures
- Enhanced training drills and scenario-based emergency training of crew
- Robust safety protocols

5. Costa Concordia

5.1 The vessel

Costa Concordia (IMO number 9320544) was an Italian flagged cruise ship built at Fincantieri shipyard in Italy. She was taken into operation in 2006 and designed for 4880 persons (3780 pax and 1100 crew).

Figure 5-1 Photo of Costa Concordia (Ministry of Infrastructures and Transports Marine Casualities Investigative Body)

Table 5-1 Main particulars of Costa Concordia

Length over all	290.20 m
Length between pp	247.37 m
width	35.5 m
Height	11.2 m
draught	14.18 m
Gross tonnage	114,137 gt
Max. speed	21.5 knots

Costa Concordia was equipped with following LSA:

- 26 lifeboats (total capacity 3,720 seats)
- 69 liferafts (total capacity 2,395 seats)
- 2 rescue boats

5.2 The accident

The incident occurred on January 13 in 2012, when the cruise ship collided with the “Scole Rocks” near the Italian Giglio Island with 4229 persons onboard: 1023 crew members and 3206 passengers, thereof 2954 adults, 200 children (under 12 years) and 52 babies (under 3 years). The collision caused due to navigating too close to the coastline at night (21:45 local time), resulted in a significant hull breach and immediate flooding of 5 watertight compartments, leading to significant list. Following the collision, the ship lost its propulsion and experienced a blackout. Though the emergency generator started, it failed to supply power continuously. The rudder remained

blocked completely starboard and no longer handled. The ship turned starboard by herself and finally grounded (due to favourable wind and current) at the Giglio Island at around 23.00 and was seriously listing to starboard side.

The weather conditions were moderate: Wind from ENE 17 knots with rough sea (sea state 4).

No emergency alarm was activated immediately, and the crews attempt to manage the situation was mulled with communication and coordination issues resulting gin confusion among passengers and crew alike. The abandon ship order was given only at 22:54 and then the first lifeboats were lowered. The ship continued listing and finally reached 80° angle during rescue operations. The Master and some officers abandoned the ship before the evacuation was complete. The cruise vessel had 4,229 people on board which included 3,206 passengers and 1,023 crew members. Rescue operations continued through the whole night with the last passenger and crew being evacuated by 06:17 on January 14th ,2012. The Costa Concordia accident is a significant maritime disaster that resulted in the loss of 32 lives and extensive damage to the vessel.

According to the accident investigation report (Ministry of Infrastructures and Transports Marine Casualities Investigative Body) a total of 4197 people were rescued. Among these, about 1270 were rescued by the rescue units intervened directly under the coordination of MRSC of Livorno. In particular, the rescue units of the Coast Guard showed the following data:

- Around 545 people transhipped from the Patrol Boat CP 305 and transferred to the port or bigger supporting rescue units
- 80 people on board the Costa Concordia liferafts were tugged
- 16 people were rescued by helicopters
- 4 people were rescued from the sea
- It is estimated that the remaining approximately 2930 people had abandoned the ship on the survival craft (boats and liferafts) and reached autonomously the coast

The emergency management practices on board the vessel was guided by the ships Safety Management System (SMS) and the decision Support System for the Master. These are designed to provide structure procedures and guidelines for handling various emergency situations, including collision, groundings and flooding. The decision system support for the Master provides a series of steps and actions to be taken in case of an emergency, such as, damage assessment, communication to notify competent authorities, damage control plan, mitigation measures, general emergency alarm and abandon ship procedures.

The decision-making process during the emergency had a lot of flaws. The Master did not immediately declare a general emergency. There was a lack of coordination among the crew. The damage control plan and decision support system for the Master were not effectively utilised. The communication towards Search and Rescue authorities were delayed and the seriousness of the situation was not conveyed. The Master abandoned the ship before the evacuation was complete, leaving crew members and passengers to manage the crisis independently.

Due to the above-mentioned facts, the evacuation process was started with significant delay. The general emergency was not activated immediately after impact, causing confusion and disorganisation. Passengers were informed of a blackout but nothing more. The abandon ship order was given at 22:54, almost one hour after the collision. The evacuation was further complicated by the ships increasing list. This made the deployment of lifeboats and liferafts difficult.

The Costa Concordia was equipped with various lifesaving appliances. During the event, 23 out of 26 lifeboats and 6 out of 69 liferafts were used for rescue. The increasing list of the ship posed a challenge in their deployment during abandonment.

The incident investigation report (Ministry of Infrastructures and Transports Marine Casualities Investigative Body) identified important safety lessons, summarized in the following overview:

- Mitigate the human contribution factor with education, training and technology
- The importance of timely activation of the general emergency alarm and clear communication with passengers and crew
- The need for effective crew training and familiarisation with emergency procedures
- The necessity of regulatory changes to improve stability, redundancy of vital equipment, emergency power generation and evacuation analysis

The Costa Concordia accident highlights the critical importance of effective emergency management, timely decision-making, and clear communication during maritime emergencies. The lessons learned from this tragedy also draws attention needed for continuous improvement in crew training, emergency procedures, and regulatory standards to ensure the safety of passengers and crew on board large cruise ships. The impact on rules and regulations is documented in chapter 9.

5.3 In-depth review

5.3.1 Root causes and contributing factors

Human element is the root cause in the Costa Concordia casualty both for the first phase of it, which means the unconventional action which caused the contact with the rocks, and for the general emergency management (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).

Following contributing factors have been found:

- The Master never considered the continue increasing of the heeling to the starboard side, and didn't realize the main meaning of the increasing flooding, which would have determined very soon, when reached the bulkhead deck level, the related sinking. Flooding reached, in fact, the deck 0, at 22:29, and spite off this he waited 26 minutes more to launch the abandon ship (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- The Master showed not to have the appropriate knowledge of the ship vital equipment location. He ignored what main equipment were contained in the core of the ship. He erroneously confused the main switchboard with the emergency switchboard (this last was not located in any of the WTCs flooded but at the 11th deck) (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- The Hotel Director failed his own fundamental role in a such serious emergency. He did not perform his duty because ignored that, occurring the flooding, he should have carried out the following tasks /9/:
    - stay in charge for the assigned duty to coordinate, as competent appointed crewmember, the cabins and saloon, lounges, living and each workplace into the related main vertical zone, the consequent evacuation.
    - gather all the related information coming from all crewmembers about the scenario, and consequently update the Master.
    - shouldn't have allowed that the Master would have given false communications to the passengers and crew, through public address, which fatal delayed them to reach the muster stations, despite he was aware that the ship would have sunk.
    - once he was aware that the emergency general signal was going to be given, he should have speed up the action to reach the muster stations.
- The signal (alarm) for the abandon ship was not given according to the right criteria. Moreover, rather than by the Master's voice, it was announced by the Staff Master. It occurred 21 minutes after the emergency general signal (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- Another contributing factor was identified: the more formal, militaristic organisational structure (hierarchy) on vessels ((Ventura, n.3 2019)) that 1. prevented the crew from intervening against the Master's decision and 2. prevented the officers from taking over the duties of the obviously incapacitated Master.
    - On a cruise ship, a fundamental coordination mechanism is the "chain of command" (direct supervision) and standardization (skills; norms and output). Ship Master broke the chain of command because of a supervisor ignoring the disaster (Ventura, n.3 2019).
    - The ship is one of the most hierarchical organisations in the 21st century", the on-board organization falls within the powers of the ship Master (Karjalainen, 2004)

5.3.2 Adherence to international, EU and national safety regulations

According with the evidences found at the end of the present investigation, it is necessary to put in evidence that Costa Concordia resulted in full compliance with all the SOLAS applicable regulations, matching therefore all the related requirements once she left the Civitavecchia Port on the evening of the 13 January 2013. (Ministry of Infrastructures and Transports Marine Casualities Investigative Body)

5.3.3 Evacuation procedure

The evacuation process was characterised by lack of organisational leadership. Crew and passengers moved by themself (without order) to reach the muster stations (Ministry of Infrastructures and Transports Marine Casualities Investigative Body), before the Master made the first (unclear) announcement communicating to the passengers to go to the muster stations. The assembly points were not adequately supervised by the crew /34/. In the beginning lifeboats and MES were used to abandon the ship, at a later stage persons escaped via the embarkation ladders, and some were airlifted. The embarkation into the lifeboats was insufficiently managed by the crew. The result was jostling and panic among the passengers. The Master left the ship long before the evacuation was completed, shirking the responsibility of coordinating the process.

5.3.4 Decision making

The support to the ship's Officer for the actions to be undertaken in case of flooding is provided by the "Damage Control Plan" (DCP) and the "Damage Control Booklet" (DCB). However, after comparing the two documents it has been found that the documents are partly incorrect and not consistent (Ministry of Infrastructures and Transports Marine Casualities Investigative Body). The ship was also equipped with the NAPA software along with the Stability Information to the Master (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).

The related procedures according with the Decision Support System was not followed (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).

The Master informed the Designated Person Ashore (DPA), about the occurrence, at 21.57.34. This Representative reached the Company building to form the "Crises Team", to support the Concordia Master. The crisis committee was formed only at 23:00.

The situation of Costa Concordia deteriorated primarily due to the following decisions:

<u>Before the accident</u>

- Decision of the Master to make that hazardous passage in shallow waters
- Decision of the officers not to intervene

<u>During the emergency</u>

- The General Emergency Alarm was not activated immediately after the impact, but at 22:33 (48 minutes after the rock contact) (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- The distress alarm by VHF was not immediately launched to all ships in the area, but at 22:38 (53 minutes after the rock contact) (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- The seriousness of the situation on board was not intentionally communicated to the SAR Organization (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- Designated Person Ashore (DPA) testified he was confident in the Master's proficiency in handling emergencies. He confirmed that he didn't provide any support to the Master and never urged him to decide for an immediate action to abandon the ship (Ministry of Infrastructures and Transports Marine Casualities Investigative Body)
- Only at 22:35:53 (50 minutes after the rock contact) the Master decides to "abandon ship" (Ministry of Infrastructures and Transports Marine Casualities Investigative Body)
- The Master failed to consider the progressive increase in heeling to the starboard side, and didn't fully comprehend the significance of the increasing flood levels. He did not recognise that once flooding reached the bulkhead deck level, it would lead to sinking. In fact, flooding reached deck 0, at 22:29, and spite this he

waited 26 more minutes before ordering the abandon ship. (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).

- A significant amount of time was lost between the collision (plus the beaching) and the start of the evacuation. During this time listing increased and progressively complicated or impeded the launching of lifeboats /35/.
- The Master's last recorded transmission from the bridge was at 23:19:30. He abandoned the bridge shortly, thereafter, leaving the Staff Master in charge, who remained until 23:32:30. The Master left the ship before the evacuation was completed (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- The Master refused to return to the ship to coordinate the rescue and inform the rescue team about the number of persons still on board ((Youtube (https://www.youtube.com/watch?v=4MtWxnRBVvg), accessed 2025-01-23) from minute 37:52).

Summary: The Master refused to acknowledge the accident and its consequences, and his decisions regarding the evacuation were characterised by this denial. He was unable to accept the situation and to take the necessary steps. Instead, he tried to downplay the severity of the situation for a long time and his actions were not in line with the standard procedures. The ship abandonment order was decided only one hour after the impact despite the Master being fully aware that the ship should have been evacuated within minutes from the impact (Bartolucci, Safety Science 134 (2021)).

5.3.5 Response time

The following table shows the timeline of the Costa Concordia accident:

Table 5-2 Costa Concordia (CC) accident - timeline of events

Time (UTC)	Δt [h:min]		
	From initial event	From General Alarm	
21:45	**00:00**	-00:48	ship collides into the rocks
21:46			blackout
21:55			Deputy CE informs the bridge about flooding of at least 3 compartments
21:57	+00:12		Master informs company about hitting a rock
22:06			MRSC Livorno contacted by carabinieri
22:07			CC contacted Harbor Master, refers to have a black-out but that situation is under control
22:12	+00:27	-00:21	By public address, passengers receive order to reach the lounges, officers begin contact with port authority of Livorno
22:15		-00:18	Pax advised to "return to their cabins"
22:16	+00:31		SAR activities started
22:22			CC is asking the assistance of two tugs, reports that situation is under control
22:25			Master reports the hull breach and requires tug assistance
22:30	+00:45	-00:03	Chief Eng suggests to the Master to abandon ship
22:33	+00:48	**00:00**	General emergency is announced
22:36	+00:51	+00:03	Ship declares to be in distress, something like an "Abandon ship" is announced but the related sentence was not pronounced, even if the announcement stated only to reach with calm the

			muster stations, following the crewmembers instructions.
22:36	+00:51		First announcement to pax to go to the muster station
22:39		+00:06	Patrol boat G104 alongside CC
22:40	+00:55		Distress launched through Inmarsat C
22:45			Ad hoc unofficial evacuation begins
22:48			Officers ask Master to raise abandon ship signal, Master hesitates
22:48			1st Deck Officer reads the inclinometer, constant 11 ° to starboard.
22:49	+01:04		2nd Master orders to prepare first LBs at starboard
22:50	+01:05		Master orders LB at sea 1,3,5,7
22:51			Master informs bridge to raise abandon ship order
22:54	+01:09	+00:21	Abandon ship order through PA in English
22:55	+01:10	+00:22	First LB lowered
22:57		+00:24	FCC communicates to MRCC that abandon ship has begun
23:10		+00:37	LB begin to move and head for harbor, liferafts are towed by SAR and placed alongside ferry “Aegilium”
23:11			the list of the ship is higher than 25-30 °.
23:19			Bridge abandoned except for 2nd Master to coordinate the evacuation
23:20		+00:47	Crewmembers, Master included, abandoned the bridge (one officer only remained on the bridge to coordinate the abandon ship).
23:32			Bridge abandoned
23:35	+01:50		FCC announced that abandonment is almost complete
23:38			Master reports to suppose there are still people onboard 300-400)
00:00 (14.01.2012)			Ship starts to list to right side, 40°
00:18			OSC informs about the presence of a hundred people on the left side of the ship
00:21			Several pax jump into the water, vessels engaged in the rescue ops put their liferafts at sea
00:34	+02:49		Master embarks on the lifeboat and abandons the ship
00:36			At least 70/80 people on board including elderly and children reported
00:53	+03:08	+02:20	Evacuation by helicopter begins
01:30	+03:45		Master abandons ship
02:00	+04:15		Seven firefighters taken on board with thermal cutting equipment
03:44			Estimated 40/50 people are still on board

04:22			Estimated 30 people still onboard
05:15			Another team of fire department boarded the ship
05:30			Last senior officer abandoned ship
06:17	+08:32	+07:44	Evacuation declared completed
07:30	+09:45	+08:57	Last living person (crew member) evacuated from ship

- The signal (alarm) for the abandon ship was not given according to the right criteria. Moreover, rather than by the Master's voice, it was announced by the Staff Master. It occurred 21 minutes after the emergency general signal.
- If the passengers would be started to leave the ship meanwhile her had 13° of heeling on starboard, and after 33 minutes, when the ship would be achieved the 30° heeling (23:12), all of them could be reached their salvation out of the Concordia, in the same position (ship already stopped) where 32 persons instead dead, because mostly of them were trapped and the others desperate were thrown into the sea. (Ministry of Infrastructures and Transports Marine Casualities Investigative Body)

5.3.6 Crew preparedness and behaviour

The presence of different backgrounds and basic training of crew members may have played a role in the management of emergencies. In this regard, several passengers from the USA testified about specific situations where crew members on duty demonstrated inadequate preparedness in handling safety procedures during the abandon ship operation. This was observed despite their commitment to assisting passengers at the muster stations /22/. Additionally, almost all passengers stated that they did not receive any information or support from the crew /25/. Regarding passengers' opinions on the training and performance of the crew, it is important to consider that when the lifeboat lowering operation began, the ship was already listing at nearly 20°. By 23:00, during the crucial phase of lifeboat and life raft deployment, the ship's heel exceeded the approved limits for life-saving equipment operation. This meant that the crew members assigned to abandon ship operations were working under extreme technical conditions beyond safety limits—yet they did their best under the circumstances. (Ministry of Infrastructures and Transports Marine Casualities Investigative Body) .

Passengers stated that some LB crew members were not experienced in operating the lifeboats (Bartolucci, Safety Science 134 (2021)): "*I noticed the Filipino or foreign attendants anyway, who were trying to reach the lifeboat, but they were unable to do such operations, until a passenger took the initiative to break the chain that prevented us from descending*" or " *Once on the lifeboat we thought it was over, but it was even worse. It was managed by waiters, Filipinos, who, however, did not know how to do anything, did not know how to close it or put it overboard, they immediately dropped it and we fell into the sea, but even there they were unable to manoeuvre it and we were going towards the ship, we heard beating and people constantly screaming*".

Additionally, crew members assigned to guide passengers to muster stations failed to follow established procedures. The evacuation process was chaotic and disorganised, with a lack of communication and no clear coordination from the bridge. The muster list and abandon ship procedures were not properly implemented, leading to confusion. While most passengers recognised the disorder, they still testified that crew members provided humanitarian support and took effective actions to help them board lifeboats and liferafts (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).

The passive attitude of the staff (team) on the bridge is just as reprehensible, and neither the most authoritative of the Officers (Deck Officer,) resulted from the records to have ever urged the Master to tighten / speed up the turn, nor gave him information about the imminent danger despite before the arrival of the Master had strongly criticized the bridge the decision to follow a route so close to the shore, calling it a true madness (Ministry of Infrastructures and Transports Marine Casualities Investigative Body)

The video "The sinking of Costa Concordia caught on camera" /40/ affirms the statements above; in the following interesting sequences have been picked out:

- Instructions given by the crew were contradictory (e.g. in (Youtube (https://www.youtube.com/watch?v=4MtWxnRBVvg), accessed 2025-01-23), minute 12:00 to 12:30 one waiter instructs the guests to sit down, while the other says: "don't stay here, because it's quite dangerous").

- Crewmembers already wearing life jackets do not ask the passengers to pick their life jackets (minute 18:58)
- Crew is requesting passengers to return to their cabins or to the lounges (minute 19:28 to 19:58)
- Even after being assembled in the crew muster station some crew members are not aware of the seriousness of the situation (minute 24:16 to 24:42)
- Crew tries to organize the embarkation of the lifeboats (minute 25:08: “slowly, slowly- there is space for everyone”)

The Master of Costa Concordia and five other Costa employees (company’s crisis director, cabin service director, first officer, helmsman and third officer) have been pleaded guilty in a plea bargain and received jail sentences. The Master was sentenced to 16 years in prison: ten years for manslaughter, five years for causing a shipwreck and one year for abandoning the vessel and his passengers.

Summary: The behaviour of the crew was driven by disinformation given by the ship’s command as well as overload with the situation.

5.3.7 Passenger behaviour

In the paper “Cooperative and competitive behaviour among passengers during the Costa Concordia disaster” (Bartolucci, Safety Science 134 (2021)) Bartolucci et al investigated the behaviour of passengers during the accident, using 49 passenger’s statements made available by the court of Grosseto:

- Passengers reported fear, confusion, ‘panic’ and competitive behaviour, as well as cooperation
- Fortunately, only few passengers followed the instruction to return to their cabins
- Passengers described a first phase of disbelief and describe feelings of fear and confusion relating to the moments immediately following the impact
- Lots of passengers referred to lack of support in terms of information, management, evacuation instructions and especially to a critical management of the boarding of the lifeboats that was one of the most crucial phases in the evacuation.
- Almost everyone in the sample claimed that they received little information or didn’t receive information at all from staff; in total 58 nodes related to instructions from crew and of these 47 (82%) resulted in opposite behaviours, 9 (15%) in general behaviour and 2 (3%) to a following behaviour
- Passengers lost trust in the authorities’ instructions
- When passengers realised that the emergency was more severe than described by the crew, passengers decided to behave spontaneously against crew instructions.
- Passengers autonomously started to evacuate the ship before a formal authorization was issued
- The lack of help, information or support, especially from the staff resulted in spontaneous behaviours and decisions in order to deal with a situation characterised by uncertainty, or even they helped the staff to evacuate people and manoeuvre the lifeboats. The decision to delay the evacuation and reassure the passengers that nothing was happening, in fact, produced a series of instructions and orders that were not followed by the people, who preferred to act following their own perception of the ongoing situation.
- According to the count of codes by person:
    - 17 (35%) passengers said they provided help to someone;
    - 21 (43%) passengers said that they received help;
    - 25 (51%) passengers reported competing behaviours and
    - 29 (59%) said they behaved in a different way to what they have been told by the crew members;
    - 41 (84%) passengers received information from others;

- 8 (16%) passengers followed other passengers; and
- 36 (73%) passengers reported a lack of information by the crew members.

- Competitive behaviour occurred in correspondence with the specific situation with the LSA: many of the passengers reported scenes of crushing, and behaviours of pushing and running in proximity to the lifeboats.

- At 00:18 hours the OSC informs about the presence of a hundred people on the left side of the ship. Three minutes after it reports that several passengers, in a panic, began to jump into the water and orders that the rescue units proceed to pick them up; MRSC Livorno orders all vessels engaged in rescue operations to put their liferafts at sea in order facilitate the rescue of survivors (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).

In the paper “The Titanic Syndrome: Risk and Crisis Management on the Costa Concordia” (Alexander, Journal of Homeland Security and Emergency Management, Volume 9, 2012) the author states:

- the panic was swiftly mitigated by spontaneous leadership and the level-headed behaviour of some passengers

Behaviour of passengers can be observed from the video “The sinking of Costa Concordia caught on camera” /40/ that was edited together from cell phone videos of passengers and crew members:

- in pax muster station: fear (from minute 24:45)
- when the embarkation of lifeboats started: passengers started to push and panic (from minute 25:20)
- Passengers had difficulties to find a seat in the lifeboats (minute 27:12, minute 27:52)

The video (Youtube (https://www.youtube.com/watch?v=4MtWxnRBVvg), accessed 2025-01-23) has been investigated in detail in the paper “Use of behavioural theories for the interpretation of human behaviour in the Costa Concordia disaster” by Viktor Kvamme (Kvamme, Report 5514, Lund 2017). The author broke down the behaviours of persons into phases, see below:

Table 5-3 Break down of person’s behaviour (Kvamme, Report 5514, Lund 2017)

Initial sequence (approx. 21:45 – 22:33) - The time between the first impact until the general emergency alarm is raised.	
Behaviors	**Observations from video recordings**
Confusion	Immediately after the impact there is great confusion amongst the people onboard, neither passengers nor crew knows what is happening.
Yelling, shouting	There is an initial state of turmoil and some people are yelling and shouting.
Anxiety	At first most people seem very anxious and leave their seats in the restaurants to head for the nearest exits.
Hesitancy, indecisiveness	Immediately after the impact, the waiters and staff are trying to calm the passengers, but they seem insecure of how to handle the situation and are giving conflicting orders. Some suggest that it is best to just sit down and wait, while others are urging the passengers to proceed to the exits.
Crying	There are young children crying as plates and glasses are falling to the floor, asking their parents what is going on.

Calming, soothing	Parents are acting calm, trying to sooth their crying children and say that there is nothing to worry about and that everything will be fine, proposing that it is just a matter of a broken engine.
Calm	A public announcement is made, stating there is a power outage and the public is ensured that the situation is under control. Thereafter, the majority of people are acting relatively calm, although many are still skeptic. Some of the kitchen staff and waiters are cleaning up the mess in the restaurants as if the order would soon go back to normal.
Humor	As people are leaving the restaurants, a few are jokingly saying that they hope the cruise company will pay for their wine bills, others are heading for the bar to ask if it is still open for business.
Leadership	Crewmembers are urging the passengers to stay calm and ensuring that the situation is under control. After a while the passengers are asked to return to their cabins or to sit down in any of the public lounges.
Skepticism	Some passengers are questioning how the ship can be listing, presumably "only" due to a technical fault and ask why the crewmembers are wearing lifejackets since they claim everything is under control. As the listing of the ship increases, more and more people gather by the muster stations. There are obvious difficulties in walking normally along the tilted corridors. A recording filmed on the bridge reveals a conversation about passengers trying to enter the lifeboats on their own, despite the instructions from the crew.

Main evacuation sequence (approx. 22:33 – 00:00) - The time after the general emergency alarm until the lifeboats on the portside of the ship can no longer be launched due to the listing.	
Behaviors	**Observations from video recordings**
Stress	When the general emergency alarm is eventually announced, the people that are not already gathered at the muster stations hurry to get their lifejackets and rush to the muster stations as they realize the situation is worse than previously assumed.
Anxiety	The passengers at the muster stations look worried and many are quiet and anxious.
Humor	Some crew and passengers are trying to keep the spirit up and are making jokes and filming each other as they are balancing back and forth across the tilted deck to pass the time.

Calm	Although there is a mixed state of mind aboard the ship and many are scared, the majority of people are acting calm as they are waiting for further instructions.
Competitive behavior (pushing, elbowing, squeezing)	When the crew finally allows passengers to enter the lifeboats, turmoil breaks out as some are trying to push and elbow their way forward to get aboard the lifeboats. Some of the people that are being squeezed and pushed are upset and there is screaming and shouting.
Goodwill	Old people with walking disabilities and families with young children are given priority by most and are being helped aboard the lifeboats, although there are still some ignoring this manner, who still try to force their way forward.
Leadership	The crew is trying to direct the evacuation and keep the passengers calm, but due to the competitive behavior shown by some people they are having difficulties in retaining the order.
Insecurity	Apart from the fact that the listing makes it difficult to launch the lifeboats, some of the crewmembers are seemingly insecure of how to release and/or maneuver the lifeboats.
Screaming, shouting	During the launching of the lifeboats, there is much yelling and shouting from both crew and passengers. Some of the passengers are screaming, seemingly afraid, as boats get stuck on the way down the side of the ship. Crewmembers are shouting at each other in attempts to communicate with the people in control of launching the boats. With all the loud noise, there are difficulties in the communication.
Fear	There are unmistakable signs of fear aboard the lifeboats as they are being launched. One crewmember falls outside one of the boats before his colleagues are helping to pull him back up. People are screaming and crying.
Patience	The people that do not fit on the first couple of lifeboats begin to make their ways to other areas of the ship to see if they have better luck elsewhere. Some passengers show signs of frustration while others are patiently waiting for their turn.
Relief	As the lifeboats finally reach the water, people are able to relax a bit more and there are spontaneous applauds and cheers of relief. However they are soon thereafter asked to quiet down in respect to the passengers still aboard the cruise ship.

Summary: The behaviour of the passengers was characterized by uncertainty and a lack of clear instructions from the ship's command and crew. The passengers fluctuated between disbelief (in the beginning) and panic (during the abandonment of the ship).

5.3.8 Impact of ship design and layout

The evacuation was negatively impacted by the rapid increasing heeling of the vessel. When the lifeboat lowering operation begun the heeling was almost 20° and therefore the maximum approved limit for launching the LSA.

The extent of damage and the immediate flooding of five watertight compartments is well beyond the survivability standard applicable to the ship according to her keel laying date. Poor consideration can be made about the five contiguous watertight compartments, where most of the vital equipment of the ship was located, because no residual stability could have been maintained either by the Costa Concordia or any other ship. However the stability calculation and simulation showed that the ship responded to the SOLAS requirement applied to her (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).

5.3.9 Adequacy and infrastructure of the LSA and safety equipment

From investigation report (Ministry of Infrastructures and Transports Marine Casualities Investigative Body)

- A total of 23 (out of 26) lifeboats and 6 (out of 69) liferafts were used and allowed rescue of survivors.
- When the lifeboat lowering operation begun, the heeling of the ship was almost 20°. During the crucial phase of the lifeboats and liferafts handling (by the time of 23 00), the related heeling was more than the approved/allowed limits of the equipment
- People who delayed to leave the ship because they were not gathered on time for disembarking – due to short time available for arranging the abandon ship when the ship was not heavily listed – disembarked themselves by the only two embarkation ladders available on board (stern and bow positioned). Those two are in compliance with reg. III/11.7 – SOLAS 74 as amended, but not enough in this case (heeling > 20°), since the alternative hydraulic devices, that should have replaced those fittings, didn't run due to the heavy list.

From other publications:

- Around 2/3 of the total people on board have been saved by the lifesaving equipment belonging to Costa Concordia.16 persons were rescued by helicopter; 4 persons were rescued from the sea (Kvamme, Report 5514, Lund 2017).
- The crew members were not able to deploy 3 lifeboats on the higher side (port) due to the extreme list degree of the ship towards the starboard side when the list angle exceeded 20 degrees (Hassan, International Journal of Mechanical Engineering, Vol.5, 2016)
- Difficulties to launch the LB is shown in video recording ((Youtube (https://www.youtube.com/watch?v=4MtWxnRBVvg), accessed 2025-01-23), min: 28:26 to 30:36)

A specific reason for the low number of liferafts used (6 out of 69) is not given in the consulted documents.

Summary: as the abandon ship started with huge delay the list of Costa Concordia exceeded the maximum angle of 20° above that the usability of LSA is limited. Embarkation ladders were the last means of escape that were usable in the later stage of the evacuation process.

5.3.10 Effectiveness of evacuation procedures

4197 persons have been evacuated from the vessel, around 2/3 of those total people on board have been saved by the lifesaving equipment belonging to Costa Concordia /12/. 16 people have been rescued by helicopter and 4 from the sea (Kvamme, Report 5514, Lund 2017).

The abandon ship started at about 22:55, at 07:30 the last living person has left the ship. This results in a duration of 8h and 35 min or on average 7.4 seconds per person. The duration of process exceeded SOLAS requirement by far.

The official investigation report on the Costa Concordia incident provides a comparison between the planned procedures/Actions as per SOLAS convention requirements to the company to provide the Master with a Decisional Support System, to be adopted in case of emergency. Below is a comparison between planned vs actual actions on board the vessel during the incident:

1. Verification of Damage:

   Planned: Second Master or Officer on duty verifies the damage
   Actual: Damage assessment was carried out by an Officer who should have supported the Master with stability and activated the Damage Control Plan

2. Identification of Compartment:

   Planned: Identify the breached compartments
   Actual: The Master did not appoint the Second Master or Deck Officer in duty to verify the damage

3. Notification:

Planned: Notify the competent MRSC and the Company
Actual: Partial Information related to the damage was communicated to Leghorn MRSC

4. Assessment and Evaluation:

   Planned: Assess and evaluate the situation with the aid of the “Damage control plan”
   Actual: The Damage Control Plan was not used to evaluate possible actions

5. SCD team deployment (Team in charge to verify the damage):

   Planned: Send the SCD team to the zone affected by the contact-breach
   Actual: The SCD team was sent to the zone affected by the contact-breach

6. Activation of Measures:

   Planned: Activate measures such as isolating compartments, pumping dry of flooding, transferring liquids to other tanks, etc
   Actual: The possibility to transfer liquid to balance the ship was not considered. The Master requested generic action but did not give specific instructions or evaluate effectiveness

7. Technical Advisor Informed:

   Planned: Inform the technical advisor about the situation.
   Actual: The technical advisor was informed about the developing situation

8. Request for Assistance:

   Planned: Requested assistance by on-site vessels and MRSC if the action taken is not sufficient.
   Actual: The distress alarm by VHF was launched 55mins after the contact, not immediately as required

9. General Emergency Signal:

   Planned: Given the General Emergency signal, and passengers and crew proceed to the planned gathering.
   Actual: The general emergency alarm was given with great delay (how delayed??)

10. Abandon Ship Procedures

    Planned: Take procedures for abandoning the ship and monitor the scenario until evacuation is completed
    Actual: The abandon ship procedure did not follow the expected Muster List procedure.

Additional steps taken:

11. The Master informed the DPA about the occurrence, who then formed the “Crisis Team”

12. The DPA contacted the Fleet Manager based on information received form the Master

13. The CMD was not immediately informed.

14. The Crisis Committee was formed only at 23:00

Procedures for the main actions to take in case of emergency are described in the document named ““Crisis Management Preparedness Plan – Operational & Reporting Procedure”. The investigation report states that “Particularly, during the emergency , different behaviour from the expected above mentioned procedures were noted […]”. Following are related to the evacuation:

- The information given by the ship to the Leghorn MRSC was not an initiative of the bridge, and when communication with shore started, the actual situation on board was not stated; the distress alarm by VHF was not immediately launched to all ships in the area, in accordance with the procedure following a black-

out; (the casualty occurred at 21.45.07, and the distress was launched by VHF at 22.38.27), but only after the request by the Leghorn MRSC, and at 22.40 by INMARSAT(55 minutes after the contact).
- The general emergency alarm on board was given at 22.33.26, with great delay.
- According to the procedure in case of contact-breach, no related actions were taken and, mainly, the general emergency in favour of the crew and the passengers was not promptly announced. The seriousness of the situation was already known by the Bridge team at 21.51 (6 minutes after the contact), but the general emergency announcement was given at 22.33.26 (such as 48 minutes after the contact).
- The abandon ship started at about 22.55, more or less the same time of the related announcement, in English, given by the Second Master at 22.54.10 via the public address system. This activity did not respect the expected procedure stated in the Muster List which says: “ORDER OF THE MASTER THROUGH THE PUBLIC ADDRESS OF THE SHIP, FOLLOWED BY A CONTINUOUS DOUBLE TONE SOUND (OR BY THE ALLARM BELLS), TILL THE SHIP EVACUATION IS COMPLETED”.

Summary: As 32 persons (5 crew and 27 passengers) lost their life the evacuation must be called ineffective. It can be assumed that the evacuation could have been much more effective, had the passengers and affected staff been provided with sufficient information at an earlier stage (/18/).

5.3.11 Communication and dissemination of information

The crew of Costa Concordia belonged to 38 different nationalities: 294 Philippines, 202 India, 169 Indonesia, 149 Italy, the passengers came from 26 countries; most of the cruise passengers were Italians (989), 569 Germans, 462 French, 177 Spanish, 129 US citizens. The working language on board was Italian. Several crew members and passengers were not able to speak Italian:

- The 1st Engineer. assigned to manage all the engine equipment, of Bulgarian nationality, testified he does not fully understand the orders given in the Italian language (the work language), during the emergency situations (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- Many USA passengers testified that during the emergency several crewmembers on duty in the muster stations were not able to speak in English (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).

5.3.11.1 Internal

Crew internal:

- At about 21:55 the Deputy Chief Engineer comes in the SCP (Electric Engine Control Room) and verifies that the local PEM (local electric propulsion engines- compartment 5) is flooded meaning therefore that the compartments flooded are at least 3 (WTC5, WTC6 and WTC7). This situation is communicated to the bridge (Ministry of Infrastructures and Transports Marine Casualities Investigative Body)
- At 22:18 personnel in the ECR realizes he has lost all automation and that no system (balancing pumps, bilge, masses, etc..) can be put into operation (Ministry of Infrastructures and Transports Marine Casualities Investigative Body) .The data is reported to the bridge.
- At 22:20:45 Master is updated about the flooding that affects the PEM, the main engines and stern generators one, two and three that is the compartments 5, 6 and 7 (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- At 22:30:07 the Chief Engineer, suggests to the Master to abandon ship (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- The lack of orders according to the Muster List addressing disoriented the crew assigned on the base of the Muster List, taking into account this specific emergency. Some contribution in the disorienting situation could be due also to the wireless communication system, which is not supplied by emergency power, but the key persons were all equipped with the PMR (Professional mobile radio) devices, and therefore those wireless breakdown was not influent. On this regard, in fact, it should be noted that the ship was in compliance with SOLAS regulation (II-2/21 4.5 and related Circular MSC 1/Circ. 1214) also in terms of portable radio equipment, addressed by the procedures included in the Annex 49 and in the related list of assigned mobile devices according to the Muster list (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- Spite of those above-mentioned serious warning, the DPA (Designated Person Ashore) never thought (as declared during two interviews towards the Prosecutor) to speed up the Master to plan the abandon ship.

Indeed, the discontinue dialogue between the Master and the DPA (meanwhile the Master was on the bridge), started at 21:57:58 and finished at 23:14:34, but it is worth to point out, that at 22:27 hours it was elapsed too long time since the Master was aware (at 22:01) about the consequences of the casualty and subsequently he should have informed properly the DPA in order to allow him to provide adequate indications about the emergency management (Ministry of Infrastructures and Transports Marine Casualities Investigative Body) .

- The evidence that DPA testified he was confident of the Master proficiency for solving those emergency, confirms that he didn't give any kind of support to the Master and never stressed him to decide for an immediate procedure to put in place for the abandon ship (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).

From (Youtube (https://www.youtube.com/watch?v=4MtWxnRBVvg), accessed 2025-01-23):

  - Communication on the bridge: lack of clarity to sound the emergency alarm ((Youtube (https://www.youtube.com/watch?v=4MtWxnRBVvg), accessed 2025-01-23), min 21:57 to 22:40)

Towards passengers

- The Cruise Director arbitrarily sent the passengers away from the Muster Stations, requesting them to return to the lounges (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- at 22:36:05, he [the Master] makes the first announcement communicating to the passengers to go to the muster station (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- At 22:54:10 the Second Master through the "public address system" communicates the "'Abandon Ship" in English (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- Almost all the passengers declared that they didn't receive any information or support from the crew (Bartolucci, Safety Science 134 (2021)).
- The crewmembers appointed to address the passenger to the muster stations didn't address, at all, according with the procedures. There was chaos and confusion, lack of communication; in other words a complete disorganization, mainly because nobody by the bridge coordinated the emergency according with the muster list and the related procedure for abandon ship. Mostly of the passengers caught this evident finding, but they however testified that, despite the chaos and their scars familiarization with the emergency, crewmembers supported with humanity and effective actions to allow the passengers to go in the lifeboats/liferafts and leave the ship ferried by the same crew (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).

5.3.11.2 External

- The Master informed the Designated Person Ashore (DPA), about the occurrence, at 21:57:34. This Representative reached the Company building to form the "Crises Team", to support the Concordia Master. The DPA, according to information received by the Master, contacted the Fleet Manager. At 22:21 the DPA reached a manager of the Company by telephone, considering him the CMD (and the latter declares to be such), to inform this person about the situation. But according to the above-mentioned procedure, the CMD was a different person, who was not immediately informed. Only at 23:00 the Crises Committee was formed (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- At 22:05:27 the Fleet Crisis Coordinator receives reassuring information from Master which also reports that he had informed the Port of Civitavecchia to have suffered only a blackout (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- At 22:18:19 Master refers by phone to the Fleet Crisis Coordinator of the Company that there are problems with the emergency diesel generator, also reports that there are at least two compartments flooded, those of diesel generators (compartments 6 and 7); aware of not having propulsion, he assumes that the ship can survive with only two compartments flooded (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- SAR organization received different news about the situation of ship emergency. In fact, several passengers have informed their relatives or acquaintances on shore that have in turn informed the Police and the Coast Guard (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).

- The information given by the DPA to the Crises Team resulted at times ambiguous (it named a wrong compartment, the blackout was not communicated at the beginning, etc.) (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- Subsequently to the communication given by the ship, the company was aware of the very serious scenario that had occurred on board, but it did not report it to the SAR Organization. Despite of this, the Company did not activate itself to address in the right way the information just reported to the SAR organization (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- At 22:22:22 the ship contacts the operations room of Civitavecchia Coast Guard asking the assistance of two tugs due to a breach, it is reported that the situation is under control thanks to the compartmentalization of the ship. Indeed, correct information about the actual situation of flooding are not provided, stating simply that the situation is currently being assessed, that there are no injured or missing people and is necessary only the intervention of one tug (Ministry of Infrastructures and Transports Marine Casualities Investigative Body).
- 22:57:41 hours (VDR) The Master of the Costa Concordia informed the MRSC Livorno to have ordered the abandon ship, the FCC communicates to MRCC Rome that the abandon ship has begun. (Ministry of Infrastructures and Transports Marine Casualities Investigative Body)

Summary: The internal and external communication was characterized by delay and incompleteness and was lacking clarity, liability and decisiveness. The fact that several crew members and passengers were not able to speak Italian (the working language) led to additional barriers in the communication.

5.3.12 Gaps and lessons learned

Following recommendations are given in the investigation report /22/:

With reference to evacuation / LSA:

Emergency and power generation

Regarding the emergency source of electrical power (ref. regulation II-1/42, SOLAS 74 as amended), the following should be considered:

1. increasing the emergency generator capacity to feed also the high-capacity pump(s) mentioned in the previous paragraph “VITAL EQUIPMENT AND ELECTRIC DISTRIBUTION”.

2. provision of a second emergency diesel generator located in another main vertical zone in respect to the first emergency generator and above the most continuous deck. In this respect, the definition of "most continuous deck" in the light of SOLAS regulation II- 1/42.1.2 seems to be necessary. This second generator could be dimensioned on the basis of selected services. The related manufacturing and handling should be as follows:
    I. new emergency diesel generators are made according to aimed and specific building techniques in order to guarantee a unfailing and long-lasting functioning.
    II. regulate in an optimal way the functioning tests, planning them once a week, under a significant load (at least 50%) and of at least two hours duration for both the emergency diesel generators.
3. provision of an emergency light (both by UPS and emergency generator) in all cabins in order to directly highlight the life jacket location.

Although the above recommendations are meant to address new ships, considerations on the applicability of items 2. and 3. also to existing ships is suggested.

Operational matters

The event demonstrated that there is the need for verifying the actuality of provisions contained in international instruments, such as SOLAS, STCW and ISM Code related to different issues such as:

1. bridge management, considering aspects such as the definition of a more flexible use of the resources (that may be tailored for responding to ordinary, critical, emergency conditions), an enhanced collective decision-making process and "thinking aloud" attitude.
2. Bridge Team Management course for certifications renewal should be mandatory by the 1st January 2015.

3. Principles of Minimum Safe Manning (resolution A.1047(27) as amended by resolution A.955(23)) that should be updated to better suit to large passenger ships. A mandatory application of these principles is also considered desirable.
4. muster list, showing the proper certification/documentary evidence necessary for crew members having safety tasks.
5. inclusion of the inclinometer measurements in the VDR.

The above items could be applicable to both new and existing ships.

Evacuation analysis

1. For new ships, it would be useful to require an evacuation analysis to be carried out at the early stage of a project (ref. regulation II-2/13-7.4, SOLAS 74 as amended), extending in mandatory way the above regulation, actually (at the time of the Costa Concordia investigation report) limited to ro-ro passenger ships.
2. Regarding the embarkation ladders: with the ship listed at an angle exceeding 20°, it was demonstrated that traditional embarkation ladders were more useful. Therefore, in the light of the above-mentioned details drafted in Par 4.6.1.4, it may be necessary to consider whether the minimum number of embarkation ladders (one) on each side should be increased (SOLAS 74 as amended reg. III/11.7)

SAR

This casualty gives us special lessons also in terms of SAR experience.

Despite the main, lesson learnt is, the delay and the lack of information from the ship, we would urge the IMO about other issues, to recommend each SAR Organization for providing its resources by the following tools:

- SAR patrol boat supplied with fix fenders, blocked in the upper side of the hull, to approach safe other ships/boats in case of extraordinary evacuation of persons. This should be able to load at least 100 passengers in their deck.
- Divers speleologist, able to rescue, even in dark condition, persons standing into the ravines of ships/wrecks.

<u>With reference to topics other than evacuation / LSA:</u>

Stability

1. Regarding stability-related issues, it is recommended that the following aspects be considered to improve existing requirements: double-skin for protecting the watertight compartments (WTCs) containing equipment vital for the propulsion and electrical production;
2. limiting of the down flooding points on the bulkhead deck to be discussed in the light of Part B-2 of Chapter II-1 of SOLAS 74, as amended
3. provision of a computerized stability support for the Master in case of flooding; and
4. interface between the flooding detection and monitoring system and the on board stability computer, taking into consideration regulations II-1/8-1 and 22-1 of Chapter II-1 of SOLAS 74 as amended.

Vital equipment and electric distribution

The following issues need to be discussed for possible improvements of the existing requirements:

1. discontinuity between compartments containing ship's essential systems (such as propulsion sets or main generators sets) in order to preserve their functional integrity (reference should be done to regulation II-2/21, SOLAS 74 as amended);
2. more detailed criteria for the distribution, along the length of the ship, of bilge pumps and requirement for the availability of at least one pump having the capacity to drain huge quantities of water (reference should be done to regulation II-1/35-1, SOLAS 74 as amended);
3. relocation of the main switchboard rooms above the bulkhead deck (reference should be done to regulation II-1/41, SOLAS 74 as amended); [Note: According to SOLAS II-1 Regulation 42.1.2 valid for passenger ships

constructed on or after 1 February 1992 “the emergency source of electrical power […] shall be located above the uppermost continuous deck […]”. Therefore this recommendation is unclear].

The above-mentioned recommendations number 1, 2 and 3 are meant to be addressed to new ships only.

4. relocation of the UHF radio switchboard above the bulkhead deck, for all existent ships which are provided with this equipment below this deck, and for the new ships, it should be located above the bulkhead deck.

6.3.14 Issues (evacuation or LSA related) not addressed in the investigation report

It is not scrutinized in the report why only 6 out of 26 life rafts have been used, and why 3 of the 26 lifeboats have not been used and why the deployed lifeboats have not been used with their full capacity.

5.4 Summary

The Costa Concordia accident was characterized by a lack of organisational leadership. The Master did not want to acknowledge the accident and its consequences and therefore was not able to make the right decisions and to give meaningful instructions. The crew and passengers were not well informed and were on their own. Panic and chaos were the result. The deployment of the LSA was ordered with delay and made difficult by the strong heeling of the ship.

Most important take aways: Almost everything depended on the Master; since he failed to accept the accident and to give the right instructions, chaos broke out. Quick decisions, clear communication and binding instructions are vital to organize the evacuation of a large cruise vessel.

5.5 References

Following references have been used:

- Report on the safety technical investigation Cruise Ship Costa Concordia Marine Casualty on January 12, 2012, Ministry of Infrastructures and Transports (Ministry of Infrastructures and Transports Marine Casualities Investigative Body)
- Cooperative and competitive behaviour among passengers during the Costa Concordia disaster, A. Bartolucci et al, Safety Science 134 (2021) (Bartolucci, Safety Science 134 (2021))
- The “Titanic Syndrome”: Risk and Crisis Management on the Costa Concordia, David E. Alexander, Journal of Homeland Security and Emergency Management Volume 9, 2012 (Alexander, Journal of Homeland Security and Emergency Management, Volume 9, 2012)
- Governance & Safety solutions in maritime industry: The case of “Costa Concordia cruise liner”, M. Ventura et. al, Electronic Journal of Management, n.3 2019 (Ventura, n.3 2019)
- Prisoners of Freedom – A study on worldview of contemporary Finnish seamen, Mira Karjalainen, University of Helsinki 2004 (Karjalainen, 2004)
- The impact of low efficient evacuation plan during Costa Concordia accident. Elnabawybahriz & Hassan, International Journal of Mechanical Engineering, Vol. 5, 2016 (Hassan, International Journal of Mechanical Engineering, Vol.5, 2016)
- Use of behavioural theories for the interpretation of human behavior in the Costa Concordia disaster, V. Kvamme, Report 5514, 2017 (Kvamme, Report 5514, Lund 2017)
    - YouTube video: The sinking of Costa Concordia caught on camera (Youtube (https://www.youtube.com/watch?v=4MtWxnRBVvg), accessed 2025-01-23)

6. Norman Atlantic

6.1 The vessel

Norman Atlantic (IMO Number 9435466) is an Italian flagged RoPax vessel, keel laid in 2006. She was designed for 852 passengers. Her main particulars are shown in Table 6-1. The vessel, owned by the Italian shipping company "Visemar di Navigazione", had been chartered by the Greek group Anek Lines for the connection lines between Italy and Greece.

Figure 6-1 Photo of Norman Atlantic (Ministry of Infrastructure and Transport, Final Report)

Table 6-1 Main particulars of Norman Atlantic

Length over all	186.45 m
Length between pp	177.4 m
width	25.6 m
draught	6.79 m
Gross tonnage	26,904 gt
Max. speed	23.5 knots

Norman Atlantic was equipped with following LSA:

- 2 lifeboats (for 150 persons each)
- 2 MES (mini-chutes) with rafts for 101 persons each
- 8 liferafts (2 for 25 persons each, 6 for 101 persons each)
- 1 fast rescue boat
- 1 rescue boat

6.2 The accident

The Norman Atlantic fire accident occurred while the RoPax ship was navigating between Igoumenitsa and Ancona, in the Strait of Otranto, between Italy and Albania, on the 28th of December 2014. There were 417 passengers on board accompanied by 55 crew members. At least 3 illegal immigrants were reported to be on the ship for the journey as well. The cargo on board consisted of 129 trucks, 90 cars, 3 buses and one motorcycle. The weather conditions were unfavourable, SSW wind 45 knots, very rough sea (sea force 6) and low air temperature (2°C).

As the vessel navigate the Strait, a serious fire broke out in the ship's open garage on deck 4. The fire was detected by the alarm system at 03:23 UTC (according to VDR). At 03:28 a crew call was issued and at 03:48 the Master gave order to prepare the lifeboat on port side (all LSA on starboard side were unusable due to the fire).

According to the investigation report (Ministry of Infrastructure and Transport, Final Report) 452 persons were rescued, of whom 449 were included in the crew / passengers list and 3 were illegal immigrants, 11 persons died, 12 are missing and 31 were injured. In addition, based on the claims submitted by the families to the competent authorities, 6 other persons could be missing. In total, the rescue means rescued 88 persons, the remaining persons were evacuated by helicopters. The Master was the last person to leave the ship, at 14:49, rescued by a helicopter of the Italian Navy.

The emergency management practices on board the vessel was guided by the ships Safety Management System (SMS) and the decision Support System for the Master. These are designed to provide structure procedures and guidelines for handling various emergency situations, including fires. The Decision Support System for the Master. These are designed to provide a series of steps and actions to be taken in case of an emergency, such as, damage assessment, communication with the competent authorities, damage control plan, mitigation measures, general emergency alarm and abandon ship procedures.

During the incident, several deviations from the expected emergency management practices were reported. The general emergency alarm was not activated immediately after fire detection resulting in a lack of coordination among the crew. Passengers were initially informed that there was a blackout, and the seriousness of the situation was not addressed properly, causing further confusion among passengers and crew. The Damage Control Plan was not utilised effectively to assess and manage the situation. The Chief Engineer and his team left the Engine Control Room without informing the bridge. This made any further fire mitigation actions impossible. There was no coordination between Master and the bridge team, and they failed to execute the emergency response plan effectively.

The Norman Atlantic was equipped with various life-saving appliances, liferafts and emergency escape breathing devices (EEBDs). The lifeboats and rafts were used during the evacuation, but the increasing list challenged their deployment. The report notes that 88 out of 452 people were rescued using the lifeboats and liferafts.

6.3 In-depth review

6.3.1 Root causes and contributing factors

The fire was very destructive, the high temperatures and extensive damage made it difficult to pinpoint the exact origin and cause of the fire. The malfunctioning of electrical devices, such as overheating or a fault in the electrical systems, is considered a highly probable cause. The possible fire causes were analysed and studied and each potential cause ruled out by reasons for exclusion. However, among the possible causes, “abnormal functioning of gas-powered machineries” cannot be dismissed.

The analysis in (Ministry of Infrastructure and Transport, Final Report), highlights the complexity of identifying the exact cause due to the extensive damage and high temperatures. The malfunctioning of electrical devices and defects in the electrical system are considered highly probable causes. However, the possibilities of an abnormal functioning of gas-powered machinery cannot be completely rules out. The report highlighted the fire events to have propagated fast, with high quantity of smoke and very high temperatures. These combined with the following causes and factors, worsened the fire event:

- long time elapsed between fire detection, warning and manual extinguishing
- High response time of active protection systems
- High fire load
- Close distance among combustible materials
- Much ventilation
- High compartment volumes
- Absence of vertical compartments.

In this specific case, the weather conditions, in particular wind, as well as the speed of the ship, were considerable and cannot be ignored. Strong south-westerly winds reaching 50/60 knots and sea conditions were rough, with waves corresponding to a force of 6 on the Beaufort scale. Such parameters have certainly played a relevant role both for the smoke detectors and in the first phases of the fire and in its propagation.

6.3.2 Adherence to international, EU and national safety regulations

The report (Ministry of Infrastructure and Transport, Final Report) states that the organisation on board was theoretically all in line with regulations. However, it was not perfect due to the following aspects:

- The emergency was highly serious (presence of smoke, alarms …)
- The human machine interface was not appropriate (valves not clearly identified because of possible smoke presence that could have limited the visibility in the Drencher room)
- The time available (the measures taken were late, if we consider when the fire broke out, so the time available to face the emergency was reduced)
- Time of the day (the emergency took place at night)
- The stressful situation generated by the fire, the behaviour of some crew members was not appropriate

According to (Ministry of Infrastructure and Transport, Final Report) the following conclusions can be made about the vessel and its compliance to regulations:

- The drencher system was in compliance with the applicable rules. However, the designated drencher system at deck 4 (are of origin of fire) was never activated. Its ineffectiveness during the emergency supply compromised firefighting efforts. It was compromised because it was supplied by the emergency fire pump instead of the drencher pump. The report also noted that the possibility they were not in place since the beginning of the incident is not to be excluded, as they were found neither intact nor in the form of debris.
- The fire detection and insulation systems were compliant with the provisions established by applicable laws, including SOLAS Convention II-2/3.1 for A-60 class divisions
- The activation thresholds for the fire detection system were set in compliance with the FSS code with a temperature threshold of 55C and a smoke threshold of 2.5% light abatement per meter. (This activation threshold accounts for the difference between pre-alarm and alarm
- The video surveillance was fully compliant with the applicable rules, although it was noted that post-incident analysis was not possible.
- The vessel was compliant with the minimum safe manning requirements
- The muster list was compliant with safety regulations, ensuring that all crew members were assigned specific roles and responsibilities during an emergency.
- The loading and lashing procedures were compliant with the company's SMS manual and applicable regulations, requiring the Master or Chief Mate to ensure proper loading plans considering adverse sea and weather conditions
- Even though the distance between vehicles were compliant with regulations, the huge dimension of the fire and the narrow spacing between vehicles, posed difficulties to the firefighting team while accessing the garage area

6.3.3 Evacuation procedure

- The evacuation procedures began at 04:50 on the 28th, initially coordinated by JRCC PIRAEUS and later by MRCC ROMA. Several merchant ships and Coastguard vessels, along with Greek and Italian military aircrafts were redirected to the vessel.
- Severe weather conditions made air evacuations necessary. The Coast Guard aircraft arrived at 12:10 and assumed the role of Air Coordinator, managing a complex operation involving 16 helicopters and 4 aircraft.
- The merchant ship Cruise Europa initially acted as On Scene Commander, later replaced by the Italian Navy ships NAVE SAN GIORGIO and Durand de la Penne.
- The first rescues involved passengers using the few remaining usable life-saving appliances (LSAs). 88 people were rescued using lifeboats and rafts, while all remaining survivors were airlifted.
- Unfortunately, some passengers succumbed to hypothermia after falling or jumping into the water. The first engineer was rescued by the oil tanker Genmar Argus at 14:13
- Tugboats also played a crucial role in the rescue operations. The rescue efforts were further complicated by severe sea and weather conditions, with sea force 6 and winds of approximately 45 knots from SSW. Due to these conditions and the severe fire, passengers still on board could only be rescued by air.
- There were also some illegal immigrants on board, hidden in trucks in the garages, with three rescued. The exact number of passengers was initially unclear due to errors in the boarding list provided by the charterer company, which initially overestimated the number of passengers by forty. Detailed checks later revealed only three additional passengers.
- The Master of the M/V NORMAN ATLANTIC was the last to leave the ship at 14:49, rescued by an Italian Navy helicopter.

The abandonment of the ship is regulated by procedures. The investigation report stated that

- "It seems that procedures 9.2 and 9.3 of the SMS were not applied in a correct and integral way, considered that the emergency phases are quite confused".
- The stressful situation generated by the fire, the behaviour of the some crew members was not appropriate (sometimes they acted without abiding by the procedures established despite the training and familiarization carried out when they joined the vessel
- not proper application of the emergency procedures by the cabin crew combined with the difficulties related to the nighttime.

Therefore it must be concluded that the procedures have not been fully followed.

6.3.4 Decision making

The key decisions made onboard the vessel are as follows:

1. Prior to the voyage: The ships route was planned; the crew briefing, and standard safety checks were conducted including inspection of LSA and fire safety equipment.
2. Initial response to fire: upon detection, the crew attempted to extinguish it using onboard firefighting equipment
3. Evacuation decision: The decision was made to evacuate. Passengers were moved to the upper decks and lifeboats as the fire spread.
4. Coordination with rescue teams: The crew coordinated with external rescue teams to facilitate the evacuation and rescue operations
5. Communication to external maritime authorities, was attempted to be maintained, so as to provide updates on the situations and receive instructions.

6.3.5 Response time

The following section provides a detailed timeline of the events that occurred during the Norman Atlantic accident. This comprehensive overview of the sequence of actions and response times is essential for analysing the effectiveness of the emergency response.

The data from Kongsberg printout and the time alignment drift found in the engine control room indicate that the first alarm was recorded at 05:21:03 (UTC+2), while the VDR recorded the alarm at 03:23:05. Aligning these time zones reveals a drift of +02:02s between the Kongsberg system and the VDR. All times in the following table are expressed in UTC, which is one hour behind Italian time and two hours behind Greek time.

The following table shows the sequence of the events during the Norman Atlantic accident:

Table 6-2 Norman Atlantic (NA) accident - timeline of events

Time (UTC)	Δt [h:min]		
	From initial event	From General alarm	
03:09			Smoke seen from bridge but dismissed as reflection
03:16			Fire pre- alarm (was cancelled)
03:23	**00:00**	-00:13	Fire alarm
03:26			Master realizes fire at deck 4
03:28		-00:08	Crew call
03:29			ECR was ordered to open the Drencher on deck 4 frame 156
03:31			1st Engineer confirms that the Drencher has been started
03:36			1st mate communicates that too much smoke and fire broke out
	+00:13	**00:00**	Distress signal launched

03:38			Radio call to Brindisi Coastguard
03:42	+00:19		VHF conversation between Master and boatswain ...”we need to abandon ship”
03:43	+00:20	+00:07	blackout
03:48	+00:25	+00:12	Master ordered preparation of the lifeboat (PS)
04:03			Info by boatswain: lifeboat is hanged
04:03		+00:27	Info by chief mate: fire cannot be extinguished
04:06			Lifeboat released at sea
04:13			Master gave “abandon ship” order to crew
04:21			Master informs via VHF Crotone Radio that one lifeboat was already at sea
04:24			Emergency Diesel Generator activated
04:30			First Eng says he is in the water
04:50			SAR led by JRCC Piraeus
04:52	+01:29	+01:16	Pax embarking the lifeboat
05:00			Patrol boat (CP809) left port of Otranto
05:04		+01:28	Info: we have two rafts at sea; the MES here (port side) is unusable
05:06		+01:30	Info: the MES here (port side) is blocked, we have two open rafts in water, but the MES tunnel is blocked, ...one raft is adrift and we are losing another one”.
05:06	+01:43	+01:30	Embarkation of MES starts
06:40			Tugboat Marietta Barretta departed from Brindisi
07:20			CP809 reaches Norman Atlantic
08:30	+05:07	+04:54	First helicopter arrived (Italian Air Force)
08:40			Tugboat Tenax starts
09:00			MRCC ROMA took control of the rescue operations
12:10			first fixed wing aircraft (Greek military) reached the area, took role of Air coordinator
12:25		+09:09	Tugboat Marietta Barretta arrived
13:00		+09:24	Tugboat Tenax arrived (8 firemen on board)
13:20			Pax blocked in the mini-chute rescued by helicopter
14:13			First Eng rescued from the water by oil tanker
17:31			Marietta Barretta is towing Norman Atlantic
18:22			Towing rope snapped
19:00			Italian Navy ship Nave San Giorgio arrives and takes role of OSC
23:35			Towing reestablished
14:00 (30.12.14)			Durand de la Penne takes role of OSC
14:49		+35:13	Last person (Master) left Norman Atlantic by helicopter

6.3.6 Crew preparedness and behaviour

- The investigation report helps identify a few issues with crew preparedness on board the Norman Atlantic. Despite being regulated by SMS procedures, the crew’s response to the fire was inadequate. Initial sign of smoke was misinterpreted and no immediate actions were taken to address the potential danger.

- There has been a record of the crew informing the bridge that “a truck, whose engine was running has smoke”. However, this was not given enough consideration, even though indicated a problem operation with the reefer engine. Therefore, no actions were taken (Ministry of Infrastructure and Transport, Final Report), such as calling the driver of the reefer to stop the operation or enhance the monitoring of the area. Consequently, the signs of the developing situation were not duly considered by the two Officers. (Ministry of Infrastructure and Transport, Final Report) Following the pre-alarms and the previous alarms, there were no proper patrolling done to keep a check on the situation.
- Of the 55 crew members, 22 were provided by the shipowner, while 33 were from the charterer (Ministry of Infrastructure and Transport, Final Report). This disparity in crew composition was a potential cause of miscommunication and lack of coordination, leading to disjointed efforts during the emergency. The report highlights that this mismatch negatively impacted the emergency response. The chartered crew reportedly acted autonomously, failing to effectively support the firefighting and evacuation efforts. However, it is noted that all crew members held the required competency certificates.
- The stressful conditions caused by the fire led to inappropriate behaviour from some crew members, who acted independently rather than following established procedures or orders from the Master during the evacuation. Passengers reported receiving no assistance from crew members in cabin areas and only minimal help near the rescue stations. Additionally, they were unable to identify crew members due to the lack of distinguishing jackets or vests.
- Although the Master correctly indicated the area affected by the fire for the opening of the Drencher, the First Engineer didn’t open correctly the valves in that area, so the situation was further worsened. The Chief Engineer and the engine staff left the ECR (Engine Control Room) without a specific reason and without informing the navigation bridge, which, in this way, could not take any further measure to mitigate the fire devastating effects. (Ministry of Infrastructure and Transport, Final Report)
- The order to abandon the ship was unclear. Although the Master gave the abandon ship order to the crew on the bridge at 04:13, the subsequent steps recorded included a "crew call" for a fire situation and a general emergency, but no specific abandon ship order. This confusion may have been influenced by the stressful situation generated by the fire (Ministry of Infrastructure and Transport, Final Report).

6.3.7 Passenger behaviour

The mentions of passenger behaviour in the report (Ministry of Infrastructure and Transport, Final Report) can be concluded in the following points:

- Passengers launched the rafts into the sea without specific order from the Master (although there is report that the Master was probably aware and periodically informed on the situation of rafts by the crew on the spot.)
- According to the second engineer's report, after the second passenger, several passengers jumped into the Marine Evacuation System (MES) without authorization and while wearing lifejackets. This action was contrary to the established launching procedure, which specifies that those jumping should not wear lifejackets or shoes. However, it is noted in Chapter 8 that it was correct to wear safety belts and shoes, except for high-heeled shoes (Ministry of Infrastructure and Transport, Final Report).

6.3.8 Impact of ship design and layout

The following key comments and recommendation were reported regarding the ship’s design and layout.

1. To prohibit open Ro-Ro cargo spaces on new passenger ship designs. The rapid spread of fire due to the high wind and open spaces was a significant contributing factor for the severity of the incident.

2. Need to enhance the passive fire protection of the LSA from fire. The LSA around garage openings were severely damaged rendering it unfit for the intended use of these critical safety devices during such a emergency.

6.3.9 Adequacy and infrastructure of the LSA and safety equipment

Figure 6-2 Safety Euipqments onboard the Norman Atlantic

The M/V NORMAN ATLANTIC was equipped with the following survival craft:

- N. 2 Lifeboats (cap. 150 pax)
- N. 1 Fast Rescue Boat + N. 1 M.O.R.
- N. 1 Rescue Boat
- N. 8 liferafts (n. 2 for 25 pax and n. 6 for 101 pax)
- n. 24 lifebuoys
- N. 2 MES mini-chute Viking (one for each side) with raft for 101 pax

Individual survival equipment:

- n. 1082 adult lifejackets
- 3+3 (watchkeeping staff)
- 82 infant lifejackets
- 114 children lifejackets
- 44 lifejackets for overweight people

The above equipment is in line with the documentation approved and regulation in force. (Ministry of Infrastructure and Transport, Final Report)
Due to the fire situation on board with high flames and smoke, all evacuation means and safety equipment on the starboard side were unusable. On the port side, the Master reported that the rafts were launched directly into the sea without specific order. Furthermore, the chute was rendered unusable when it got obstructed by two people who had remined trapped inside and damaged due to adverse weather condition and flames. Only the lifeboat on the portside was usable, and it seemed to have been launched into the sea without specific orders from the Master.

The survival equipment on the starboard side was significantly compromised, with flames destroying/damaging much of it within minutes. The mini-chute was unusable due to the detachment/missing connection of the related life raft and damage from both the fire and adverse sea and weather conditions. The Marine Evacuation System (MES) faced operational restrictions during the incident. The criteria for evaluating the functionality of such devices were challenged by the actual navigation conditions, highlighting the limitations of the existing survival craft.

The report identified a need to evaluate a different position or alternative solutions to protect the Lifesaving appliances from direct contact with fire. Additionally, with reference to the MES, its operational restrictions shall be reviewed according to the navigation actually made, similarly the criteria for evaluating the functioning of such devices shall be reconsidered, namely replacing them with other suitable survival craft. (Ministry of Infrastructure and Transport, Final Report)

Situation of the mini chute:

The investigation into the Norman Atlantic incident revealed several critical issues regarding the Marine Evacuation System (MES) and its mini chute:

1. Initial Communication and Condition: At 04:04 (VDR), the second engineer reported that the MES was unusable due to a broken pipe, preventing people from jumping. By 04:06, he further informed the navigation bridge that the MES tunnel was blocked, with one raft adrift and another being lost.
2. MES Deployment and Operation: The MES on the portside was used as the starboard side MES was inaccessible due to flames. The MES was designed to evacuate 101 persons via a vertical slipway connected to a raft. However, the system was not prepared correctly, leading to the detachment of the necessary raft.
3. Crew and Passenger Actions: The second engineer, after leaving the engine room, took charge of the MES but found the responsible staff missing. He waited for the Master's orders and began moving passengers down the chute after receiving authorization. However, passengers jumped without authorization and wearing lifejackets.
4. Obstructions and Failures: During the evacuation, a passenger became trapped in the chute, leading the second engineer to halt operations and inform the Master. Despite efforts to assist trapped individuals, adverse weather conditions and flames rendered the mini chute unusable. Two persons remained trapped, one of whom died.
5. Rescue Efforts: An EH-101 helicopter of the Italian Navy eventually cut the MES tube, rescuing one trapped individual while the other had already died. The MES was not designed to withstand the extreme weather conditions experienced, with VDR wind speeds showing values around 50/60 knots, far exceeding the system's design specifications (25 knots).

6.3.10 Effectiveness of evacuation procedures

During the Norman Atlantic incident, the evacuation was primarily conducted through air rescue means, as only a limited number of passengers (88) could use the lifeboat on the port side. The majority of passengers were evacuated by helicopters to Coast Guard vessels and other merchant vessels redirected for the emergency. According to the investigation report 16 helicopters were involved in the event, no further details about the helicopter evacuation are available.

The effectiveness of the evacuation was significantly compromised. Passengers reported the following (Ministry of Infrastructure and Transport, Final Report):

- there was no audible alarm or a public announcement in the area of passenger cabins.
- there was not any announcement via the public address system on a later stage.
- it seems the alerting of the passengers happened solely by themselves.
- there was no help from any crew member in the area of passenger cabins and only very minor help in the area of the rescue means.
- the passengers were not able to identify the crewmembers, because they did not wear special jackets or vests.

These issues could be addressed to the damages that affected the ship electrical system since the early stages from one side and on the other hand to a not proper application of the emergency procedures by the cabin crew combined with the difficulties related to the nighttime.
However, interviews of the crewmembers and other evidences gathered during the investigation do not confirm fully the above mentioned criticalities (Ministry of Infrastructure and Transport, Final Report).

Only 88 of 475 persons (18.5 %) have been evacuated via the shipboard LSA. The evacuation started at 04:06 with LB in the water and ended when last passengers were extracted from mini-chute at 13:20. Therefore the average evacuation duration was 64 seconds per person (494 min for 475 persons).

6.3.11 Communication and dissemination of information

Effective communication is crucial in managing crises, and the following section identifies several areas where communication fell short, both internally among the crew and passengers and externally with the rescue services.

6.3.11.1 Internal

1. Initial response to fire: At the pre-alarm stage, the seriousness of the situation was misinterpreted by the crew and hence miscommunicated to the Master. This delay in recognizing the severity of the fire hindered the further steps and actions. The fire team failed to intervene before the breakout of the fire. Upon noticing the fire from the bridge, the Master ordered to open the drencher at deck 4. The investigation evidence showed that the wrong drench valves were opened (all on deck 3).

2. Evacuation orders: There is no clear record to indicate that the Master ordered immediate action to launch the lifeboats or ensure the proper preparation for swift evacuation. It was reported that the passengers launched the rafts into the sea directly without a specific order.

3. Language of Instruction: The language used for instructions onboard was not consistently understood by all crew members, leading to confusion and miscommunication during the emergency.

4. Crew coordination and leadership: The chief engineer and the engine staff left the ECR room without a specific reason and without informing the navigation bridge, which stopped further fire mitigation actions. The report notes crew members often acted out of personal initiatives as opposed to the Masters orders (even during evacuation procedures).

5. Coordination and Communication among Crew: The crew exhibited a lack of coordination and communication. The disjointed efforts among crew members, partly due to the mix of personnel from different sources, led to ineffective emergency management.

6. The details of the abandon ship order remain unclear: The investigation report states on the one hand, that "*[the Captain] gave the necessary orders, whenever possible, to deal with the fire and very serious situation*" on the other hand It is reported that the Master gave the crew present at bridge the abandon ship order at 04:13 and "*the following steps were indeed recorded: a timely "crew call" for fire situation followed by a situation of general emergency without any specific order to abandon the ship*".

7. Passenger Information: Passengers were not informed in a timely manner about the emergency. According to the report (Ministry of Infrastructure and Transport, Final Report), passengers alerted themselves to the situation as there were no announcements via the Public Address System (PSA) at later stages of the incident.

6.3.11.2 External

1. Distress Signal: The distress signal was launched 13 minutes after the fire alarm was raised. This delay in communicating the emergency to external authorities impacted the timely deployment of rescue operations.

2. The communication from the Norman Atlantic to external agencies was inefficient, contributing to significant delays in the emergency response. The failure to provide clear, timely, and detailed information about the severity of the fire, the number of people on board, and the evolving emergency conditions hindered the coordination of rescue operations and ultimately led to a slower and less effective response.

3. LSA Deployment Status: Information on the deployment status of life-saving appliances (LSA) was continuously communicated with the rescue teams. This ongoing communication helped coordinate the rescue efforts, although the overall response was hampered by earlier delays and miscommunications.

6.3.12 Gaps and lessons learned

While it is difficult to conclude on specific regulatory gaps, the following lessons were learned from the Norman Atlantic incident:

1. The incident underscores the importance of robust and well-protected life-saving equipment that can withstand extreme conditions. The failure of the mini chute and MES highlights the need for thorough evaluation and potential redesign to enhance their reliability and functionality during emergencies.

    I. The mini chute and related life-saving appliances were not adequately protected from fire and adverse conditions. This resulted in a failure during the emergency.

II. The positioning and operational restrictions of the MES need to be carefully considered to ensure their effectiveness in real situations.

III. The life-saving appliances (LSA) around garage openings were severely damaged by the fire, rendering them unfit for use during the emergency. The report highlights the need to enhance the passive fire protection of LSAs to ensure their functionality in critical situations.

2. Safety level of human intervention:

I. Faults/pre-alarms/alarms controls and accessibility: The crew failed to properly interact and act on the initial fire pre-alarm and smoke detection. The misinterpretation and lack of action allowed the escalation of the situation. In order to silence certain buzzer, no particular safety procedures are needed, anyone can do it. However, some operations such as alarm reset, silencing general sirens and enable/disable the single loop sensors, require a higher level of safety, a key is required to be inserted. Furthermore, the operation to disable an entire loop (disconnect the power supply) technically requires additional safety level of a password along with the key. Through the interviews for the reports indicated that such password could be possibly known by the crew members.

II. Misreading critical Indications: The crew did not take any action or consider the smoke from the truck engine as a significant threat. This error in dismissing or misreading the critical indication of danger delayed the necessary actions that could have helped contain the situation.

III. Proper training and skilled personnel: Although the Master correctly indicated the area affected by the fire for the opening of the Drencher, the First Engineer didn't open correctly the valves in that area, so the situation was further worsened.

3. Lack of clear communication and coordination among crew (Lack of adherence to procedure): Several areas of the report record the crew members having acted autonomously without establishing procedures or orders form the Master. This lack of coordination and adherence to protocols complicate the emergency response effectiveness.

4. The problems mentioned above, combined with the different nationality and the comprehension problems for the English language, whose knowledge/comprehension level among lashing staff in certain cases was low, as it was appreciated during the interviews, have probably caused some difficulties/misunderstandings, which could have had a negative effect in the correct execution of these tasks. For these reasons, a review of the lease agreements is recommended, the so called "deck & engine", where each person's responsibility shall be better identified. (Ministry of Infrastructure and Transport, Final Report)

5. Importance of accurate passenger data records: The confusion caused by incorrect passenger data registration and transcription errors highlight the need for accurate and reliable passenger list to ensure effective emergency response and rescue measures.

6. Condition of reef trucks: A periodical inspection/certification, aimed to verify the safe working conditions of the refrigerating units installed on the reefers followed by controls carried out by ticketing offices - at the moment of ticket purchase - of the validity of related certifications would increase safety.

7. The minimum distance among the vehicles lashed in the garage and for enabling the operational and safe passage of the fire-fighting team on board shall be established.

8. The incident underscored the need for improved fire resistance of VDRs. The high temperatures during the fire severely impacted the VDR's functionality, indicating that current fire resistance standards may not be sufficient. This resulted in critical data loss and challenges while retrieval of incident data.

9. The rapid spread of fire due to high winds and open spaces significantly contributed to the severity of the incident. The report recommends prohibiting open ro-ro cargo spaces in new passenger ship designs to mitigate such risks.

6.3.13 Safety recommendations and impact on rules and regulations

1. Evaluate a different position or alternative solutions of the survival equipment to protect them from direct contact with fire.

2. With reference to the MES, its operational restrictions shall be reviewed according to the navigation made, similarly the criteria for evaluating the functioning of such devices shall be reconsidered, namely replacing them with other suitable survival craft. (Ministry of Infrastructure and Transport, Final Report)

3. Issuance of Circulars: Following the incident, the Italian Coast Guard Headquarters issued Circular N. 106 on January 22, 2015, aimed at addressing and mitigating issues related to passenger data registration and verification. With reference to the registration of the passengers embarked, the Italian Coast Guard Headquarter, through Circular titled Sic. Nav n. 106 of 22/01/2015, issued detailing instructions so as to prevent such situations from occurring again, namely situations in which people could not be properly identified on board, immediately after the rescue operations. (Ministry of Infrastructure and Transport, Final Report)

4. Enhanced Regulatory Compliance: The incident highlighted the need for enhanced regulatory compliance and stricter enforcement of procedures related to passenger data management. In this case, although the mentioned procedures were all compliant with the regulation and approved, during the emergency there were problems in determining the exact number of persons on board, such problems were mainly due to the confusion generated by the wrong registration of passengers' data (for ex. maiden name for women) and/or transcription errors. (Ministry of Infrastructure and Transport, Final Report)

5. While the overall management of ship operations appears to be safe, it is recommended to review the SMS procedures. This should include more frequent internal audits to ensure the proper implementation of operational procedures, specific training for staff responsible for these operations, and clearer guidelines for loading, lashing, and socket connection tasks.

6. A review of patrol procedures during navigation should be conducted. This includes better defining roles and ensuring that staff responsible for these operations have adequate knowledge of the English language, verified by both the ship owner and the charterer.

7. A greater protection of cables and/or their placement in different areas, for example on the sides (for ships of recent construction) is therefore recommended.

Recommendations to IMO from the official Investigation report

In the investigation report (Ministry of Infrastructure and Transport, Final Report) several recommendations regarding registration of passengers, cargo list, loading and lashing operations, fire safety, and VDR are given.

With regard to LSA and evacuation following recommendations are of interest:

- Implementing measures aimed at ensuring that the staff on board is actually familiar with the working language and that this language is really used on board.
- In case on board there is more than one person with same role (for example Chief Mate) for which the ISM manual clearly establishes the tasks, the Master shall specifically assign each person the related tasks.
- The complete list of passengers shall be provided before the departure, pursuant to the regulation in force, so that the Macan ascertain that the number of passengers embarked doesn't exceed the number allowed.
- A study / analysis shall be carried out to develop solutions, which are different from the existing ones, concerning the aspects and structural/constructive criticalities mentioned above:
  - Passive protection of the areas where collective rescue means (including the MES and *evacuation stations* as defined by the SOLAS) are placed. Their placement shall also be made considering any hull opening of Ro-Ro areas, so as to prevent direct contact with open flames in case of fire
- Providing simpler and more intuitive operational instructions for using security devices.

6.3.14 Issues (evacuation or LSA related) not addressed in the investigation report:

- Despite ongoing efforts to enhance crew training and emergency preparedness, the standardisation of realistic (fire and evacuation) drills, as well as their frequency may not be uniformly or fully enforced. It is crucial that these trainings are also provided to chartered crew members to ensure consistency and effectiveness. Requirements for crew to be identifiable during a crisis event.
- Many vessels, especially older ones, still reply on outdated communication systems during emergencies, which can be compromised in the event of fire or power loss. Modernising these essential systems in order to ensure reliable communication during crisis.
- The efficiency and ease of deployment of life-saving appliances, as well as their availability are critical. Issues such as system deployment failure during real evacuation and their fire protection and fire resistance functionalities needs to be addressed to ensure availability during crisis.
- Evacuation routes requiring clarification or updating based on use and aligned with practices on ship after realisation of ship design. Evacuation routes may require clarification or updating based on their actual use and alignment with practices in the ship after its design realisation. Ensuring these routes are clear and practical is vital for effective evacuation.
- Passenger participation in drills and frequent passenger awareness campaigns may not be universally implemented. Increasing involvement, communication and regular update and guidance

6.4 Summary

The Norman Atlantic incident occurred on December 28, 2014, when a fire broke out on the roll-on/roll-off passenger ferry in the Adriatic Sea, resulting in the tragic loss of at least 11 lives. The fire that was likely to have originated from the car deck due to electrical faults or presence of other heating equipment. The initial signs of smoke were dismissed by the crew and a lack of further patrolling or actions against the pre-fire alarm led to aggravation of the fire. The bad weather on open deck along with other contributing factors led to a quick escalation and high flame of the fire. The intense heat and flames of the fire rendered one side of the ship’s LSA equipment, lifeboats and liferafts, unusable. Despite the damages due to bad weather, the remaining LSA, lifeboat and life raft, on the unaffected side, were used to evacuate the passengers. Helicopter sand nearby vessel played a crucial role in rescue operations. The LSA, particularly the Marine Evacuation System (MES), was found to be ineffective due to improper preparation and extreme weather conditions. Significant failures in the preparation, operation, and communication regarding the MES and its mini chute, compounded by extreme weather conditions, severely impacted the effectiveness of the evacuation and contributed to the tragic outcomes. The crew's response to the Norman Atlantic incident was inadequate, with misinterpreted smoke signals and a lack of immediate action. Poor monitoring and coordination among crew members led to disjointed efforts, while passengers received minimal assistance and struggled to identify crew members. Passengers also acted independently, launching rafts and jumping into the Marine Evacuation System (MES) without authorization, reflecting the chaotic and stressful nature of the emergency. Overall, these factors highlight the critical need for improved preparedness and coordination in emergency situations to ensure the safety and well-being of all on board. The communication during the Norman Atlantic incident was marked by significant shortcomings, both internally among the crew and externally with passengers and rescue services. These communication breakdowns critically hindered the effectiveness of the emergency response and highlighted the need for improved protocols and training.

The Norman Atlantic incident highlighted the need for stricter regulations on passive fire protection of LSA equipment, prohibition of open deck cargo-hold spaces, improved fire detection and suppression systems, and enhanced training for crew members in emergency response. Ensuring the availability and functionality of LSA on both sides of the vessel is also critical for effective evacuation during emergencies.

6.5 Reference

Following reference has been used for the review:

- Final Investigation Report: Italian Ministry of Infrastructure and Transport, Directorate General for Rail and Marine Investigations, 3rd Division – Marine Investigations, Fire on board of the ro-ro pax NORMAN ATLANTIC (Ministry of Infrastructure and Transport, Final Report).

7. Caribbean Fantasy

7.1 The vessel

The Panama-flagged RoPax vessel Caribbean Fantasy (IMO Number 8814263) was delivered in 1989. She was designed for 950 persons. Her main particulars are shown in Table 7-1.

Figure 7-1 Photo of Caribbean Fantasy (National Transportation Safety Board, June 2018)

Table 7-1 Main particulars of Caribbean Fantasy

Length over all	194.33 m
Length between pp	176.80 m
width	25.0 m
draught	6.39 m
Gross tonnage	27,362 gt
design speed	28 knots

Caribbean Fantasy was equipped with following LSA:

- 2 partially enclosed lifeboats for 150 persons each (LB 1 and 2)
- 1 fully enclosed lifeboat for 70 persons (LB 3)
- 23 liferafts with a total capacity of 780 persons
- Fast rescue boat

7.2 The accident

The Caribbean Fantasy accident occurred on the 17th August 2016. It was due to a fire that broke out in the main engine room of the roll-on/roll-off (Ro/Ro) passenger vessel. The Caribbean Fantasy was navigating between San Juan, Puerto Rico and Santo Domingo in Dominican Republic. The fire started in the engine room at 07:25 local time. It was caused by fuel spraying from a leaking flange coming in contact with a hot surface on the port main propulsion engine. There were attempts made by the Master and the crew to fight the fire and bring the situation under control, however the fire could not be curbed.

The weather conditions were good: wind from E 13 to 17 knots, wave height at 1.2 m, air temperature 28.7°C.

The Master eventually ordered the ship to be abandoned. The US Coast Guard and other first responder vessels, along with Samaritan vessels helped transport all 511 passengers and crew to port. Several injuries occurred during the firefighting and abandonment efforts, but none was life-threating. The burning vessel drifted in the wind and grounded on the sandy bottom outside the port. Three days later, the vessel was towed into the harbour, where

shore-based firefighters extinguished the last bit of the fire. The accident resulted in $20million (around) in damage to the Caribbean Fantasy, which eventually had to be scrapped.

There were flaws in execution of the Ship Management System (SMS). Upon detecting the fire, the SMS required the crew to follow specific procedures for the emergency, including activating the general emergency alarm and informing the Master. The general alarm was not activated immediately after the fire was detected, leading to the confusion and disorganisation in the vessel.

The life-saving appliances on board the vessel included lifeboats and MES. During the evacuation, there were some challenges in their deployment and usage due to factors such as listing. However, the Master and crew were able to resolve troubles and successfully evacuated all 511 passengers and crew using these appliances.

The Investigation report (National Transportation Safety Board, June 2018) on the accident produced by the National Transportation Safety Board identified the following safety recommendations:

- Require operators to perform full function tests of quick-closing valves during inspections and examinations and associated systems shut down as designed and intended
- Evaluate feasibility of creating a passenger vessel safety specialist billet for search and rescue activity for immediate assistance to a large number of passengers in distress
- Worst case risk assessment scenarios to ensure existing freshwater supply is sufficient to be performed
- Review of LSA training program, including record keeping procedures and programs to ensure crew proficiency with onboard systems (The need for effective crew training and familiarization with emergency procedures)
- Provision of formal and recurrent training to shoreside management and senior shipboard officers

The report provides several regulatory recommendations, including improvements in stability, vital equipment and electric distribution, emergency power generation, and operational matters. These recommendations aim to enhance the safety of large passenger ships and prevent similar tragedies in the future.

7.3 In-depth review

7.3.1 Root causes and contributing factors

The National Transportation Safety Board determines that the probable cause of the fire aboard Caribbean Fantasy was Baja Ferries' poor safety culture and ineffective implementation of their safety management system on board the vessel, where poor maintenance practices led to an uncontained fuel spray from a blank flange at the end of the port main engine fuel supply line onto the hot exhaust manifold of the engine (National Transportation Safety Board (NTSB), June 5, 2018).

Contributing to the rapid spread of the fire were fuel and lube oil quick-closing valves that were intentionally blocked open, fixed firefighting systems that were ineffective, and a structural fire boundary that failed (National Transportation Safety Board (NTSB), June 5, 2018).

The investigation report (National Transportation Safety Board (NTSB), June 5, 2018) states further that the failure of the Panama Maritime Authority and the recognized organization to ensure Baja Ferries' safety management system was functional contributed to the fire and the prolonged abandonment effort.

7.3.2 Adherence to international, EU and national safety regulations

Following non-compliances with regulations have been listed in (National Transportation Safety Board (NTSB), June 5, 2018):

- Entries in the Caribbean Fantasy's official logbook indicated that quarterly launching and in-water operations of lifeboats no. 1 and no. 3, as required by SOLAS regulations, had last been conducted in October 2015 (10 months before the accident).
- Per SOLAS regulations, MESs are required to be deployed on board each vessel every 5 years for testing and training purposes. Additionally, each crewmember assigned to MES duties is required to participate in the deployment of a system every 2 years (but in no case longer than 3 years). Of the crewmembers

responsible for the deployment of the MESs on Caribbean Fantasy, only one had witnessed a deployment of an MES prior to the accident.

- Investigators found two different versions of the emergency plan and station bill on board the Caribbean Fantasy following the accident. A plan found posted in the engine control room was stamped “approved” by the vessel’s classification society, and dated February 2, 2016.21 Another plan found on the bridge was stamped “provisionally approved” and dated July 3, 2016 (the date that the vessel left the Tunisian shipyard). The two plans differed significantly, with variations in survival craft assignments, code words and signals, and emergency duties of crewmembers. For example, the code for a fire emergency in the February plan was “red-red-red,” while the code for the same emergency on the July plan was “Mr. Skylight.”

Potentially there was an additional issue with crew drills (National Transportation Safety Board (NTSB), June 5, 2018):

- Crew drills were required to take place no less than weekly based on SOLAS regulations. Weekly drills were conducted on board the Caribbean Fantasy; however, investigators were unable to verify crewmember attendance. Attendance checklists were printed from the safety officer’s computer using the emergency plan database and, according to her, attendance records were maintained in that database. It was not possible to recover these records from the safety officer’s computer.

7.3.3 Evacuation procedure

At 07:34, 9 minutes after the fire was reported to the bridge, the master informed the passenger reception desk about the fire in the engine room. He requested that the hotel crew start to gather all passengers to bring them to their muster stations, and he told the crew that he would make an announcement. At 07:45 the General Alarm was sounded. At 07:46 the announcement was made in English, followed by an announcement in Spanish. The passengers were informed of the fire and abut the decision to abandon the vessel. At 07:58 the “prepare for abandon ship” Signal was sounded. The passengers were ordered to embark survival craft shortly after receiving the order to proceed to their muster stations. Therefore, no complete mustering of passengers has taken place. No information about the location or orders to put on life jackets is given in the available documents.

At 08:19 the first lifeboat (LB 1) was ready to be lowered with 100 people on board. At 08:37 LB 2 was lowered with (estimated) 105 passengers and 4 crew on board. At 08:47 the last LB (LB 3) was ordered to be lowered (estimated 100 persons (which is in contradiction to the description of the LSA that states that LB 3 had a capacity of 70 persons)). Further persons evacuated via the starboard side MES. Due to several problems with the LSA (see section 7.3.9) the evacuation was full of obstacles. The investigation report (National Transportation Safety Board (NTSB), June 5, 2018) describes the process as “delayed”, “disorganized” and “inefficient”.

Finally, the majority of 511 passengers and crew were evacuated via lifeboats (approx. 309 persons = 61%) and MES (approx. 194 persons = 38%), 8 persons (predominantly elderly and disabled passengers) have been airlifted. All passengers and crew survived the accident, 50 people had to be treated in hospitals for knee, ankle, and leg injuries; hypertension; high blood pressure; fainting; body aches; breathing difficulties; vomiting; dehydration; and conditions related to pregnancy.

7.3.4 Decision making

No information regarding decision support systems is given in the investigation report (National Transportation Safety Board (NTSB), June 5, 2018).

The situation on board of Caribbean Fantasy was mainly influenced by following decisions made:

- During the accident, the Master directed the cadet to make the initial announcement in English, which he did (at 07:46). The second officer then made an announcement in Spanish. The Master’s intended announcement, given by the cadet, directed passengers to follow the instructions of the crew. However, the second officer’s Spanish announcement stated that the fire was out of control and that a decision was made to abandon ship. Because the Master did not speak Spanish, he did not realize that the abandon-ship announcement was being made at that time.
- The “prepare for abandon ship signal” (one long signal sounded on the ship’s alarm system) has been given at 07:56.

- The abandon-ship order came before any firefighting or boundary-cooling efforts commenced. According to the Master, the following factors, taken together, necessitated the abandonment (National Transportation Safety Board (NTSB), June 5, 2018):
  - Fire, smoke, and explosions were reported in the engine room and the garages, and the fires were not under control;
  - the CO_2 fixed firefighting system had been deployed in the engine room;
  - there was no indication or confirmation of the operability of the water-mist system in the engine room;
  - the vessel was listing to port about 4 degrees, and further use of the drencher system would have increased the list;
  - there was smoke intrusion into the accommodation areas; and
  - operating on emergency electrical power, the vessel had no operational hotel support systems such as potable water, toilets, galley equipment, or air conditioning.

- The NTSB concluded that the decision to abandon the Caribbean Fantasy was reasonable given the availability of nearby response resources, the proximity to a large port, and the uncertainty of the effects on the vessel from the fire.
- Coast Guard Sector San Juan immediately responded, launching every available asset /9/.

7.3.5 Response time

The following tables shows the timeline of events during the Caribbean Fantasy accident:

Table 7-2 Caribbean Fantasy (CF) accident - timeline of events

Time (UTC)	Δt [h:min]		
	From initial event	From General Alarm	
07:20		-00:25	Smell of fuel noticed in ER
07:23			Chief Eng informed Master about the leak
07:25	**00:00**	-00:20	Fire in ER reported to bridge
07:27	+00:02	-00:18	Crew and firefighting team alerted by codeword via PA
07:29		-00:16	Information to Master that ER is evacuated
07:34	+00:09	-00:11	Master informed pax reception desk about the fire, request to hotel crew to gather all pax and bring them to muster stations
07:37			CO2 released
07:39			VHF call to all vessels “ship not under command”
07:42			Master directed the activation of the drencher system for garage B
07:45	+00:20	**00:00**	General Alarm + Info to coast guard
07:46	+00:21	+00:01	PA announcement in English and Spanish to pax to abandon ship and to direct all crew to survival craft embarkation stations
07:46	+00:21		PanPan message to all vessels on VHF by CG
07:47	+00:22	+00:02	Announcement to abandon ship + communication with CG about number of persons on board, number of LB, color of liferafts
07:49			Explosion in garage B reported
07:54	+00:29	+00:09	MES deployment ordered by Master

07:56			Pan-Pan message issued by CG to all vessels
07:56		+00:11	Info to bridge that all pax and crew had been evacuated from the ship's internal spaces
07:58	+00:33	+00:13	"prepare for abandon ship signal" sounded
07:59			First coast guard vessel (CG45751) arrived on scene
08:02	+00:37	+00:17	Port side MES reported to be on the water
08:02			Coast Guard small boat (CG33139) arrived
08:03			Staff captain reported that smoke was blowing onto portside MES and slide angle to steep
08:04	+00:39		MES prep teams ordered to starboard side MES to prepare it
08:04			Two more Coast Guard vessels arrived
08:08	+00:43	+00:23	Master ordered embarkation of LB2
08:12	+00:47		Master's order to prepare LB3
08:18			Staff captain reports that starboard side MES bowsing line is broken
08:19	+00:54	+00:34	LB1 ready to be lowered with 100 persons, Master gave order to lower
08:23			Master informs Coast Guard that the fire cannot be controlled and that pax will be evacuated by LB
08:25	+01:00	+00:40	LB1 in the water, but unable to release the hooks
08:29			Two persons jumped or fell into the water and were rescued by Coast guard small boat
08:37	+01:12	+00:52	LB2 lowered with approx. 105 pax+4 crew on board
08:47	+01:22	+01:02	Order to lower LB3
08:50			Joseph Tenzanos arrives and takes role of OSC
08:53	+01:28	+01:08	LB3 in the water (approx. 100 pax), not able to open the hooks
08:53	+01:28		More vessels and a helicopter arrived
08:53	+01:28	+01:08	First persons going down slide to starboard side MES
09:06		+01:21	Master ordered to stop sending pax down the chute as not enough rafts were available at the MES platform
09:12			More rafts had been pulled to the MES platform but the large openings ware facing away from the platform, loading process slowed down. Coast Guard supported in turning the rafts
09:12			Master requested Coast Guard to assist LB3
09:16		+01:31	Crew hoisted LB3 back out of the water, winch tripped of when LB was about 6 feet above the water
09:23			Master informs CG that one of the liferafts filled with people was let go and drifting to the shoreline, life raft was recovered by small CG boat
09:25	+02:00		14 firefighters ferried to CF by helicopter

09:48			Master reported on request that approx. 70 persons are still on board
10:00	+02:35	+02:15	Persons from LB3 extracted to Coast Guard vessel,
10:09		+02:24	Angle of MES slide improved by support of CG boat
10:11	+02:46		Master ordered to send remaining pax and crew down the MES
10:12	+02:47	+02:27	CG helicopter evacuates elderly and disabled pax
10:21			Ship's stern grounded on sandy bottom
10:30	+03:05	+02:45	Master informs OSC that last pax had abandoned the ship
11:04	+03:39	+03:19	Last person (crew) coming down MES slide
11:19			Master info: 6 persons remaining on board + fire fighters
11:30	+04:05	+03:45	All persons from LB3 transferred to CG vessel
12:24	+04:59	+04:39	Remaining crew evacuated by helicopter
13:00	+05:25	+05:05	Last fire fighters picked up

Coast Guard Sector San Juan immediately responded, launching every available asset. (Warren, Winter 2020):

- "*Enacting the San Juan Annex to District 7's Mass Rescue Operation Plan, we immediately made notifications to federal, commonwealth, and local agencies"*
- "Our response efforts were quickly joined by Customs and Border Protection vessels, response boats from Puerto Rico's marine police units, three local ferries, six tugs, and numerous Good Samaritan vessels in an extraordinary demonstration of unity of effort".

As the command center worked down their Quick Response sheets and MRO checklists, Coast Guard advance teams from Sector and Station San Juan deployed to the pre-designated landing site at Pier 6 to assist the Coast Guard's passenger vessel safety specialist who had deployed to the site almost immediately after the initial call. Sector San Juan simultaneously began standing up our incident command system (ICS) structure. Like many sectors, Sector San Juan had standing ICS teams that were on call for a week at a time in the event a scenario like this occurred. Teams from the sector's planning staff, response, prevention, and logistics departments, as well as members of Base Miami Beach's Electronics Support Detachment, established a fully staffed incident command post. Completed in just two hours, it would support the mobilization of 25 federal, commonwealth, local, and industry partners for the unified response. (Warren, Winter 2020)

7.3.6 Crew preparedness and behaviour

Deck and engine crew in safety-critical positions had completed required training in crisis management and human behavior, basic safety training, and security training. Hotel crew were not required to have a certificate of competency; however, most were required to have specific training necessary to fulfill their emergency duties as personnel designated on muster lists to assist passengers in emergency situations, shipboard familiarization training, and safety training for personnel providing direct service to passengers in passenger spaces

- Of the crewmembers responsible for the deployment of the MES on Caribbean Fantasy, only one had witnessed a deployment of an MES prior to the accident. The safety officer—the person tasked with training and familiarizing the crew with the ship's MES—had not witnessed or participated in a deployment (National Transportation Safety Board (NTSB), June 5, 2018).
- The second officer (off watch), who had joined the ship 4 days prior to the accident, stated that he did not have familiarization training upon reporting. He stated that he did not attend any crew musters or fire drills during his time on the vessel. The familiarization checklist for this second officer was not found in the binder that held all crew familiarization records (National Transportation Safety Board (NTSB), June 5, 2018).

- The second officer (off watch), who commanded lifeboat no. 1 during the accident, stated that he had not received training for the lifeboats on board the Caribbean Fantasy, nor had he reviewed the lifeboat manual (National Transportation Safety Board (NTSB), June 5, 2018).
- According to the third officer, who was the commander of lifeboat no. 2 at the time of the accident, there was no training on how to operate the new release hooks. He stated that he had read the manual. He also said that the manual explained that when the lifeboat touched the water, the hooks should have released automatically. Investigators found that, contrary to the third officer's statement, there was no automatic means to release the lifeboats once in the water.
- SOLAS regulation requires crew involved in deploying an MES to have participated in the actual deployment of an MES every 2 years. However, none of the Caribbean Fantasy crew other than the staff captain had ever deployed an MES or witnessed an MES deployment (National Transportation Safety Board (NTSB), June 5, 2018) .
- The staff captain's training record included a document signed by a VIKING service manager attesting to receiving "instruction in handling and deployment of a VIKING Evacuation Slide" with rafts on June 5, 2014, more than 2 years before the accident (National Transportation Safety Board (NTSB), June 5, 2018).
- The safety officer, who deployed the port MES and was responsible for training the crew on the system, said she had never seen one deploy until the day of the accident. Her only MES training had been to watch an instructional video shown to Caribbean Fantasy crew during recurrent MES training (National Transportation Safety Board (NTSB), June 5, 2018).
- The third officer, who launched the starboard-side MES, did not have any information in his company training record to document a previous deployment of an MES. The AB who released the first two liferafts from the starboard side told investigators he had never seen an MES deploy (National Transportation Safety Board (NTSB), June 5, 2018)
- Entries in the Caribbean Fantasy's official logbook indicated that quarterly launching and in-water operations of lifeboats no. 1 and no. 3, as required by SOLAS regulations, had last been conducted in October 2015. Reports to the company during the months of January, February, and March 2016 informed the vessel's management of the problem with putting the starboard-side boats in the water, and the last report noted that this would be done in the shipyard period. Although there was evidence of the starboard-side lifeboats being launched during the shipyard period, the launching was not done with the assigned crew (National Transportation Safety Board (NTSB), June 5, 2018).
- All lifeboat release hooks had been replaced during the shipyard maintenance period in Tunisia to comply with a recently implemented SOLAS regulation that was enacted to reduce the number of accidental releases of lifeboats. Each hook included a "recovery pin" that prevented the hook from inadvertently releasing when the boat was hoisted after inspections and drills. The previous hook arrangements did not include this design feature (National Transportation Safety Board (NTSB), June 5, 2018). It can be assumed that the crew was not trained with the new hooks / recovery pin arrangements.
- No record of training was found in logs and training records, and crewmembers interviewed on-scene confirmed that they had not completed any training related to the manufacturer's procedures for opening the newly installed lifeboat hooks. During the port state control drill held on August 9, 2016, the crew of lifeboat no. 2, the only lifeboat launched during the drill, was only able to manually release the hooks by opening the gate and removing the lifting ring out from under the closed hook from outside the lifeboat in calm waters (National Transportation Safety Board (NTSB), June 5, 2018).
- The emergency plan called for pursers and assistant pursers assigned to each muster station to conduct a "roll call" of passengers and crew. However, the hotel director told investigators that the roll call of passengers did not take place because passengers were ordered to embark survival craft shortly after receiving the order to proceed to their muster stations. Although there was no full accounting of passengers and crew, the Master stated that he was confident no one remained on board because the crew had conducted several sweeps of the accommodation and public spaces (National Transportation Safety Board (NTSB), June 5, 2018).

Summary: to summarise, it can be said that there was a considerable lack of crew competence in handling the rescue equipment. According to (National Transportation Safety Board (NTSB), June 5, 2018) crew drills were required to take place no less than weekly based on SOLAS regulations. Weekly drills were conducted on board the Caribbean Fantasy; however, investigators were unable to verify crewmember attendance. Attendance checklists were printed from the safety officer's computer using the emergency plan database and, according to her, attendance records were maintained in that database. It was not possible to recover these records from the safety officer's computer

As the accident happened close to the port of Puerto Rico the Coast Guard was on scene immediately and played an important role in the evacuation. In (Warren, Winter 2020) the Sector commander of the Coast Guard sector San Juan states the following: "*In fact, during the five years prior to the Caribbean Fantasy fire and grounding, the sector's planning and force readiness branch and passenger vessel safety specialist had held nine exercises around the island of Puerto Rico and U.S. Virgin Islands, well exceeding Coast Guard and sector requirements. Specifically, Sector San Juan conducted six table-top exercises, one functional exercise, and two full-scale exercises in the previous five years. Moreover, in one of the table-top exercises held about one month prior to the Caribbean Fantasy incident, the scenario required an evacuation of a large cruise ship in San Juan Harbor. Not only were the responders knowledgeable of the plan details, but the rapport, trust, and relationships established during the exercise at all levels of the responding agencies became critical during the actual event".*

7.3.7 Passenger behaviour

Before the accident

Prior to departure from Santo Domingo a safety briefing for passengers has been conducted by the hotel crew. In accordance with SOLAS regulations a prerecorded announcement has been used, followed by a lifejacket demonstration (National Transportation Safety Board (NTSB), June 5, 2018).

During the emergency

A short YouTube video (Youtube, assessed 2025-01-15) taken by a passenger shows passengers standing on deck wearing lifejackets. No signs of panic are visible there.

From the investigation report (National Transportation Safety Board (NTSB), June 5, 2018) it can be deduced that panic only occurred after the problems with the lifeboat hooks:

- *About 0829, the crew in lifeboat no. 1 was still attempting to open the release hooks when an unidentified person either jumped or fell in the water. Video taken from a passenger's mobile phone captured a second person jumping in the water from the lifeboat. The Master requested assistance in rescuing the people, and both were rescued by a nearby Coast Guard small boat.*
- *The lifeboat commander told investigators that as the passengers were transferred to the Coast Guard vessel, he had to convince some passengers who were beginning to panic not to jump into the water. The transfer of all passengers and crew from lifeboat no. 3 took about an hour and a half to complete.*

7.3.8 Impact of ship design and layout

Following design / layout aspects have impacted the evacuation:

- All lifeboat release hooks had been replaced during the shipyard maintenance period in Tunisia. The new hooks were "U-Hook" release systems designed and installed by Bianchi & Cecchi Service Inc. (BC Service). The hooks were replaced to comply with a recently implemented SOLAS regulation that was enacted to reduce the number of accidental releases of lifeboats. Each U-Hook included a "recovery pin" that prevented the hook from inadvertently releasing when the boat was hoisted after inspections and drills. The previous hook arrangements did not include this design feature (National Transportation Safety Board (NTSB), June 5, 2018)

7.3.9 Adequacy and infrastructure of the LSA and safety equipment

Lifeboats no. 1 and no. 2, located on the starboard and port side of the vessel, respectively, were a partially enclosed lifeboat design constructed of glass-fiber-reinforced plastic (GRP), with a capacity of 150 persons. Lifeboat no. 3, located on the starboard side, was a fully enclosed lifeboat design constructed of GRP, with a capacity of 70 persons. From March 26 to July 3, 2016, the Caribbean Fantasy completed a shipyard period in Menzel Bourguiba, Tunisia. During this period all lifeboat release hooks were replaced in compliance with revised regulations under the

International Convention for the Safety of Life at Sea (SOLAS). The hooks, which were installed on each of the vessel's three lifeboats, attached the boats to the falls (wire ropes) on the gravity davits. The hooks for each boat were designed to be released via a mechanism inside the boat once it was lowered to the water. At the completion of the shipyard period, the Caribbean Fantasy departed the facility without conducting sea trials or testing of major systems to ensure proper operation. On June 22, 2016, the three lifeboats were examined and tested. A surveyor employed by the shipyard and authorized to carry out the exams documented his findings in a service report for each lifeboat. The reports noted that the examinations and operational tests were conducted in compliance with SOLAS regulation and included an operational test of all the lifeboat hook releases, running the lifeboat engines for 3 minutes, and making sure each lifeboat bilge pump operated.

During the yard period in Tunisia, Caribbean Fantasy received 14 new liferafts. All starboard-side liferafts were replaced with rafts inspected for service in June 2016, except for life raft no. 21 inspected in May 2016. Portside rafts 2, 4, and 6 were replaced with new rafts inspected in June 2016. Because of travel warnings for Tunisia, authorized VIKING technicians did not travel to the shipyard to install the new rafts and integrate them into the MES system. Instead, shipyard employees who were authorized to carry out the work by the classification society installed the raft containers on the racks. VIKING was not consulted in this arrangement. The portside liferafts that had not been replaced were due for inspection in August 2016. On August 10, 2016, the Panama Maritime Authority issued a letter authorizing a 3-month extension of the inspection deadline for those portside rafts until November 18, 2016.

None of the LSA systems functioned faultlessly:

Starboard MES (National Transportation Safety Board (NTSB), June 5, 2018):

- At 0818, the staff captain at the starboard-side MES station reported to the bridge that the "line is broken," referring to the MES's bowsing line. The bowsing line was a rope that ran from the MES platform to a winch on the ship. It was designed to adjust tension on the slide and platform, thereby enabling the system to be in the best position for use.
- the Master turned his attention to the starboard MES, ordering all 11 starboard-side liferafts inflated. He then ordered the staff captain to assign a crewmember to go down the slide and work on gathering the rafts around the platform. The staff captain responded that the slide was not opening as it should and, if anyone was sent down, an accident could result. The Master told the staff captain that from his view on the starboard bridge wing the slide looked fine and that the staff captain should send a crewmember down.
- A crewmember went down the slide and, once he was on the platform, attempted to pull the liferafts alongside. When integrated with the MES, the liferafts should have remained in their containers when they were released to the water. The rafts that had dropped from the starboard side had inflated, however, and it was difficult to pull the rafts to the platform by hand in the winds and seas. Consequently, the Master made multiple requests for the Coast Guard to position the rafts at the platform using their boats. The deck cadet also requested that all vessels near the Caribbean Fantasy pick up any liferafts and bring them to the platform for the embarkation of passengers.
- According to Coast Guard records, the first report of people going down the starboard-side slide was at 0853. However, at 0906, the Master observed that there were not enough rafts at the MES platform. He ordered the staff captain to hold off on sending any passengers down and to send only crew down to help pull the liferafts to the platform.
- By 0912, liferafts had been pulled alongside the MES platform, but the large openings in the raft canopies that allowed for mass boarding were facing away from the platform. With the smaller opening facing the platform, the loading process was slowed. The Master contacted the Coast Guard by radio and requested assistance with the raft alignment. After some confusion due to the Master's accent and use of unfamiliar terminology, the OSC responded that assistance would be provided to help turn the liferafts.

Portside MES (National Transportation Safety Board (NTSB), June 5, 2018):

- the slide angle was too steep ("near vertical," according to the staff captain) for passengers and crew to slide down (see Figure 5 2). The Master also requested that a vessel pull the MES platform forward (toward the Caribbean Fantasy bow) to make a better angle for the slide, noting that there were injuries because of the existing steep angle. About 1009, a Coast Guard small boat attached a line from its bow to the MES platform. Operating in astern propulsion, the small boat pulled the platform forward as requested by the Master. (see

Figure 5 3). About 2 minutes later, upon seeing an improvement in the angle of the slide, the Master ordered the staff captain to send the remaining passengers and crew down.

- When interviewed, the staff captain told investigators that he activated the remote releases for the liferafts on the port side of the ship before proceeding to the starboard side. However, only 1 of the 12 liferafts dropped from the port rack to the water.

Lifeboat 1 (National Transportation Safety Board (NTSB), June 5, 2018):

- the commander of lifeboat no. 1, which was now in the water, reported that he was unable to release the hooks that connected the boat to the davit falls (wire ropes). The Master replied, “The release works; you don’t know how it works, but it works.” The lifeboat no. 1 commander was then given instructions over the radio to break the clear plastic cover on the hooks’ release mechanisms, which was an override procedure for the hooks’ hydrostatic interlock systems
- The lifeboat no. 1 crew eventually freed the boat from the hooks by removing each lifting eye from the closed hook by hand. The crew then attempted to clear the boat away from the ship, but, according to the first engineer who was on board, the engine started but did not have any thrust. The lifeboat was also taking on water, so one of the arriving tugboats, the Diane Moran, transferred the passengers and crew to the deck of the tugboat. The empty lifeboat no. 1 was later towed into San Juan harbour by the Coast Guard.

Lifeboat 2 (National Transportation Safety Board (NTSB), June 5, 2018):

- Once lifeboat no. 2 was lowered to the embarkation deck, there was a gap between the lifeboat and the ship’s side because the ship was listing about 4 degrees. This gap was too wide to embark passengers, so the crew hoisted the boat back up and adjusted the forward and aft bowsing/tricing gear to the correct length and tension of the gear. (Bowsing/tricing gear is designed to pull in and hold the boat against the side of the ship at the embarkation deck for conditions of ship movement or list.) While this was taking place, the Master directed crew and passengers at the embarkation station for lifeboat no. 2 to go to the embarkation station for lifeboat no. 1 and board that lifeboat. When lifeboat no. 2 was lowered back to the embarkation deck, the gap was closed.
- Once the problem with the gap was resolved, the Master was informed that the boat’s commander (the third officer) and first engineer were missing. (Both had moved to lifeboat no. 1 as directed by the Master while the gap at the lifeboat no. 2 embarkation station was corrected.) In response, the Master directed the chief engineer via the ship’s internal radio to have someone from the engine crew go to lifeboat no. 2; he did not receive a reply. The second officer (on watch) then called the third officer, who was now on the starboard side, and directed him back to lifeboat no. 2.
- At 0837, the Master gave orders to lower lifeboat no. 2. According to the commander of the boat, once lifeboat no. 2 was in the water, he was unable to open the hooks using the release handle, so the crew had to manually remove each lifting eye from the closed hook by hand. When clear of the blocks and the ship, lifeboat no. 2 was escorted under its own power by a Coast Guard small boat into the port of San Juan. The commander estimated he had 105 passengers on board, together with 4 crew.

Lifeboat 3 (National Transportation Safety Board (NTSB), June 5, 2018):

- The Master then ordered the crew to prepare lifeboat no. 3. Upon hearing the order, the second officer (on watch) asked who should command lifeboat no. 3, because he was the assigned commander. In response, the Master ordered the second officer (off watch) to take lifeboat no. 3. The second officer (on watch) stated over the radio that he would then take lifeboat no. 1.
- Although directed to command lifeboat no. 3, the second officer (off watch) boarded and took command of lifeboat no. 1, the boat he was originally assigned to.
- Passengers and crew lined up on deck 7 aft of lifeboat no. 3 as it was prepared for embarkation. However, embarkation of the boat was delayed because there was no commander for the boat. Consequently, the Master ordered the second officer (on watch) to go to lifeboat no. 3. From then on, only the Master and the cadet remained on the bridge.
- At 0847, the Master ordered lifeboat no. 3 to be lowered when ready. About 6 minutes later, when the boat was in the water, the boat commander reported that the crew was unable to open the release hooks. In response, the Master ordered the commander to try to release the hooks manually. At 0854, the commander

informed the Master he could not manually release the hooks, and, after all attempts to release the hooks failed, the commander reported that the boat was getting damaged from waves pushing it against the Caribbean Fantasy's side.

- About 0916, the crew hoisted lifeboat no. 3 back out of the water. During the hoist, the winch tripped off line, leaving the boat suspended about 6 feet above the water. (The prime mover for the winch was designed to lift the lifeboat with a crew of six only and not a fully loaded lifeboat.19) With the boat hanging at the ship's side and unable to be lowered, none of the Coast Guard small boats were able to be effectively positioned to remove people from the lifeboat. The Master, who was monitoring this from the starboard-side bridge wing, requested assistance from the Coast Guard ATON boat, which had a higher freeboard (nearly 6 feet). The OSC responded by directing the ATON boat to lifeboat no. 3. About 1000, the ATON boat began extracting people from the lifeboat, a process that was slowed by the height of the lifeboat and the motion of the vessels in the seas. The lifeboat commander told investigators that as the passengers were transferred to the Coast Guard vessel, he had to convince some passengers who were beginning to panic not to jump into the water.

Figure 7-2 LB3 suspended about 6 feet above the water

Source: https://gcaptain.com/fire-out-on-caribbean-fantasy-ferry-in-puerto-rico-damage-photos/

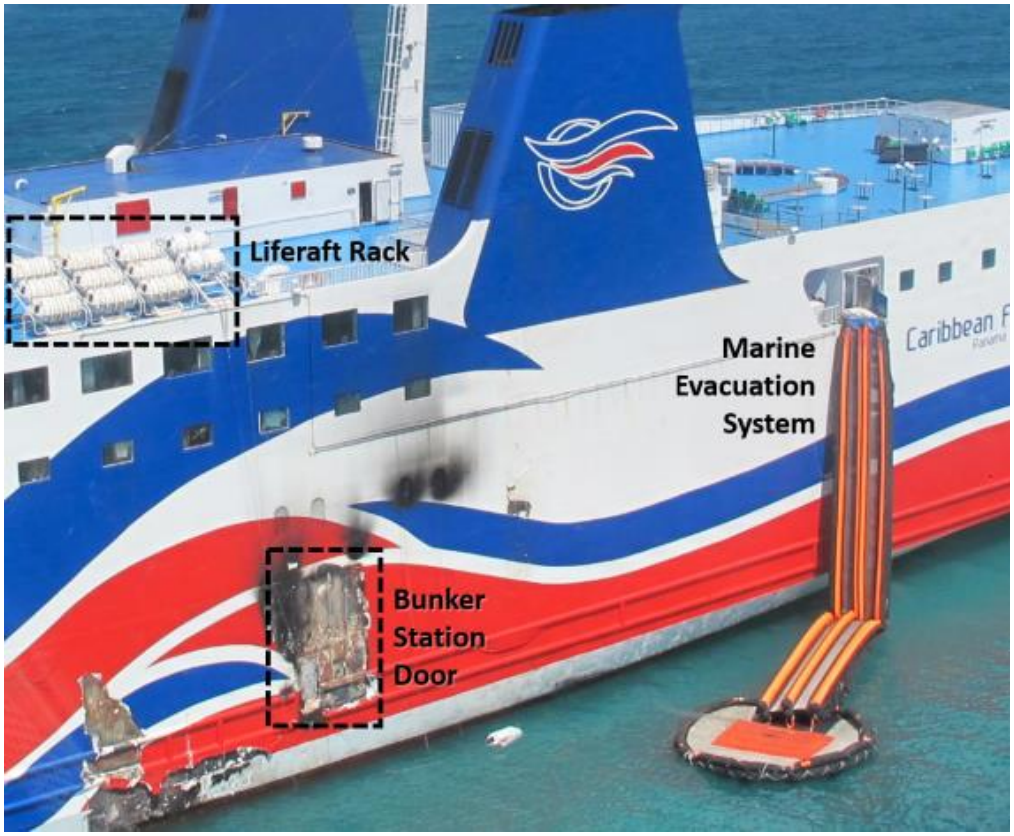

Figure 7-3 Situation of the portside MES (Ministry of Infrastructure and Transport, Final Report)

Figure 7-4 Coast Guard vessel assisted with towing the MES (Warren, Winter 2020)

In the aftermath of the event following was found out (National Transportation Safety Board (NTSB), June 5, 2018):

- The VIKING team could not determine why some of the liferafts were “floating around, not connected with the connection lines.” The team noted that the rafts were not installed by an authorized VIKING service technician and offered two possible causes: the rafts were not connected correctly during installation or there was “incorrect handling by the crew during evacuation.”
- The commanders for all lifeboats reported that during the abandonment they were unable to open the release hooks. When the lifeboats were lowered to the water, the hydrostatic interlocks should have disengaged, allowing the hooks to open when the lifeboat commander rotated the release handle. Failing that, the crew could have broken the clear plastic cover on the release control unit (RCU), manually disengaged the hydrostatic interlock, and opened the hooks using the release handle. The operations manual provided a final option of opening the hooks by means of designated wrenches. Evidence indicates that back-up options were not attempted on any of the boats, and lifeboats no.1 and no. 2 were released only after the crew employed a dangerous manual method of releasing the lifting ring from each hook.
- Evidence from lifeboat no. 3 indicates that the safety pin in the RCU was not removed and recovery pins in the hooks were in the inserted position, both of which would have prevented the boat’s release. Investigators and the hook manufacturer examined the hooks after the accident and concluded that they were functional at the time of the accident. According to the commander of lifeboat no. 3, the pins were put in the recovery position prior to the attempted hoist of the lifeboat back to the embarkation deck. It could not be determined if the pins were in the stowed or recovery position prior to the boat being lowered.

Summary: the deployment of the LSA was accompanied by numerous breakdowns on both the technical and the operational side. Due to the proximity to the port, numerous external rescuers were quickly on hand to assist with the evacuation. In case the accident had happened far off the coast, the outcome would have been much worse.

7.3.10 Effectiveness of evacuation procedures

Of the 511 persons on board 8 persons (1.6%) have been evacuated by helicopter (National Transportation Safety Board (NTSB), June 5, 2018), approximately 309 (60.5%) by lifeboats and the rest (approx. 194 persons = 38%) by MES.

The Spanish-language announcement to abandon the Caribbean Fantasy was made at 07:47 (National Transportation Safety Board (NTSB), June 5, 2018) . The last person removed from lifeboat no. 3 that was suspended from the side of the vessel was about 11:30 (National Transportation Safety Board (NTSB), June 5, 2018), 3 hours and 43 minutes after the abandon-ship order was given.

The average duration of the evacuation was 26 s / person (511 persons in 3:43 hours).

The duration of 3:43 hours is exceeding the SOLAS regulation that requires all survival craft needed in a full abandonment be launched with their full complement of persons and equipment within a period of 30 minutes from the time the abandon-ship signal is given.

The investigation report (National Transportation Safety Board (NTSB), June 5, 2018) states that the abandonment was significantly delayed by the crew’s lack of training on the lifesaving equipment and unfamiliarity with the abandonment process. Although all passengers survived the accident, the NTSB concludes that the abandonment process on board the Caribbean Fantasy was disorganized and inefficient.

Given the chaotic abandonment process on board the ship, the safe recovery of the passengers and crew is proof alone that the mass rescue operation (MRO) (“the largest rescue operation in U.S. waters in 60 years” (Warren, Winter 2020)) was successful. Sufficient response vessels and aircraft responded to the scene, an on-scene coordinator directed the actions of most response assets, a shoreside receiving area for the management and care of the survivors was established, and most importantly, all passengers and crew were evacuated from the vessel.

Summary: In summary, it can be said that the fortunate outcome of the accident was mainly due to the proximity to the port, the daylight, the favourable weather conditions and the rapid and numerous interventions of the Coast

Guard. In addition, it should be mentioned that the Master acted confidently despite the numerous problems with the fire and the LSA. Finally, the NTSB concludes that the mass rescue operation was effective /8/.

7.3.11 Communication and dissemination of information

Most of the crew and passengers spoke Spanish.

The working language on board was English: *The Baja Ferries' SMS established English as the working language for the Caribbean Fantasy and stated that "all crew members must be able to communicate between each other, read, hear and understand [International Safety Management (ISM)] instructions."* (National Transportation Safety Board (NTSB), June 5, 2018). According to the DPA, the company was having problems with crewmembers, primarily the hotel staff, not "communicating sufficiently in English. […] Some of the officers and crewmembers who had a record of a passed English proficiency exam stated during on-scene interviews that they could not speak English and required a translator. Most of the crew and passengers spoke Spanish, yet instructions for emergency equipment and procedures were primarily in English. Moreover, upon examination of the vessel, investigators found multiple cases of drawings, instructions, placards, and emergency equipment manuals in other languages. The Master, the Staff captain and the chief engineer did not speak or understand Spanish (National Transportation Safety Board (NTSB), June 5, 2018).

Investigators found two different versions of the emergency plan and station bill on board the Caribbean Fantasy following the accident. A plan found posted in the engine control room was stamped "approved" by the vessel's classification society, and dated February 2, 2016.21 Another plan found on the bridge was stamped "provisionally approved" and dated July 3, 2016 (the date that the vessel left the Tunisian shipyard). The two plans differed significantly, with variations in survival craft assignments, code words and signals, and emergency duties of crewmembers. For example, the code for a fire emergency in the February plan was "red-red-red," while the code for the same emergency on the July plan was "Mr. Skylight."

7.3.11.1 Internal

Crew internal

- Crew call using codeword "Mr. Skylight" at 07:27 via PA (18 minutes prior to General Alarm)
- Bridge team: According to both the Master and the deck cadet, three languages were spoken on the bridge of the Caribbean Fantasy: English, Spanish, and French. The cadet explained that the only time languages other than English were spoken on the bridge was when the discussion related to personal matters. However, according to the vessel's VDR audio, all three languages were being spoken on the bridge during the accident sequence (National Transportation Safety Board (NTSB), June 5, 2018).
- While the Master was on the radio, the second officer (on watch) used the ship's internal radio to inform the safety officer that they needed to know when all persons were evacuated from the engine room in preparation for using the CO_2 fixed firefighting system (National Transportation Safety Board (NTSB), June 5, 2018).

Towards passengers

Communication towards passengers was affected by language issues:

Instructions for passengers were in languages unfamiliar to the predominantly Spanish-speaking travellers and were obsolete. For example, passenger emergency instructions in case of fire shown on a placard on the back of a deck 6 cabin door were in English and Italian and conflicted with the approved emergency plan and station bill. The signal for a major fire on the placard was "two long blasts followed by the alarm bells," whereas the emergency plan and station bill had no specific signal to inform passengers of a fire. In another example, lifejacket donning instructions found posted on board were in Japanese and English and provided directions for lifejackets no longer in use aboard the Caribbean Fantasy.

During the accident, the Master directed a cadet to make the initial announcement in English, which he did. The second officer then made an announcement in Spanish. The Master's intended announcement, given by the cadet, directed passengers to follow the instructions of the crew. However, the second officer's Spanish announcement stated that the fire was out of control and that a decision was made to abandon ship. Because the Master did not speak Spanish, he did not realize that the abandon-ship announcement was being made at that time.

7.3.11.2 External

The role of On Scene Coordinator (OSC) was taken over by Coast Guard cutter Joseph Tezanos but Caribbean Fantasy was not informed about Joseph Tenzanos' role.

- Using VHF channel 16, the OSC aboard the Coast Guard cutter Joseph Tezanos communicated with the Master of the Caribbean Fantasy in English, while communicating with some of the other response vessels in Spanish. At one point, as recorded on the Caribbean Fantasy's VDR, the Master said over the radio, "please speak English!" as he did not understand what was being said and did not know who was speaking to whom. The cadet stated in his interview that he attempted to assist the Master with communications because internal and external communications were on two different VHF channels and "it was not easy to revert." (National Transportation Safety Board (NTSB), June 5, 2018)
- The Joseph Tezanos commanding officer assigned dedicated personnel to handle radio traffic on the internal Coast Guard frequency, various VHF radio channels, and a radio channel for aircraft. He also established a 15-minute communications schedule with the Sector San Juan command centre using a Coast Guard cell phone, and he assigned an individual to record the event using the vessel's surveillance camera system.

7.3.12 Gaps and lessons learned

With regard to LSA and evacuation following can be learned from the Caribbean Fantasy accident (National Transportation Safety Board (NTSB), June 5, 2018):

- Crewmembers assigned to safety-critical roles on the lifeboats were not proficient with the procedures for opening the lifeboat release hooks, which delayed the abandonment and put lives at risk.
- The crew assigned to deploy the marine evacuation system and liferafts were not adequately trained, which delayed the abandonment
- The crew did not follow the manufacturer's procedures when launching the starboard marine evacuation system liferafts, which resulted in the premature inflation of the liferafts.
- The five ankle injuries resulted from using the marine evacuation system deployed at a steeper angle than designed.

With regards to topics other than evacuation / LSA following learnings are listed in the investigation report (National Transportation Safety Board (NTSB), June 5, 2018)

<u>Quick closing valves</u>

- Use of improper gasket material on the pressurized fuel supply end flange for the port main engine resulted in a breakdown of the gasket material and the eventual fuel spray that led to the fire.
- The nonstandard blanking plate used on the end flange of the port main engine fuel supply system potentially exacerbated the leak that led to the fire.
- Bolts inserted by Caribbean Fantasy engineering personnel into the quick-closing valves to prevent their closing were permanently in place for use during routine operations.
- The uninterrupted flow of fuel to the fire from the blocked-open quick-closing valves allowed the fire to exceed the design criteria of the structural fire protection for the engine room, and as a result the fire spread to the garage deck above.
- Testing during recent class surveys and port state control examinations did not adequately test the full functionality of the quick-closing valves.
- Lack of adherence to manufacturer's guidance and proper machinery maintenance procedures contributed to the fire aboard the Caribbean Fantasy

<u>Fire fighting</u>

- The water-mist fixed firefighting system did not suppress the fire likely due to the simultaneous activation of multiple coverage zones and a reduced water supply as a result of drencher system activation.
- The carbon dioxide fixed firefighting system did not extinguish the fire due to ventilation dampers that failed to properly close.

<u>Others</u>

- The company failed to successfully implement its safety management system, both ashore and on board the Caribbean Fantasy.
- Baja Ferries possessed a poor organizational safety culture, as evidenced by management's lack of commitment to core safety programs and it disconnect from the training, maintenance, and operations on board the Caribbean Fantasy
- The recognized organization, RINA Services, failed to meet its responsibilities, on behalf of the Panama Maritime Authority, to ensure that the Caribbean Fantasy met and remained in compliance with international and statutory requirements

Following Recommendations are given in investigation report (National Transportation Safety Board (NTSB), June 5, 2018):

With reference to evacuation / LSA:

To US Coast Guard

- Evaluate the feasibility of creating a passenger vessel safety specialist billet at each sector that has the potential for a search and rescue activity characterized by the need for immediate assistance to a large number of persons in distress, and staff sector-level billets, as appropriate, based on the findings of that evaluation

To Baja Ferries S.A. de C.V.

- Review your lifesaving appliance training program, including recordkeeping procedures, and revise the program to ensure that crewmembers have proficiency with onboard systems.
- Provide formal and recurrent training to shoreside management and senior shipboard officers on the International Safety Management (ISM) Code to ensure that all senior leaders are fully knowledgeable about the policies and procedures in the safety management system.

With reference to topics other than evacuation / LSA

To US Coast Guard

- Require operators to perform full function tests of quick-closing valves during inspections and examinations, ensuring that the associated systems shut down as designed and intended

To Baja Ferries S.A. de C.V.

- Perform a worst-case scenario risk assessment for all active water-based fire suppression systems on your vessels to evaluate whether the existing freshwater supply is sufficient.

To classification society:

- Require operators to perform full function tests of quick-closing valves during surveys, ensuring that associated systems shut down as designed and intended
- Review the performance of auditors who conducted either International Safety Management Code document of compliance audits at Baja Ferries S.A. de C.V. or safety management certificate audits on the Caribbean Fantasy to ensure that their individual actions met the intent of class society's rules and guidance.

To IACS

- Encourage all member organizations to require operators to perform full function tests of quick-closing valves during surveys, ensuring that associated systems shut down as designed and intended

To the Panama Maritime Authority

- Review the performance of classification society, acting on behalf of the flag-state administration, to determine whether the classification society is meeting International Maritime Organization guidelines.

- Review actions taken as the flag state of the Caribbean Fantasy and revise procedures to ensure future actions meet the intent of International Maritime Organization guidelines.

7.3.13 Issues (related to evacuation and LSA) not addressed in the investigation report:

- The causes of the problems with opening the hooks and with the MES slide alignment could not be conclusively clarified
- The report does not discuss why LB 1 and 2 have not been used with their full capacity. LB 1 and 2 were designed to accommodate 150 persons, according to the report LB 1 was lowered with 100 people on board and LB 2 with (estimated) 105 passengers and 4 crew.
- LB 3 was designed to accommodate 70 persons, according to the report LB 3 was lowered with "close to 100 pax". This inconsistency has not been addressed.

7.4 Summary

The evacuation of Caribbean Fantasy was characterized by problems with the vessel's LSA: none of the three lifeboat crews could release the hooks from their falls when the boats first entered the water. The crews in lifeboats no. 1 and no. 2 were only successful when they attempted the last-resort procedure for releasing the hooks. The crew in lifeboat no. 3 was never able to release the hooks. The crew was not familiar with the use of MES. The Master managed to overcome most problems by quick decisions and support from the Coast Guard vessels. It seems that he has never lost the overview and he never gave up. The procedures were not fully followed, as no complete assembly of persons has been performed.

Most important take-aways: Crew must be familiarized with the LSA, updates of LSA must be well explained and trained. In case the accident would have happened far from the shore or in adverse weather conditions and the Coast Guard would not have been at the scene so quick, the accident would have turned into a disaster.

7.5 References

Following references have been used for the review:

- National Transportation Safety Board "Fire aboard Roll-on/Roll-off Passenger Vessel Caribbean Fantasy, Atlantic Ocean, 2 Miles Northwest of San Juan, Puerto Rico, August 17, 2016 (National Transportation Safety Board (NTSB), June 5, 2018)
- Capt. R. W. Warren: "The Caribbean Fantasy Fire and Grounding" The Coast Guard Journal of Safety and Security at Sea, Winter 2020 (Warren, Winter 2020)
- Youtube video: (unedited video) Caribbean Fantasy Cruise Ship Fire (Youtube, assessed 2025-01-15)

8. Viking Sky

8.1 The vessel

Viking Sky (IMO Number 9650420) is a Norwegian flagged cruise vessel built at Fincantieri shipyard in Italy, delivered in January 2017. She is designed for 930 passengers and 550 crew. Her main particulars are given in Table 8-1.

Figure 8-1 Photo of Viking Sky (Norwegian Safety Investigation Authority, March 2024)

Table 8-1 Main Particulars of Viking Sky

Length over all	228.3 m
Length between pp	195.5 m
width	28.8 m
draught	6.67 m
Gross tonnage	47,842 gt
Max. speed	20 knots

Viking sky was equipped with following LSA:

- 4 lifeboats for 235 persons each
- 2 lifeboats for 150 persons each
- 19 liferafts for 35 persons each
- 2 rescue boats

8.2 The accident

The Viking Sky incident which occurred on 23rd March 2019, when the cruise vessel experienced a blackout during a storm while voyaging of the Norwegian coast. With 1,374 persons on board, the vessel came within a ship's length of running aground. The incident began at 13:58 when the cruise vessel encountered strong winds from S to SW (BF7 to BF10) and heavy seas (significant wave heights up to 7 m). The vessel had left the port with one out of four diesel generators unavailable and therefore without the redundancy required under Safe Return to Port (SRtP) regulations. All three operational diesel generators shut down due to low lubricating oil pressure. The blackout caused loss of propulsion and steering.

Upon blackout, the crew initiated emergency procedures. The Master immediately sent out a Mayday signal at 14:00 local time (UTC+1) and instructed the crew to drop the anchors, but they did not hold and it continued to drift. Despite measures to fix the storage of lubrication oil, the engine faced challenges in restarting and connecting engines to main switchboard and complexity of the control system actions required. The general alarm was activated by 14:13 and passengers and crew began to muster at designated assembly stations.

The emergency management practices on board the Viking Sky were guided by the ship's Safety Management System (SMS) and the Decision Support System for the Master. The investigation revealed that while blackout drills had been carried out, recovery from full blackout without a standby generator had never been drilled on board. This lack of guidance and training contributed to the time-consuming recovery process during the incident. At the time of the occurrence, the Master sent out a mayday signal and instructed crew on counter measures and fixing the problem

at hand. The Master communicated with the onshore organisation and kept the passengers informed over the PA system. The general alarm was activated at 14:13 and passengers and crew were called to muster stations. The helicopter evacuation was initiated, and the first helicopter arrived at 15:03 and the evacuation was conducted well despite the challenging conditions.

The Viking Sky was equipped with lifeboats and liferafts, but the Master considered the weather too rough to lower the lifeboats and liferafts. He hence decided to evacuate passengers by helicopter. This was carried out effectively and without any accidents or casualties.

The accident investigation report by the Norwegian Safety Investigation Authority (Norwegian Safety Investigation Authority, March 2024) proposed 14 safety recommendations with following (summarized) content:

- Lube oil sump tanks to be designed and built in compliance with SOLAS regulations and class rules
- Maintain adequate lubricating oil levels to ensure continuous generator operation, their management and overall compliance to safe operation of systems under dynamic inclinations
- An engine room alarm management performance standard to be developed
- VDR performance standard is amended to also include recording of sounds from the engine control room

Some additional comments also translate to improving the following safety practices:

- Conduct regular and comprehensive training for blackout recovery procedures.
- Ensure strict compliance with Safe Return to Port (SRtP) and SOLAS regulations
- Prepare well for emergency situations with clear communication and coordination

The Viking Sky accident highlights critical safety issues related to insufficient lubricating oil that led to a blackout and near grounding in a storm. Key recommendations include ensuring compliance with SOLAS regulations, improving alarm management systems, and enhancing crew training for emergency situations.

8.3 In-depth review

8.3.1 Root causes and contributing factors

The accident was caused by insufficient lubricating oil in all of the operating diesel generators' lubricating oil sump tanks, in combination with pitching and rolling in rough seas. The investigation has identified operational, technical, and organisational safety issues that in different ways contributed to the blackout (Norwegian Safety Investigation Authority, March 2024):

- Insufficient training:
  - Blackout drills had been carried out, but recovery from a full blackout without a standby generator had never been drilled on board. The engineers were therefore faced with a situation they were not practised in managing
  - Oil low level alarms not followed up
- One of the four diesel generators (DG) unavailable prior to departure
- Weather: storm force (BF10) winds 25 m/s from southwest with gusts up to 30–35 m/s and wave heights up to 8–11 metres

8.3.2 Adherence to international, EU, and national safety regulations

According to the investigation report (Norwegian Safety Investigation Authority, March 2024) the vessel was not in compliance with following regulations:

- Five days prior to the departure from Tromsø, DG3 became unavailable due to a turbocharger failure, rendering the vessel non-compliant with the Safe Return to Port (SRtP) regulations.
- the lube oil sump tank design was noncompliant with the SOLAS regulation.

8.3.3 Evacuation procedure

After the General Alarm (at 14:13, 15 minutes after the black out) the passengers were mustered in two assembly stations. As the use of LSA was seen to dangerous the evacuation via helicopters started at 15:20. After the airlifting of 460 passengers the evacuation was stopped at next morning at 09:15 as the vessel was free of the coast making headway and was connected to two tugboats.

Since the helicopters were unable to land on the ship, the passengers had to be evacuated by means of a rescue hoist (dsb Norwegian Directorate for Civil Protection, 1 September 2021). A total of six rescue helicopters were involved in the evacuation. The operation was performed as a series of continuous airlifts by helicopters that flew back and forth between a hold position, Viking Sky and the onshore reception centre located only about 2 km away where they delivered the rescued passengers and refuelled. The operation was therefore organised in a way that ensured full utilisation of resources. Injured passengers were hoisted up together with a rescue crewman. Many of the other hoist operations were carried out as tandem lifts to save time and increase capacity (Norwegian Safety Investigation Authority, March 2024). The pre-defined and primary area for receiving helicopters and hoisting passengers was on the port side of deck 8. An additional space for evacuation was considered in order to increase capacity by allowing two helicopters to perform the hoist operation simultaneously, but this was considered too risky due to the weather and the vessel's movements (Norwegian Safety Investigation Authority, March 2024).

All passengers and crew survived the incident, 19 injuries to passengers during the event have been registered, on of which was regarded as serious.

8.3.4 Decision making

The situation of Viking Sky was mainly influenced by following decisions made:

1. The decision to sail

   The investigation report (Norwegian Safety Investigation Authority, March 2024) concluded, that the decision to sail was wrong. As Viking Sky did not comply with the applicable safety standards, it should not have departed Tromsø under the prevailing circumstances.

   - None of the decision makers on board, including senior officers on the bridge and in the engine department, have mentioned any concern related to SRtP. None have reported that not leaving port was an option. The reason for this, and for the limited support from the organisation on shore is not known, but there are several possible contributing factors.

   - The organisation on shore had not sufficiently implemented the SRtP regulations into the safety management system to support the crew making decisions on board.

2. In preparation for the expected weather conditions the Master ordered the checklist B10 "Navigation in heavy weather" to be completed. The list included an item on optimising the DG lube oil sump tank levels (Norwegian Safety Investigation Authority, March 2024).

   - Even though the heavy weather checklist was logged as completed, and despite the fact that low lube oil level alarms went off both for DG2 and DG4 during the voyage southbound from Tromsø, no oil had been transferred into the DG sump tanks in the days preceding the accident (Norwegian Safety Investigation Authority, March 2024).

3. First low lube oil sump tank level alarms (at 01:11, 05:02, 07:04 and 09:04) have been acknowledged with no further action taken by the engineer on watch.

4. Decision to evacuate the passengers

   The decision to evacuate the passengers was made 28 minutes after the black-out as the vessel was not under command and drifting towards the shore in heavy weather.

5. Decision not to use ship's LSA

   The Master, supported by the pilots, considered it too dangerous to evacuate the passengers and crew in the vessel's lifeboats or by transfer to other vessels (Norwegian Safety Investigation Authority, March 2024).

Summary: The decision-making after the blackout was fast and straightforward. The Master was immediately aware of the seriousness of the situation:

- 2 minutes after the blackout the vessel sent out Mayday.

- 15 minutes after the blackout the General Alarm was sounded
- 28 minutes after the blackout the decision to evacuate the vessel was made.

The timing of the decision to evacuate is not discussed within the available documents. Taking into account the circumstances it seems reasonable as the Master first had to gain an overview of the situation, lower the anchors (which did not hold) and give the engineer time to restart the DGs (which failed in the beginning).

The decision not to deploy the ship's LSA is not judged within the available documents. As it was a precautionary evacuation the decision of the Master is comprehensible. The wave height (4 to 6 m) and the chance to be pressed onto the nearby rocky lee shore by the strong offshore winds (BF9) would have made the use of lifeboats and life rafts risky. According to the investigation report the decision was supported by the pilots.
The LSA code (section 6.2.2.1.7 (LSA Code International Life-Saving Appliances Code, 2020)) provides following requirements regarding the weather limits for MES: "*A marine evacuation system shall be capable of providing a satisfactory means of evacuation in a sea state associated with a wind of force 6 on the Beaufort scale*". For lifeboats no such requirements are available.

As all persons on board survived the incident it can be concluded that the decision was at least not wrong.

8.3.5 Response time

The following table shows the timeline of events for the Viking Sky incident.

Table 8-2 Viking Sky (VS) accident - timeline of events

Time (UTC+1)	Δt [h:min]		
	From initial event	From General alarm	
13:17		-00:56	Heavy weather checklist completed
13:37			Alarms on DG4 low lube oil pressure and automatic load reductions (Cleared)
13:40			Alarms DG1 Low lube oil (cleared)
13:45			DG4 shut down
			DG2 shut down (seconds later)
			Chief engineer down at ECR
13:56			DG2 restarted
13:58	**00:00**	-00:15	DG1 & DG2 shut down Blackout, loss of propulsion and steering
			Emergency diesel generator started and power to emergency switchboard established
14:00	+00:02	-00:13	Mayday sent out
14:13	+00:15	**00:00**	General Alarm, crew and pax began to muster
14:15		+00:02	KV Njord left Kristiansund and headed towards VS
14:22			DG2 restarted and connected to MSB
14:26	+00:28	+00:13	VS reported to JRCC that they wanted to evacuate pax asap
14:37		+00:24	Both propulsion motors operational, 1-5 knots ahead
15:00	+01:02	+00:47	First vessels arrive
15:00	+01:02	+00:47	Door to assembly station B damaged by wave impact
15:03	+01:05	+00:50	First helicopter above VS
15:20	+01:23	+01:07	First helicopter hoist

15:24			DG4 restarted
15:40		+01:27	First helicopter set down with evacuated pax
15:46			DG1 restarted
16:40		+02:27	Coast guard vessel KV Njord reached VS – role of OSC
17:05		+02:52	Tugboat Vivax arrived
17:20		+03:07	47 pax evacuated
18:08		+03:55	71 pax evacuated
19:45		+05:32	Decision to send tugboat Ocean Response to VS
20:29	+06:31	+06:16	Last stretcher case evacuated
00:00 (24.03.2019)		+09:47	180 pax evacuated
01:30		+11:17	192 pax evacuated
02:45		+12:32	Tugboat Ocean Response arrived
08:18	+18:20	+18:05	Towlines attached
09:15		+19:02	Master decided to stop helicopter evacuation, 460 pax evacuated
15:11	+25:13	+24:58	Mayday cancelled
16:25	+25:27	+25:12	VS moored in port of Molde

8.3.6 Crew preparedness and behaviour

The investigation report (Norwegian Safety Investigation Authority, March 2024) does not contain special information about crew's preparedness and behaviour during the evacuation process. None of the recommendations made in the report is related to crew training. Therefore, it must be assumed that the crew acted according to the procedures.

- The heavy weather checklist was recorded as completed in the deck logbook at 13:17. The checklist contained 44 items within the departments navigation and communication, stability and stress, engine room, accommodation and deck (Norwegian Safety Investigation Authority, March 2024)

Passengers praised the crew for their behaviour:

- "Crew was magnificent" ((Youtube video, assessed 2024-12-12), Min: 01:01), "Crew was amazing, kept calm, kept the pax calm, took care for the pax" ((YouTube, assessed 2024-12-12), Min 05:07).

However, one indication that the Viking Sky crew needed support might be derived from (Norwegian Safety Investigation Authority, March 2024):

- After a while, the crew of Rescue5 [helicopter] decided to position a rescue crewman on board the vessel to organise the rescue work and optimise the operation.

8.3.7 Passenger behaviour

In the investigation report (Norwegian Safety Investigation Authority, March 2024) it is mentioned that NSIA sent out a survey to passengers after the accident. Results of this survey are neither given in the report nor in other publicly available documents. Therefore, there are only a few facts about the behaviour of the passengers; some insights and impressions have been taken from following resources:

- In YouTube video "The Viking Sky cruise disaster: True terror on board" (Youtube, assessed 2024-12-12) passengers talk about their feelings and perception of the situation, they use words like: "panic (Min 04:40), "very frightened" (minute 04:42, 05:49), "dramatic" (minute 05:12). However, the pictures of the time of abandon ship alarm (minute 08:18) and the assembly stations (minutes 05:35, 06:16, 08:41, 09:57) and of

the queue of passengers waiting to be airlifted (minute 09:05) show a controlled situation and calm passengers.
- The YouTube video “Passenger describes being airlifted amid cruise ship scare” (YouTube, assessed 2024-12-12) show controlled situation during queuing for being airlifted (minute 02:01), “terrifying situation” (minute 04:20), controlled situation in muster station (minute 05:26).
- YouTube video “The Viking Sky Cruise Disaster: Vacation Turned Horror…” (YouTube, assessed 2024-12-12) : minutes 10:07 and 15:01 shows passengers in the assembly station B. Despite the water ingress passengers appear calm.

Summary: Summarizing it can be assumed that the situation on board was very scary for the passengers, but the crew managed to control the crowd.

8.3.8 Impact of ship design and layout

The design and layout of the ship indirectly impacted the mustering / evacuation process in the following ways:

- The Door to assembly station B was damaged by wave impact, water ingress into assembly station, large quantities of loose objects (assembly station B = dining room) and unsecured furniture (Norwegian Safety Investigation Authority, March 2024), pax had to be relocated to spaces in the atrium or Assembly station A.
- Lifeboat No. 3 and all LB davit control stations and lifejacket boxes on starboard side have been damaged by wave impact (Norwegian Safety Investigation Authority, March 2024).
- Only one hoisting area (port side, deck 8) was usable, secondary hoisting area (aft, Deck 7) was not usable (Norwegian Safety Investigation Authority, March 2024).

8.3.9 Adequacy and infrastructure of the LSA and safety equipment

Viking Sky had four lifeboats for 235 persons each, two lifeboats for 150 persons each and in addition 19 liferafts for 35 persons each which give a total capacity for the lifeboats/-rafts of 1,905 persons, equally distributed on each side (Norwegian Safety Investigation Authority, March 2024). The lifeboats were not lowered, as lifeboats were not considered a safe means of evacuation in such rough weather close to shore. Lifeboat No. 3 (standard size lifeboat, positioned on starboard, 2nd from bow) and all LB davit control stations and lifejacket boxes on starboard side have been damaged by wave impact.

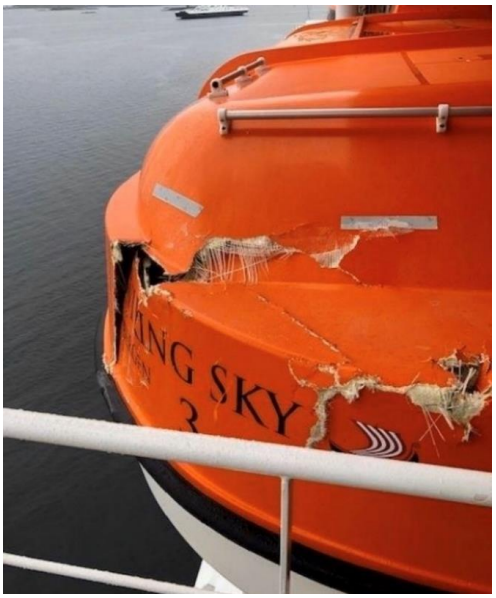

Figure 8-2 Damage to LB3 (Norwegian Safety Investigation Authority, March 2024)

8.3.10 Effectiveness of evacuation procedures

460 passengers (50.3% of the passengers initially on board) have been evacuated by helicopters. The first hoist was at 15:20 (01:20 after blackout), the Master decided to stop the evacuation at 09:15 the next morning. For the overall

rescue operation, the average time to evacuate each passenger is 2 minutes 20 seconds (dsb Norwegian Directorate for Civil Protection, 1 September 2021).

Even if "*the complex and extended helicopter operation was carried out effectively with no accidents or casualties, however both the first rescue helicopter and the first tug arrived after the vessel would have grounded if propulsion had not been regained*" ((Norwegian Safety Investigation Authority, March 2024)). This shows that "*helicopters cannot be counted upon to constitute an efficient means of evacuation, even if available in the vicinity, as they have insufficient capacity to evacuate the large number of people on board a cruise ship*" (Norwegian Safety Investigation Authority, March 2024).

Assuming the average evacuation duration of 2:20 minutes per person, the complete evacuation of the 1374 persons on board would have taken 53 hours and 26 minutes.

8.3.11 Communication and dissemination of information

There is no information about the nationalities of crew and passengers in the investigation report ((Norwegian Safety Investigation Authority, March 2024)), but in (dsb Norwegian Directorate for Civil Protection, 1 September 2021) it is stated that "*most of the passengers were English speaking*". An information about the working language is given in none of the used references.

According to the investigation report the communication was divided up as follows: *"One of the pilots took over communication with the JRCC and rescue personnel, and the staff captain-initiated preparations for helicopter evacuation of passengers. The Master communicated with the onshore organisation and kept the passengers informed over the PA system"* (Norwegian Safety Investigation Authority, March 2024).

8.3.11.1 Internal

Crew internal

- The means of crew internal communication are, with one exception, not named in the investigation report: "*Immediately after the shutdown of DGs 4 and 2, the engineer on watch informed the chief engineer by telephone*" (Norwegian Safety Investigation Authority, March 2024). No information is given about a potential pre-alarm for the crew.

Towards passengers

- The communication with the passengers happened via the PA System. The Master gave regular updates to the passengers and crew over the PA system, including information about the helicopter evacuation and that the lifts on board were not to be used. (Norwegian Safety Investigation Authority, March 2024)
- In a YouTube video passengers praised the crew: "*Crew was magnificent*" ((Youtube video, assessed 2024-12-12), Min: 1:01), "*Crew was amazing, kept calm, kept the pax calm, took care for the pax"* ((YouTube, assessed 2024-12-12), Min 05:07). From these statements it can be concluded that there was constructive communication from crew towards passengers.

None of the publications used mentioned deficits with regard to internal communication.

8.3.11.2 External

Viking Sky – shore/supporting vessels and helicopters

The external communication between Viking Sky and external actors was taken over by the staff captain and one of the pilots on board. The pilot took over communication with the JRCC and rescue personnel, and the staff captain initiated preparations for helicopter evacuation of passengers (Norwegian Safety Investigation Authority, March 2024).
On-Scene Coordinator Coast Guard vessel KV Njord communicates with other vessels in the area via VHF and remains in constant contact with the pilot and the Viking Sky Master (dsb Norwegian Directorate for Civil Protection, 1 September 2021).

During the incident, Emergency Network was used in addition to VHF. The Emergency Network is the national radio common communication frequency for the emergency services, JRCC, and other actors involved in emergency preparedness and coordination. The different actors remain in close contact with each other to coordinate and manage the situation in the best way possible. In addition to internal status meetings at JRCC-SN, there is continuous contact with the Police operations center, AMK (Emergency Medical Communications Center Alesund), and 110 Center. The Nødnett emergency network and VHF are used in addition to ordinary cell phones, email exchanges and logging. Additionally, JRCC-SN remains in frequent contact with the pilot and the Master on board Viking Sky, KV Njord, lying alongside, other vessels in the waters around Viking Sky, as well as Møre Approach via Avinor's liaison in JRCC-SN. The aircraft coordination function was performed by JRCC-SN through the rescue controller and an air traffic controller from Avinor. Initially, it was the rescue helicopter in Florø (CHC), and later Møre Approach, that were the link between helicopter resources and JRCC-SN. Owing to the limitations in common communication coverage (VHF Air 123.1 MHz) it was not possible for JRCC-SN to communicate directly with all helicopters (dsb Norwegian Directorate for Civil Protection, 1 September 2021).

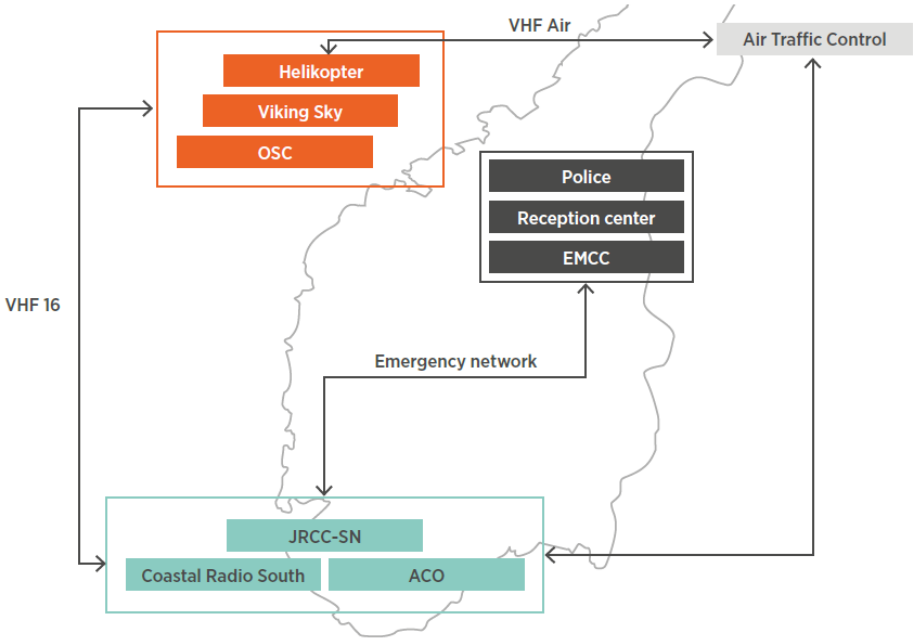

Figure 8-3 Use of communication platforms (dsb Norwegian Directorate for Civil Protection, 1 September 2021)

Figure 8-3 shows the different communication platforms used during the accident. In order to streamline the a joint understanding of the situation for all actors the report of Ministry of Justice and Public Security (Ministry of Justice and Public Security, 02/2022) recommends: "*The Norwegian authorities should therefore explore common digital communication platforms that also take into account the special challenges posed by incidents at sea. In the event of an incident with a larger cruise ship, it will often be necessary to use more helicopters. Good air coordination is then particularly important. Work on the concept of air coordination should therefore be intensified*."

In the aftermath of the incident, JRCC-SN identified a lesson learned related to transmitting the Mayday relay. The Mayday was sent out on many transmitters (VHF, CHF DSC46 and MF DSC47), and thus had a broad coverage area. It is not unusual for a Mayday relay to cover a smaller geographical area than a Mayday. (dsb Norwegian Directorate for Civil Protection, 1 September 2021)

Regarding the communication towards friends and family of the passengers the report of Norwegian Directorate for Civil Protection (dsb Norwegian Directorate for Civil Protection, 1 September 2021) stated that – regarding the communication "*there was too little communication in English. Most of the passengers were English-speaking. JRCC-SN sent out a tweet in English that was read by many. This is something JRCC-SN should have done more".*

Summary: No detailed information or problems regarding the internal communication on board of Viking Sky is given in the analysed sources. For external communication Emergency Network (the national radio common communication frequency for the emergency services) was used in addition to VHF. In the aftermath of the event it was recommended to streamline the communication by introducing common digital communication platforms.

8.3.12 Gaps and lessons learned

With regard to LSA and evacuation following can be learned from the Viking Sky accident:

- LSA (LB 3, LB davit control stations and lifejacket boxes), rescue boat and Assembly station door not able to withstand the weather
- LSA cannot be used in certain weather / ambient conditions
- Loose items and unsecured furniture in the Assembly Station (dining room) put the persons at risk.
- Helicopters cannot be counted upon to constitute an efficient means of evacuation, even if available in the vicinity, as they have insufficient capacity to evacuate the large number of people on board a cruise ship /15/

Following safety recommendations are given in (Norwegian Safety Investigation Authority, March 2024) and (Ministry of Justice and Public Security, 02/2022):

With reference to evacuation / LSA:

- The Norwegian authorities should actively take advantage of the opportunities provided by the satellite-based broadband development in the High North to provide new practical services within maritime safety, emergency preparedness and rescue. (Ministry of Justice and Public Security, 02/2022)
- The Norwegian authorities should explore common digital communication platforms including in the event of incidents at sea. (Ministry of Justice and Public Security, 02/2022)
- In cooperation with the cruise industry, the Norwegian authorities should establish requirements that the safety crew and other employees on board who play a key role in connection with evacuation from passenger ships operating in Svalbard, shall have a supplementary course in passenger and crisis management with a focus on the challenges in polar waters. (Ministry of Justice and Public Security, 02/2022)
- The Norwegian authorities should consider making the requirement in the International Convention for the Safety of Life at Sea (SOLAS) for SAR cooperation plans applicable to passenger ships that are not certified for international travel, and which operate in Norwegian territorial waters. (Ministry of Justice and Public Security, 02/2022)
- Norway should work through the International Maritime Organization (IMO) to introduce a requirement for an operational assessment in connection with the certification of all passenger ships, similar to those for ships certified according to the Polar Code. (Ministry of Justice and Public Security, 02/2022)
- Norway should actively participate in the work of establishing an objective- and function-based rescue chapter in the International Convention for the Safety of Life at Sea (SOLAS). (Ministry of Justice and Public Security, 02/2022)
- The Norwegian authorities should stimulate research and innovation with regard to life-saving appliances, and in particular the extent to which lifeboats for passenger ships can be used under different conditions. (Ministry of Justice and Public Security, 02/2022)
- The cruise industry should ensure that new and safer technology for lifeboats and other life-saving appliances is used. (Ministry of Justice and Public Security, 02/2022)

With reference to topics other than evacuation / LSA:

- Several recommendations with regard to lube oil tank design (Norwegian Safety Investigation Authority, March 2024), lube oil management and monitoring
- the NSIA recommends that the Norwegian Maritime Authority make a proposal to the IMO that the VDR performance standard is amended to also include recording of sound from the ECR, see Safety Recommendation Marine No. 2024/19T in chapter 4. (Norwegian Safety Investigation Authority, March 2024)

7.3.13 Issues (related to evacuation and LSA) not addressed in the investigation report:

Following facts regarding evacuation / LSA have not been addressed in the safety recommendations

- No recommendations are made regarding improvement of heavy weather capabilities of LSA
- LB3, davit control stations and, lifejacket boxes have been damaged by wave impact, no recommendations have been made to better protect these.

- The Door to assembly station B was damaged by wave impact, leading to water ingress into assembly station, no recommendations have been made to improve the durability of assembly station doors.
- Loose objects, unsecured furniture and ceiling panels caused injuries.

No recommendations have been made regarding these issues.

8.4 Summary

The Viking Sky accident was characterized by the harsh weather conditions that on the one hand caused the lubricating oil deficiency in the diesel generators and on the other hand prevented the deployment of vessel's LSA. The decision making and the actions of the Master were quick and straight forward. The emergency procedures (alarm, mustering) have been followed. The internal and external communication was clear, and target orientated.

The passengers felt well informed and taken care of. The evacuation by helicopters was time consuming although the distance to be flown was short.

Most important take-aways: Lifeboats and MES cannot be used in certain environmental conditions. Complete evacuation of large cruise vessels via helicopters is not possible within a reasonable timeframe.

8.5 References

Following references have been used for the review:

- Report of Norwegian Safety Investigation Authority (NSIA) "Loss of propulsion and near grounding of Viking Sky, Hustadvika, Norway, 23 March 2019" (Norwegian Safety Investigation Authority, March 2024)
- Report of Norwegian Directorate for Civil Protection (dsb) "Assessment of the Viking Sky Incident" (dsb Norwegian Directorate for Civil Protection, 1 September 2021)
- Report of Ministry of Justice and Public Security "Cruise traffic in Norwegian waters and adjacent sea areas – Maritime safety, emergency preparedness and rescue challenges and recommendations" (Ministry of Justice and Public Security, 02/2022)
- YouTube videos
    - "The Viking Sky cruise disaster: True terror on board" (Youtube, assessed 2024-12-12)
    - "Passengers recount airlift evacuation from Viking Sky cruise ship" (Youtube video, assessed 2024-12-12)
    - "Passenger describes being airlifted amid cruise ship scare" (YouTube, assessed 2024-12-12)
    - "The Viking Sky Cruise Disaster: Vacation Turned Horror…" (YouTube, assessed 2024-12-12)

9. Impact on Rules and regulations

With regard to the accident's impact on rules and regulations for evacuation and LSA the reports of IMO's Maritime Safety Committee (MSC) Sessions MSC 91 (November 2012) until MSC 108 (May 2024) and SSE 1 (March 2014) until SSE 10 (March 2024) have been investigated using following search terms:

- Costa Concordia
- Norman Atlantic
- Viking Sky
- Caribbean Fantasy
- Lifeboat(s)
- Liferaft(s)
- Evacuation
- Abandonment
- LSA

- Assembly (station)
- Muster (station)

In case one of the above-mentioned search terms occurred relating to passenger ships the corresponding text was taken over into this report.

9.1 MSC and SSE

MSC 91 (Nov 2012, (IMO Maritime Safety Committee MSC 92/6, Februar 2013) (IMO Maritime Safety Committee MSC 92/6, Februar 2013)**)**

Having considered the submission and proposals, the Committee approved draft amendments to SOLAS regulations III/19.2.2 and III/19.2.3, concerning muster policy for ships engaged on a voyage where passengers are scheduled to be on board for more than 24 hours, as set out in annex 14 to document MSC 91/22, with a view to adoption at this session.

The Committee noted that the text of the aforementioned draft SOLAS amendments (refer to Circular letter No.3334 of 11 December 2012) might need additional clarification in regard to the words "immediately upon departure" in draft regulation III/19.2.2, taking into account the comments and proposals which may be submitted to MSC 92 when the draft amendments will be considered for adoption.

The Committee agreed to supplement the Recommended interim measures for passenger ship companies to enhance the safety of passenger ships contained in MSC.1/Circ.1446 with three new elements, namely: voyage planning (in relation to conditions under which changes to the approved voyage plan should be conducted); recording the nationality of persons on board; and lifeboat loading for training purposes. These elements were incorporated into a revised MSC circular, subsequently issued as MSC.1/Circ.1446/Rev.1.

MSC 92 (June 2013, (IMO Maritime Safety Commitee MSC 93/6, March 2014) (IMO Maritime Safety Commitee MSC 93/6, March 2014)**)**

MSC 92, having noted the working group's consideration of documents MSC 92/6/2, MSC 92/6/4, MSC 92/6/10 and MSC.1/Circ.1238 related to evacuation analysis, instructed SDC 11 to consider the mandatory application of evacuation analysis to non-ro-ro passenger ships and advise MSC 93 accordingly (see paragraphs 17 and 18).

MSC 92 approved MSC.1/Circ.1446/Rev.2 on Recommended interim measures for passenger ship companies to enhance the safety of passenger ships. In this connection, the Committee noted the view of the group that, a future, decision would be required regarding the final status of the above interim guidance.

MSC 93 (May 2014, (IMO Maritime Safety Committee MSC03/22, May 2014) (IMO Maritime Safety Committee MSC 94/WP.1, November 2014)**)**

The Committee, having considered document MSC 93/20/4 (France, Germany, Spain and CLIA), proposing to expand the existing output on "Review of the recommendations on evacuation analysis for new and existing passenger ships (5.1.1.3)" to include amendments to SOLAS regulation II-2/13 and chapter 13 of the FSS Code, to make mandatory the application of evacuation analysis to all types of passenger ships, agreed to expand the scope of the output 5.1.1.3, replacing the existing title with "Amendments to SOLAS and FSS Code to make evacuation analysis mandatory for new passenger ships and review of the recommendation on evacuation analysis for new and existing passenger ships", and to include it in the biennial status report of the Sub-Committee and provisional agenda for SDC 2, with a target completion date of 2016. The Committee confirmed that there should be no requirements on survey or certification associated with this work.

SSE 1 (March 2014, (IACS)**)**

The Sub-Committee concurred with all the proposals in paper SSE 1/17/7, which reviewed and provided comments on the discussion at DE 57 relating to UI SC244 on the on-load testing of hooks intended for the primary release of lifeboats and rescue boats. The Sub-Committee subsequently agreed the text of a draft MSC circular (Annex 4 to WP.6). This draft circular will be considered at MSC 94 with a view to its approval.

Having considered SSE 1/17/8, which included in its annex the latest version of UI SC213 on embarkation station and stowage location of the liferaft as required by SOLAS regulation III/31.1.4, the Sub-Committee agreed on the text of a draft MSC circular (Annex 1 to WP.6). Following on interventions by Spain and the US, the text of the draft MSC circular omits paragraph 6 of the interpretation provided in UI SC213 relating to the length of the embarkation ladder and provides additional wording to clarify the areas that require illumination. This draft circular was submitted for consideration and approval at MSC 94.

The Sub-Committee considered MSC 90/9/2 (IACS) on the application of the increased average person mass for occupants of liferafts to 82.5 kg, and the effect this has on the Safe Working Load of any davits employed to launch these liferafts. Based on an intervention made by ICS, it was finally agreed that no specific action needs to be taken as MSC.1/Circ.1361 is applicable to passenger ships only and, therefore, on cargo ships, the Safe Working Load of launching appliance should not be less than the certified weight of the liferaft.

MSC 94 (November 2014, (IMO Maritime Safety Committee MSC 94/WP.1, November 2014) (IMO Maritime Safety Committee MSC 95/22, June 2015)**)**

The Committee recalled that, following the capsizing of the passenger ship Costa Concordia, MSC 90, MSC 91, MSC 92 and MSC 93 had established a Working Group on Passenger Ship Safety. As a result of the work, the Committee had adopted resolution MSC.336(90) on Measures aimed at enhancing safety of passenger ships, approved MSC.1/Circ.1446/Rev.2 on Recommended interim measures for passenger ship companies to enhance the safety of passenger ships and approved the Revised long-term action plan on passenger ship safety (MSC 93/WP.6/Rev.1, annex 3).

SSE 2 (March 2015, (IACS, 2015)

The Sub-Committee considered SSE 2/11/9, which provided a further draft revised version of IACS UI SC145 on application of provisions in SOLAS and the LSA Code relating to the general emergency alarms and public address systems. The Sub-Committee subsequently agreed to a draft UI for submission to MSC 96 for approval.

MSC 95 (June 2015, (IMO Maritime Safety Committee MSC 95/22, June 2015) (IMO Maritime Safety Committee MSC 96/WP.1, May 2016)**)**

The Committee recalled that, since the capsizing of the passenger ship Costa Concordia, MSC 90, MSC 91, MSC 92 and MSC 93 had established a Working Group on Passenger Ship Safety. As a result of the work, the Committee had adopted amendments to SOLAS chapter III on emergency training and drills (resolution MSC.350(92); adopted resolution MSC.336(90) on Measures aimed at enhancing the safety of passenger ships; approved MSC.1/Circ.1446/Rev.2 on Recommended interim measures for passenger ship companies to enhance the safety of passenger ships; and approved the revised action plan for long-term work on passenger ship safety (MSC 93/WP.6/Rev.1, annex 3).

The Committee approved the draft amendments to SOLAS regulation II-2/13 on evacuation analysis, as set out in annex 14, and requested the Secretary-General to circulate the above amendments in accordance with SOLAS article VIII, with a view to subsequent adoption at MSC 96.

The Committee noted that High Level Action 5.1.2 – "Development and review of safe evacuation, survival, recovery and treatment of people following maritime casualties or in case of distress" and the associated planned output 5.1.2.2 – "Measures to protect the safety of persons rescued at sea" were included in the HLAP and the parent organs for output 5.1.2.2 are MSC and FAL, with NCSR and III as coordinating and associated organs, respectively.

The Committee considered the information provided by the Secretariat (MSC 95/6) on work currently underway within the Organization related to the safety of passenger ships, most of which might also be applicable to ro-ro passenger ships. The Committee noted that the accident involving the ro-ro passenger ship **Norman Atlantic** and the recent fire on the Sorrento had again focused attention on the safety of ro-ro passenger ships and the rescue of passengers. The Committee further noted that the international nature of the passengers and crew highlighted the need for an international response, through IMO, to evaluate the reports of the marine accident investigations and take action, as appropriate, to enhance the current safety regime for ro-ro passenger ships.

SSE 3 (March 2016, (IMO Sub-committee on ship systems and equipment SSE 3/16, March 2016)**)**

MSC 95, in discussing whether the Sub-Committee is authorized to propose further amendments to SOLAS chapter III while finalizing the draft MSC resolution on *Requirements for periodic servicing and maintenance of lifeboats and rescue boats, launching appliances and release gear*, endorsed, in principle, the suggestion that the SOLAS regulations should address the questions "What is to be done?" and "When is it to be done?" and that the draft MSC resolution should address "How is it to be done?" and "Who does it?"; and agreed that SOLAS regulations III/20 and III/36 as well as the *Guidelines for developing operation and maintenance manuals for lifeboat systems* (MSC.1/Circ.1205) should be further reviewed for the purpose of consistency, but without introducing any amendments not specifically related to this matter.

For large passenger ships, SOLAS chapter II-2 requires that special attention be given to the fire integrity of windows facing open or enclosed lifeboat and liferaft embarkation areas, etc., in light of the specific fire risk of category (4) – Evacuation stations and external escape routes (see paragraph 2.2.3.2 and table 9.1 of SOLAS regulation II-2/9);

The Sub-Committee, having noted that the group was not in a position to conduct the detailed review either of the draft MSC circular on Guidelines on safety during abandon ship drills using lifeboats or the draft amendments to MSC.1/Circ.1205, endorsed the group's view that a detailed review of the draft MSC circular on Guidelines on safety during abandon ship drills using lifeboats and the draft amendments to MSC.1/Circ.1205, as set out in annexes 4 and 5 to document SSE 3/WP.3, was needed in order to capture possible inconsistencies deriving from the revision of the draft MSC resolution, and invited Member Governments and international organizations to submit comments and proposals to SSE 4. MSC 96 was invited to agree with the above decision of the Sub-Committee.

Arrangements for remotely located liferafts

> In considering document SSE 3/12/11 (IACS), providing a copy of IACS UI SC213 (Rev.3) clarifying the specifications for self-contained battery powered lights that are used as an adequate means of illumination for the embarkation station and stowage location of remotely located survival craft, the Sub-Committee noted the information that, with regard to paragraph 6 of the revised IACS UI SC213, the associated draft amendment to SOLAS regulation III/11.7 has already been proposed by Liberia, the Marshall Islands and IACS for consideration at MSC 96 (MSC 96/24/6).
>
> The Sub-Committee also noted that the revised UI SC213 will be applied by IACS Members on ships contracted for construction on or after 1 January 2017, unless they are provided with written instructions to apply a different interpretation by the Administration on whose behalf they are authorized to act as a recognized organization.
>
> Following discussion, the Sub-Committee endorsed the text of the new paragraph 2.4 to be inserted in the unified interpretation of SOLAS regulation III/31.1.4, set out in the annex to MSC.1/Circ.1490, and agreed to the draft amendments to MSC.1/Circ.1490, as set out in annex 10, for submission to MSC 97 with a view to approval as MSC.1/Circ.1490/Rev.1. The Sub-Committee also endorsed that the text of paragraph 6 of the revised IACS UI SC213 should be kept in square brackets, pending the decision by MSC 96.

MSC 96 (May 2016, (IMO Maritime Safety Committee MSC 96/WP.1, May 2016) (IMO Maritime Safety Committee MSC 97/WP.1, November 2016)**)**

The Committee agreed to consider the draft MSC circular on Revised guidelines on evacuation analyses for new and existing passenger ships under agenda item 11 (Ship design and construction (Report of the third session of the Sub Committee)).

The Committee recalled that the draft amendments to SOLAS regulation II-2/13 on evacuation analysis (MSC 96/3, annex 1; and MSC 96/WP.5, annex 1), had been prepared by SDC 2 and approved by MSC 95.

The Committee approved MSC.1/Circ.1530 on Unified interpretations of SOLAS regulations III/6.4 and III/6.5 and section 7.2 of the LSA Code related to general emergency alarms and public address systems in ro-ro spaces.

The Committee recalled that the draft amendments to SOLAS regulations III/1.4, III/30 and III/37 on damage control drills for passenger ships (MSC 97/3, annex 1; and MSC 97/WP.5, annex 1) had been developed by SDC 3 and approved by MSC 96 (MSC 96/25, paragraph 11.19).

MSC 97 (November 2016, (IMO Maritime Safety Committee MSC 97/WP.1, November 2016) (IMO Maritime Safety Committee MSC 98/WP.1, June 2017)**)**

Subsequently, the Committee approved the draft amendments to paragraphs 6.1.1.5 and 6.1.1.6 of the LSA Code, , and requested the Secretary-General to circulate the draft amendments in accordance with SOLAS article VIII, with a view to adoption at MSC 98.

SSE 4 (March 2017, (Lloyd's register , 2017)**)**

Revision of requirements for escape route signs and equipment location markings in SOLAS and related instruments

> As part of the recommendations following the Costa Concordia incident the Ad Hoc Working Group on Passenger Ship Safety included a review of the adequacy of shipboard safety signs and markings in their work. SSE3 considered proposals for harmonizing the requirements of SOLAS II-2/13, III/9, III/11 and III/20 taking into account the ISO standard 24409 series on “Design, location and use of shipboard safety signs, safety-related signs, safety notices and safety markings” and decided to reflect the ISO standards in an IMO instrument which will incorporate the graphical symbols without any changes.
>
> SSE 4 finalized the draft Assembly resolution which will go to MSC 98 for approval before adaption at Assembly 28 in November 2017. The new resolution should be used in conjunction with resolution A.952(23) Graphical symbols for shipboard fire control plans and will be applicable to new ships or ships undergoing repairs, alterations or modifications on or after a date to be decided at MSC 98.

Draft amendments to MSC1. Circ 1205 Guidelines for developing operation and maintenance manuals for lifeboat systems

> MSC 96 adopted MSC.402(96) Requirements for maintenance, thorough examination, operational testing, overhaul and repair of lifeboats and rescue boats, launching appliances and release gear which makes the provisions of MSC.1/Circ. 1206/Rev.1 mandatory. The SOLAS amendments and resolution will enter into force 1 Jan 2020.

Review SOLAS chapter II-2 and associated codes to minimize the incidence and consequences of fires on ro-ro spaces and special category spaces of new and existing ro-ro passenger ships

> MSC 97 considered proposals concerning minimizing the incidence and consequences of fires on the ro-ro decks of passenger ships and agree dot include a new output in the agenda for SSE 4 on “Review SOLAS chapter II-2 and associated codes to minimize the incidence and consequences of fires on ro-ro spaces and special category space of new and existing ro-ro passenger ships. SSE 4 developed a draft scope of work to be undertaken and the necessary work plan will go to MSC 98 for agreement.

MSC 98 (June 2017, (IMO Maritime Safety Committee MSC 98/WP.1, June 2017) (IMO Maritime Safety Committee MSC 99/22, June 2018)**)**

The Committee approved circular on Amendments to the guidelines for developing operation and maintenance manuals for lifeboat systems (MSC.1/Circ.1205).

SSE 5 (March 2018, (IACS, 2018)**)**

LSA for ships operating in Polar waters, ventilation of totally enclosed LB, novel LSA

MSC 99 (May 2018, (IMO Maritime Safety Committee MSC 99/22, June 2018)**)**

No outcome related to passenger ship evacuation or LSA

MSC 100 (December 2018, (IMO Maritime Safety Commitee MSC 100/20, January 2019)**)**

No outcome related to passenger ship evacuation or LSA

SSE 6 (March 2019, (IMO Sub-committee on ship systems and equipment SSE 6/WP.1, 2019) **)**

Ventilation, launching of free-fall LB, oil-resistance of inflatable liferafts

MSC 100/17/6 (Marshall Islands and RINA), suggesting that the LSA Code required amendments to ensure that the proposed seating arrangements for lifeboats properly allowed adequate space to make sure the accommodation and survival of the number of persons the design was certified to carry.

Outcome of MSC 101 (June 2019, (IMO Maritime Safety Committee MSC 101/24, July 2019)**)**

The Committee approved draft amendments to the Guidelines for developing operation and maintenance manuals for lifeboat systems (MSC.1/Circ.1205) agreed by SSE 6 (SSE 6/18, annex 13), for dissemination as MSC.1/Circ.1205/Rev.1.

The Committee approved MSC.1/Circ.1618 on Unified interpretations of SOLAS regulations III/20, III/22 and III/32, concerning regulations III/20.11 (Operational readiness, maintenance and inspections, maintenance, thorough examination, operational testing, overhaul and repair of lifeboats, rescue boats and fast rescue boats, launching appliances and release gear), III/22.1.1 and III/32.1.1 (Personal life-saving appliances, lifebuoys).

SSE 7 (March 2020, (IMO Sub-committee on ship systems and equipment SSE 7/21, 2020)**)**

Ventilation, free-fall LB, ventilation

SSE 8 (March 2022, (IMO Sub-committee on ship systems and equipment SSE 8/20, 2022)**)**

Ventilation, LB operation of engine and fuel consumption test, LB in polar regions

MSC 105 (April 2022, (IMO Maritime Safety Commitee MSC 105/20, May 2022) **)**

In considering the intended meaning of the above-mentioned terms, the Committee recalled that the option explained in paragraph 9 of document MSC 105/3/4 had already been used by SSE 8 in the draft MSC resolution on amendments to the LSA Code (SSE 8/20, annex 1), following a proposal by IACS (SSE 8/3/1).

The Committee also noted the information provided by China in document MSC 105/INF.16, on improving information management of ferry companies to strengthen shore-based monitoring of ferries and the crew, thereby improving safety of ferry navigation; document MSC 105/INF.17, on new life-saving equipment designed to meet the demand for rapid evacuation of passengers of all ages on board compact ferry boats to avoid casualties from ferry accidents; and document MSC 105/INF.18, on ferry hull colouring and marking measures taken to improve visibility of ships to avoid collisions when ships were crossing narrow waterways. The observer from ILAMA shared their interest in assisting Member States with research initiatives to improve ferry safety.

MSC 106 (November 2022, (IMO Maritime Safety Commitee MSC 106/19, November 2022)**)**

The Committee noted, with appreciation, document MSC 106/INF.3 (EC), providing information on the EU research project SafePASS that aimed to develop the next generation of evacuation and abandonment processes and life-saving appliances.

SSE 9 (March 2023, (IMO Sub-committee on ship systems and equipment SSE 9/20, 2023)**)**

This Organization has previously considered the issue of the unacceptably high number of accidents with lifeboats in which crew were being injured, sometimes fatally, while participating in lifeboat drills and/or inspections, and identified inadequate maintenance of lifeboats, davits and launching equipment as a cause of such accidents. These concerns were addressed, in part, by requirements in MSC.1/Circ.1049, MSC.1/Circ.1093, and later by MSC.1/Circ.1206, MSC.1/Circ.1206/Rev.1, and MSC.1/Circ.1277, which were made mandatory by resolutions MSC.402(96) and MSC.404(96).

MSC 107 (June 2023, (IMO Maritime Safety Commitee MSC 107/20, June 2023)**)**

agreed to modify the draft amendments to paragraph 6.1.2.10 of the LSA Code as suggested in document MSC 107/14/5 and approved the draft amendments to the LSA Code (paragraphs 6.1.2.8 and 6.1.2.10), as set out in annex 31;

SSE 10 (March 2024, (IMO Sub-committee on ship systems and equipment SSE10/WP.1, 2024) **)**

Testing of free-fall LB

mandating self-righting and canopied reversible liferafts would lead to a surge in global demand that manufacturers may struggle to meet, which needs to be thoroughly examined. The LSA Working Group should further consider the matter, taking into account passenger capacity and approval by Administrations; and no compelling need had been established for the proposed requirements, which might cause significant difficulties for the industry

9.2 SOLAS Chapter III amendments (concerning passenger ships)

2012:

Part B Section I Regulation 17-1 Recovery of persons from the water: This regulation was added by res. MSC.338(91), as inserted above, adopted 2012-11-30 and applicable from 2014-07-01.

Part B Section I Regulation 20 Operational readiness, maintenance and inspections:

2013:

Part B Section I Regulation 19 “Emergency training and drills”:

This regulation was amended by res. MSC.350(92), as inserted above, adopted 2013-06-21 and applicable from 2015-01-01:

2016:

Part B Section I Regulation 20 “Operational readiness, maintenance and inspections”:

This regulation was amended by res. MSC.404(96), as inserted above, adopted 2016-05-19, applicable from 2020-01-01: Paragraphs 3.1 and 11 were totally replaced. Previous text applicable to 2020-01-01, see preceding (replaced) version of regulation 20 applicable to 2020-01-01.

2017:

Part B Section I Regulation 30 “Drills”.

This regulation was amended by res. MSC.421(98), as inserted above, adopted 2017-06-15, applicable from 2020-01-01

Part B Section V Regulation 37 “Muster list and emergency instructions”

This regulation was amended by res. MSC.421(98), as inserted above, adopted 2017-06-15, applicable from 2020-01-01

2022:

Part B Section I Regulation 6 “Communications”

This regulation was amended by res. MSC.496(105), as inserted above, adopted 2022-04-28, applicable from 2024-01-01.

9.3 Summary

While accidents are not always explicitly referenced in IMO regulatory texts, a review of the documentation shows that several major passenger ship incidents have clearly influenced the direction and prioritization of rulemaking in IMO and in the EU.

In particular, the Costa Concordia accident in 2012 served as a critical catalyst for regulatory enhancements related to evacuation analysis, muster procedures, and lifeboat systems. Similarly, incidents such as the Norman Atlantic and others highlighted operational gaps and prompted discussions and revisions concerning LSA functionality and fire protection.

The following key changes related to evacuation and life-saving appliances (LSA) have been adopted or progressed at IMO since 2012:

- Amendments to SOLAS regulation II-2/13 extend the requirements for evacuation analysis to all passenger ships, not just ro-ro passenger ships. The analysis should be used to identify and eliminate, as far as practicable, congestion which may develop during an abandonment due to normal movement of passengers and crew along escape routes, including the possibility that crew may need to move along these routes in a direction opposite to the movement of passengers. In addition, the analysis should be used to demonstrate that escape arrangements are sufficiently flexible to provide for the possibility that certain escape routes, assembly stations, embarkation stations or survival craft may not be available as a result of a casualty.
- MSC.1/Circ.1446/Rev. 2 (IMO, August 2013) "Recommended interim measures for passenger ship companies to enhance the safety of passenger ships". This Circular was developed in the light of the Costa Concordia accident. The circular revises the operational safety measures to enhance the safety of passenger ships:
    - Lifejackets: Passenger ship owners / operators are asked to consider
        - carrying additional lifejackets in public spaces, at assembly stations, on deck or in lifeboats
        - providing lifejackets of a similar design and can be donned by passengers in a similar manner with the intent of avoiding confusion when donning lifejackets
        - ensuring, when lifejackets are stowed in passenger cabins, the lifejacket location is visible under all possible lighting conditions.
    - Emergency instructions for passengers: Passenger ship owners / operators should
        - review the adequacy of the dissemination and communication of the emergency instructions on board their ships, taking into account the number of languages likely to be understood by the passengers on board.
        - consider extending the use of an accompanying video for passenger emergency instruction notices, where appropriate. It is also recommended that emergency information cards are made available for passengers, on request, that complement the information required by SOLAS
        - including the following common elements into their passenger muster and emergency instructions:
            - when and how to don a lifejacket;
            - description of emergency signals and appropriate responses in the event of an emergency;
            - location of lifejackets;
            - where to muster when the emergency signal is sounded;
            - method of accounting for passenger attendance at musters both for training and in the event of an actual emergency;
            - how information will be provided in an emergency;
            - what to expect if the Master orders an evacuation of the ship;
            - what additional safety information is available;
            - instructions on whether passengers should return to cabins prior to mustering, including specifics regarding medications, clothing, and lifejackets;
            - description of key safety systems and features;
            - emergency routing systems and recognizing emergency exits; and
            - who to seek out for additional information.

        - have policies and procedures in place to promote passenger participation in emergency training and drills required by SOLAS regulation III/19 and encouraged by regulation III/30

    - Passenger muster policy:

        - On a ship engaged on a voyage where passengers are scheduled to be on board for more than 24 hours, it is recommended that the muster of newly-embarked passengers should take place prior to the departure at every port of embarkation. In cases where new passengers arrive after the above muster has been completed, they should be promptly provided with individual or group safety briefings

        - To support the Master in preparing or revising the Muster List, companies owning and/or operating passenger ships should consider adopting a process that positively matches each crew member assigned to emergency duties with any required training and/or certification, whether by regulations or company policy. Such process may include the use of a paper-based or automated system on board that can effectively prevent assignment of a crew member to an emergency duty where the crew member is not trained or certified for such duty

    - Access of personnel to the navigating bridge and avoiding distractions: Companies owning and/or operating passenger ships should

        - ensure that bridge access control and bridge organization policies are developed and harmonized. To avoid disruptions and distractions of bridge team members in accomplishing their direct and indirect duties during any period of restricted manoeuvring, or while manoeuvring in conditions that the Master or company bridge procedures/policy deems to require increased vigilance (e.g. arrival/departure from port, heavy traffic, poor visibility), it is recommended that access to the bridge should be limited to those with operational or operationally-related functions during these periods

- Harmonization of bridge navigational procedures:

    - Companies owning and/or operating passenger ships should adopt a policy that bridge navigational procedures should be harmonized as much as possible across their fleet or fleets, taking into account any unique operating characteristics.

- Voyage planning

    - Companies owning and/or operating passenger ships and their Masters should take steps to ensure that the ship's voyage plan has taken into account the Guidelines for voyage planning (resolution A.893(21)) and, if appropriate, the Guidelines on voyage planning for passenger ships operating in remote areas (resolution A.999(25)), including addressing the conditions under which changes to the plan are consistent with company policies.

    - Any deviation from the voyage plan should follow the guidance of resolution A.893

    - Recording the nationality of persons on board

        - In order to facilitate the effective and immediate availability of key information on passengers in the event of an emergency situation, in addition to the information required by SOLAS regulation III/27, companies owning and/or operating passenger ships should consider ensuring that the nationality of each person on board is also provided.

        - Lifeboat loading for training purposes: Companies owning and/or operating passenger ships should consider adopting a policy that at least one lifeboat is to be filled with crew members equal in number to its certified number of occupants at least every six months. Under such a policy

- for safety considerations, the loading of lifeboats for training purposes is to be performed only while the boat is waterborne and the boat should be lowered and raised with only the minimum number of crew on board, taking into account annex 2 to the Measures to prevent accidents with lifeboats (MSC.1/Circ.1206/Rev.1);
- lifejackets should be worn;
- all lifeboat crew and embarkation/boarding station crew are to be required to attend the lifeboat loading drill; and
- if not placed inside the lifeboat, those crew members are to observe the filling of the lifeboat to its certified number of people.

- Securing heavy objects

  - Companies owning and/or operating passenger ships should adopt a policy to incorporate procedures into their Safety Management Systems (SMS) to help ensure the securing of heavy objects either permanently, when not in use, or during heavy/severe weather, as appropriate.

  - Practices and procedures for securing heavy objects should be monitored by each Head of Department and/or as otherwise specified by the ship's command structure, and during routine shipboard inspections and audits.

- Inclinometer data for the VDR: Companies owning and/or operating passenger ships are encouraged to investigate means of providing rolling motion data to the VDR.(Remark: same in Viking Sky, 7 years later)

- MSC.1/Circ.1618 “Unified Interpretations of SOLAS Chapter III”:

  - The thorough examinations, overhauls and operational tests carried out at intervals of at least once every five years, should be done in the presence of a surveyor

Most of the (passenger ship) LSA related topics discussed in MSC / SSE in the period under review was related to ventilation in lifeboats and the use of lifeboats in polar waters. These topics are mainly related to the situation in the waterborne lifeboat during waiting for rescue. In none of the four cases under consideration persons had to sail a longer time or distance in the lifeboats / liferafts. In all the cases the availability or deployment of the LSA was the main problem: On Viking Sky the harsh weather conditions and the proximity of the coast prevented the use of the vessel’s LSA and in addition one lifeboat, all lifeboat davit control stations on starboard side and lifejacket boxes have been damaged by wave impact. On Costa Concordia the high heeling made deployment of LSA difficult. On Caribbean Fantasy technical problems and lack of crew experience made the deployment of LSA difficult. On Norman Atlantic all LSA on starboard side were destroyed by the fire.

So far there is no solution for the evacuation of passenger vessels under extreme weather conditions.

10. Comparison of the accidents

Comparing the Costa Concordia, Norman Atlantic, Caribbean Fantasy, and Viking Sky incidents provides valuable insights into maritime safety and emergency response. Despite differences in the nature of the accidents—ranging from grounding and capsizing (Costa Concordia) to fires (Norman Atlantic and Caribbean Fantasy) and engine failure in severe weather (Viking Sky)—common themes emerge. By examining both the similarities and differences in these incidents, we can identify key lessons and best practices to enhance maritime safety and emergency preparedness, ultimately contributing to safer seas for all.

The four incidents exhibit notable differences in the specifics of life-saving appliances, safety management, and evacuation and rescue operations. The Costa Concordia disaster was marked by a chaotic evacuation process, with delays and confusion exacerbated by inadequate crew training and poor communication. In contrast, the Norman Atlantic and Caribbean Fantasy incidents involved fires that rendered some life-saving equipment unusable, highlighting the importance of fire prevention and suppression systems. The Viking Sky incident, caused by engine failure in severe weather, demonstrated the need for robust engineering and maintenance practices to prevent such failures. These differences illustrate the diverse nature of maritime risks and the necessity for tailored safety measures to address specific threats effectively.

Despite these differences, the incidents exhibit similarities in their concerns and lessons learnt. All four incidents underscore the critical importance of life-saving appliances, safety management, and effective evacuation and rescue operations. Each incident revealed significant challenges in ensuring the readiness and functionality of life-saving equipment, such as lifeboats and liferafts, which are essential for passenger safety. Additionally, these incidents highlighted the necessity for robust safety management systems that include regular maintenance, crew training, and adherence to safety protocols. Effective evacuation and rescue operations were crucial in all cases, with external assistance from helicopters and nearby vessels playing a vital role in saving lives. These commonalities emphasize the need for comprehensive safety measures and preparedness to handle emergencies at sea and a shift in focus from topics such as, LSA habitability and effectiveness at sea, to ensuring their initial availability at the time of emergency and deployment.

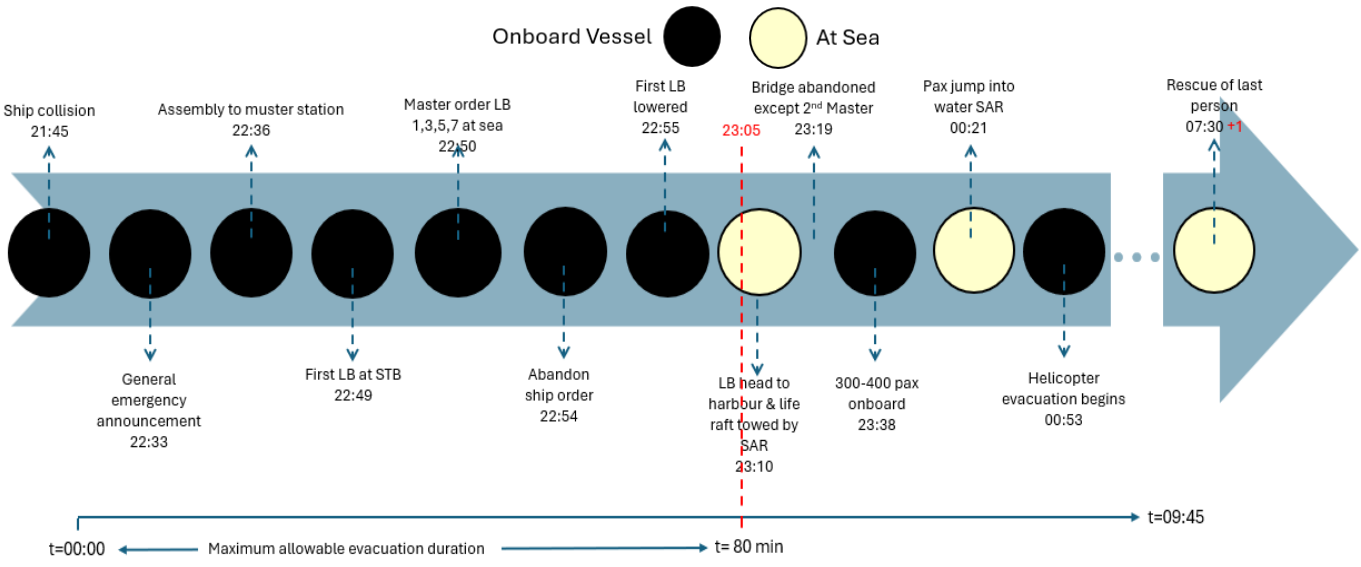

Figure 10-1 Costa Concordia Alarm to Rescue Timeline

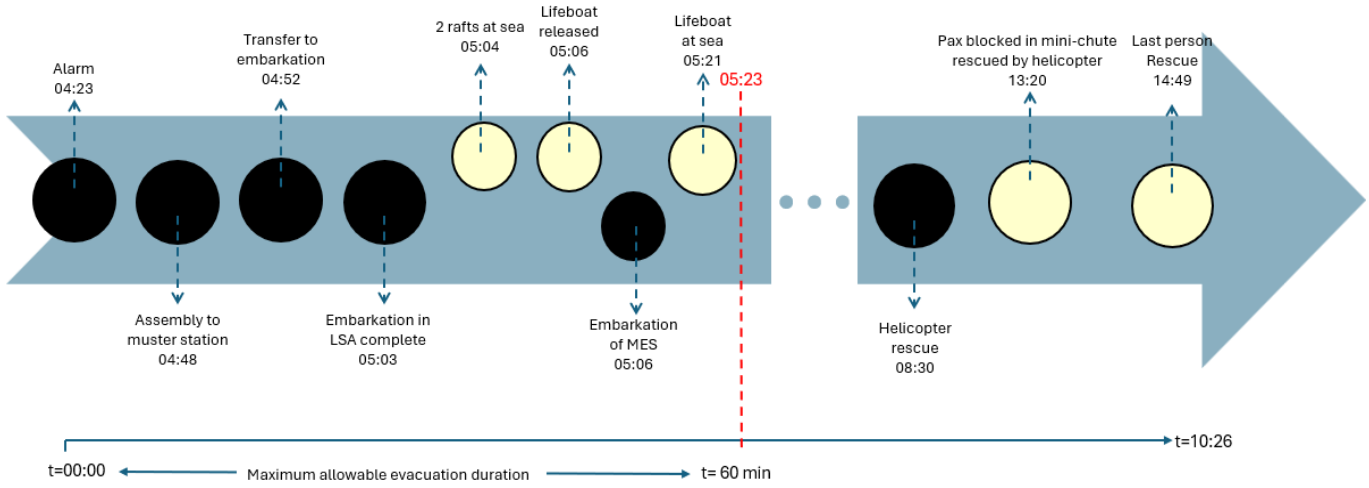

Figure 10-2 Norman Atlantic Alarm to Rescue timeline

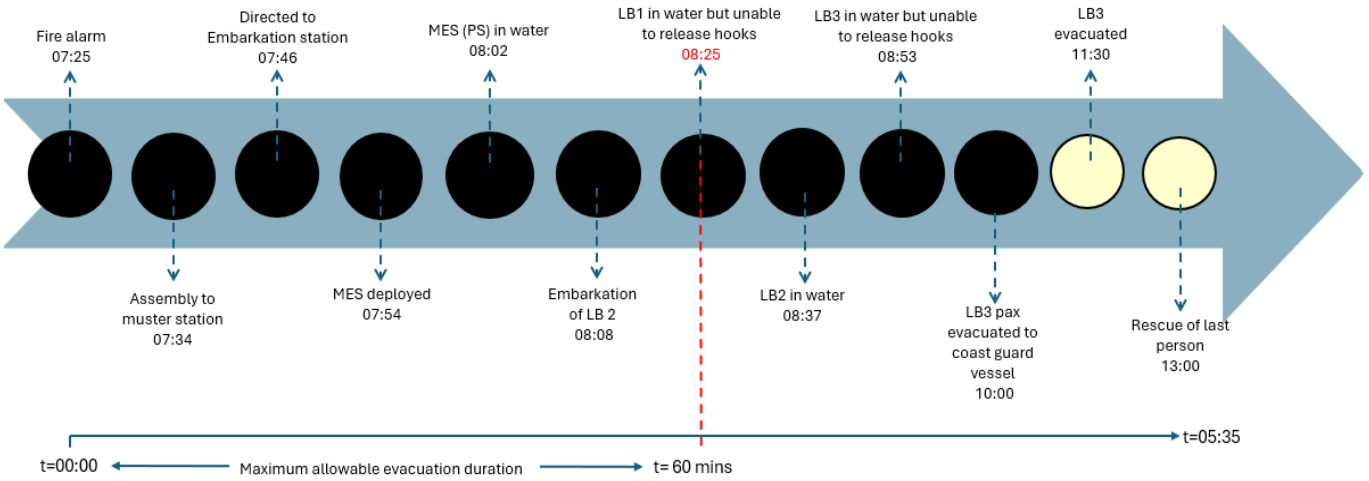

Figure 10-3 Caribbean Fantasy Alarm to Rescue timeline

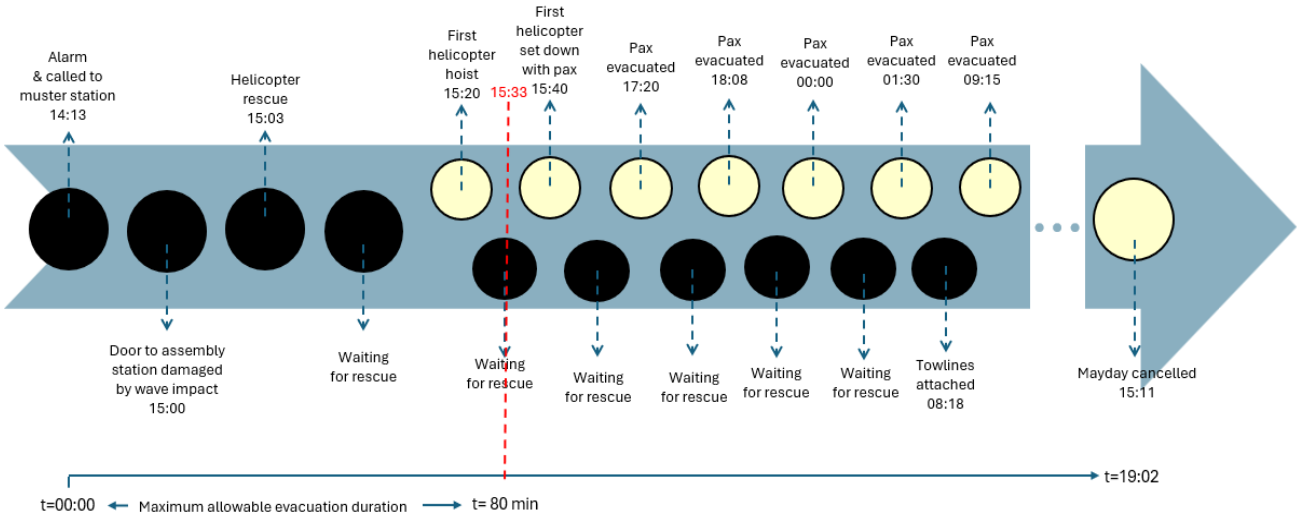

Figure 10-4 Viking Sky Alarm to Rescue timeline

11. Summary and Conclusion

86 notable passenger ship evacuation incidents have been identified for the period 2000 to 2024 and assigned to the accident categories “Fire/Explosion” (44.2%), “Grounding/Stranding” (31.4%), “Collision/Contact” (10.5%), “Capsizing/Listing” (8.1%), “Loss of control” (3.5%) and “Others” (2.3%). Of these 86 accidents 44% happened on cruise vessels, 33% on RoPax vessels, 8% on inland/river cruise ships and 15% on other passenger ships. In total more than 5000 persons lost their life in these accidents. From these following four specific cases have been selected that are most significant in terms of their impact and potential learning on evacuation procedures:

1. Costa Concordia:
2. Norman Atlantic
3. Caribbean Fantasy
4. Viking Sky

These four cases are well suited for further investigations in the context of the study: Detailed accident reports and additional sources or publications are available for them. Two of the cases are cruise ships (Costa Concordia and Viking Sky), two of them are RoPax vessels (Norman Atlantic and Caribbean Fantasy). The selected cases cover different accident categories: 2 x “Fire / Explosion” (Norman Atlantic and Caribbean Fantasy), 1 x “Loss of control” (Viking Sky) and 1 x “Grounding / Stranding” (Costa Concordia) and different ambient conditions (with regard to time of day, weather, distance to the coast, etc.). The outcome of the accidents ranges from numerous deaths and injuries (Costa Concordia, Norman Atlantic) to successful outcomes without personal injury (Caribbean Fantasy). Furthermore, the four cases differ significantly in terms of the means of evacuation: from helicopters only (Viking Sky) to the use of lifeboats and MES and different failures and problems with the LSA on the other vessels.

In none of the four accidents the LSA could be used as intended; the reasons were different:

- on Costa Concordia the heeling of the vessel was already above the limits when the evacuation started.
- on Norman Atlantic the LSA on starboard side was destroyed by the fire.
- on Caribbean Fantasy the lifeboat hooks could only be opened with a delay or not at all, the MES slide angle was to steep, assistance of a coast guard vessel was required to make the slides usable.
- on Viking Sky the LSA were not used due to the harsh environmental conditions the rough ambient conditions, additionally LSA have been damaged by the waves.

In summary, this means that in none of the four studied cases fulfilling SOLAS III/21.1.3 “ *All survival craft required to provide for abandonment by the total number of persons on board shall be capable of being launched with their full complement of persons and equipment within a period of 30 min from the time the abandon ship signal is given after all persons have been assembled, with lifejackets donned”* was achieved. Table 11-1Table 11-1 and Table 11-2 summarize the evacuation methods, the portion of persons evacuated by ship-own and other means as well as the assignment of evacuees to lifeboats and liferafts.

Furthermore, it can be concluded,

- That organisational leadership is the key for a successful evacuation.
- Communication issues, as language barriers and VHF problems, occurred in most of the accidents and complicate and delay the processes.
- External support was vital for the success of the evacuations. Helicopters have been used to evacuate persons in all four cases, coast guard vessels played a vital role in the successful evacuation of Caribbean Fantasy.
- The impact of lessons learned on rule development is time consuming and could be more consistent.

Table 11-1: Environmental conditions and evacuation methods

Accident	Wind(knots)	Wave Height(m)	Weather category	Evacuation method	People evacuated	% by own LSA	% by other means
Costa Concordia	ENE 17 knots	1.2-2.5 m	Moderate	Lifeboats, liferafts, Helicopters	4197 (of 4229)	~67%	~33%
Norman Atlantic	SSW ~55 knots	4-6 m	Rough	Lifeboats, MES, Helicopters	452 (of ~475)	18.5 %	81.5%
Caribbean Fantasy	E 13-17 knots	1.2 m	Good	MES, lifeboats	511 (of 511)	98.4%	1.6%
Viking Sky	SW 41 - 68 knots	4-6 m	Rough	Helicopters	460 (of 1374)	0 %	100%

Table 11-2: Number and utilisation of LSA

Accident	Life-boats on board	Life-boats capa-city	Life-rafts or MES on board	Liferafts or MES capa-city	Life-boats Used	Life-rafts of MES used	Total person s Eva-cuated	% via Life-boats	% via Life-rafts or MES	Utilisation Lifeboat factor
Costa Concordia	26	3720	69	2395	23	6	4197	~65%	~2%	~73%
Norman Atlantic	2	300	10	858	1	0	452	18.5%	0%	29.3%
Caribbean Fantasy	3	370	23	780	3	?	511	60.5%	38%	83.5%
Viking Sky	6	1240	19	665	0	0	460	0%	0%	0%

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Appendix A List of Accidents

Year	Ship name	IMO Number	Ship type	Flag	Event	People onboard (Pax+Crew)	Evacuated / by	fatalities	injuries
2024	Tenacia	9350707	RoPax	Italy	Fire (Engine Room)	350+61	All / MES?	0	0
2023	Astoria Grande	9112789	Cruise	Palau	damage after hitting the wharf	385+283	No evacuation was needed ?	0	0
2023	Viking Orion	9796250	Cruise	Norway	Fire (pax cabin)	600	Vessel was Docked	0	0
2023	Maud	9247728	cruise	Norway	loss of power in heavy weather	266+131	all pax in Muster stations, no evac needed	0	0
2023	Spirit of Discovery	9802683	Cruise	UK	loss of propulsion in heavy weather		No evacuation was needed.	0	0
2023	Celebrity Equinox	9372456	Cruise	Malta	Aground	596+15	All/ Another vessel	0	0
2023	MV Lady Mary Joy3	9006760	Passenger	Philippines	Fire (cabin)	252	231/ Passengers leapt into water. Ferry, navy, coast guard vessel arrived for rescue	12	23
2023	Isle of Innisfree	8908466	RoPax	Cyprus	Fire (Engine room)	94+89	All/ Lifeboats & Tugboats	0	0
2023	Stena Europe	7901760	RoPax	Cyprus	Fire (Engine room)	88+59	No evacuation was needed.	0	0
2023	Pentalina	9437969	RoPax	UK	grounded	59+13	lifeboat	0	0
2022	MV Mercraft 2	9000166	high-speed ferry	Philippines	Fire (Engine room)	157	127/ Passengers leapt into water. Another vessel came for rescue	7	29
2022	Spirit of Norfolk	8861618	Passenger	USA	Fire (Engine Room)	106	Vessel was Docked	0	0
2022	Euroferry Olympia	9010175	RoPax	Italy	Fire (car deck)	239+51	279/lifeboats and coast guard vessels	11	11
2022	Asia Philippines	7434262	RoPax	Philippines	Fire (Engine Room)	49+38	no order for evacuation, pax saved from water by other ships	2	1
2022	Stena Scandica	9329849	RoPax	Denmark	Fire (car deck)	241+58	33 pax by helicopter / rest in port	0	0
2021	MSC Lirica	9246102	Cruise	Panama	Fire (lifeboat)	0+51	Vessel was Docked	0	0
2021	American Jazz riverboat	1295690	River Cruise	USA	Aground	120+44	All/Pontoon boats	0	0
2020	Asuka II	8806204	Cruise	Japan	Fire (storage area)	0+	All/Vessel was Docked	0	0
2020	Amorella (now: Mega Victoria)	8601915	cruiseferry	Finland	Mechanical Failure --> Aground	200+80	All/lifeboats and local ferries	0	0
2020	Pride of Hull	9208629	RoPax	Bahamas	Fire (Engine room)	264	crew and pax mustered	0	0

Year	Ship name	IMO Number	Ship type	Flag	Event	People onboard (Pax+Crew)	Evacuated / by	fatalities	injuries
2020	MS Viking Grace	9606900	RoPax	Finland	Aground	331+98	All/Tugboats	0	0
2019	Viking sky	9650420	Cruise	Norway	Engine problems, drifting towards shore	915+458	480 / helicopter	0	28
2018	Nyerere	N/A	domestic ferry	Tanzania	capsized (overcrowding, overloading, poor maintenance)	>270	41 / search & rescue operations (by police and defense authorities, volunteers, fire brigade and community fishermen)	229+	
2018	KM Sinar Bangun	N/A	domestic RoPax	Indonesia	Overloading	188 (cap:43)	21/ rescue	3 + 164 (missing)	
2018	Akademik Ioffe	8507731	Pax carrying research vessel	Russia	aground	126 + 37	All pax by inflatable boats to another vessel	0	0
2017	Lucky 7	8943703	Casino Cruise ship	Panama	aground	? + 19	4 crew /by helicopter	0	1
2017	Milford Wanderer	8975665	Cruise	New Zealand	aground	30 + 9	All pax / ?	0	0
2017	Caledonian Sky	8802870	Expedition cruise	Bahamas	human error/technical error --> aground	102 + 79	No evacuation was needed.	0	0
2017	Swiss Crystal	N/A	Inland cruise	Switzerland	Allision with bridge pier	103+27	Another river cruise ship	0	25
2016	Royal Iris	8633712	Pax ferry	UK	holed after contact with dolpin	66+9	All /via dredger alongside	0	0
2016	Stena Spirit	7907661	RoPax	Bahamas	fire (car deck)	551+95	pax evacuated to external deck, left ship in port	0	0
2016	Caribbean Fantasy	8814263	RoPax	Panama	Fire (engine room) / aground	387+124	All /davit lifeboat/MES (problems with hooks and MES)	0	0
2016	Jean Nicoli	9161948	RoPax	France	Bomb scare	77	All/ in port	0	0
2016	Sea dream I	8203438	Small cruise	Bahamas	Fire (engine room)	105+91	105 pax + 61 crew / coast guard vessel	0	0
2015	Celestyal Crystal	7827213	Cruise	Malta	collision	853+382	all pax mustered, no evac, ship sailed to port	0	4
2015	Le Boreal Ponant	8914219	Cruise	France	Fire (engine room)	347	Lifeboats +liferafts+ heli	0	0
2015	Freedom of the seas	9304033	Cruise	Bahamas	Fire (casing)	4454+1428	Standby at assembly stations but no evacuation	0	1

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2015	Carnival liberty	9278181	Cruise	Panama	Fire (engine room) in port	3347 + 1151	All / gangway (in port)	0	0
2015	Noordam	9230115	Cruise	Netherlands	Bomb scare		All / in port	0	0
2015	Eastern star	N/A	River Cruise	China	storm	410+46		442	0
2015	Sorrento	9264312	RoPax	Italy	Fire (car deck)	110+4	All / lifeboats	0	0
2015	Star Pride	8707343	Small Cruise	Bahamas	Grounded	156+140	All pax/tender	0	0
2014	Escapade	7802689	casino ship	USA	Aground	96+27	some by helicopter, rest by coast guard vessels	0	0
2014	Insignia	9156462	Cruise	Marshall Islands	Fire (engine room)	656	In port	3	0
2014	Britannia (Nicko Tours)	9285195	River Cruise	Switzerland	Holed	154+40	All/ ?	0	0
2014	Sewol	9105205	RoPax	Korea	overloading, veering	476	crew instructed against evacuation/no rescue boat	295+9	172
2014	Norman Atlantic	9435466	RoPax	Italy	Fire (car deck)	(417 (+3)) + 55	helicopters, some in lifeboats & rafts; weather limited efforts of rescue vessels	23	31
2014	Bahamas Celebration	8001571	RoPax	Bahamas	Aground (near shore)	792+378	Shore gangway system	0	0
2013	Dawn Princess (now Pacific Explorer)	9103996	Cruise	Liberia	Fire (el. Substation)	1922+	Standby at assembly stations but no evacuation	0	0
2013	Zenith	8918136	cruise	Palau	fire (Engine Room)	1672+600	pax mustered, standby on open deck, no evac	0	0
2013	Grandeur of the seas	9102978	Cruise	Bahamas	Fire (aft mooring deck)	2224+796	Standby at assembly stations but no evacuation	0	0
2013	Louis Joliet	5212749	Small Passenger vessel	Canada	Aground	57+21	All pax and some crew / 2 pilot boats and a tug	0	0
2012	Azamara Quest	9210218	cruise	Malta	fire (Engine room)	590+411	pax mustered, no evac	0	1
2012	Costa Concordia	9320544	cruise	Italy	grounded	3206+1023	23 lifeboats+6 liferafts	33	157
2012	Regina Rheni	N/A	River Cruise	Netherlands	Fire (galley)	102+32	by other river cruise vessel	0	0

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2012	Rabaul Queen	8351297	RoPax	Papua New Guinea	Capsized (Overcrowded and rough weather)	360+16	life rafts/rescue vessels/helicopter (246)	142	?
2012	Mecklenburg-Vorpommern	9131797	RoPax	Sweden	fire (car deck)	136+40	in port / gangway?	0	0
2011	Ocean Star Pacific	7027411	cruise	Panama	grounded after Fire (generator)	522+226	522 pax and 226 crew /catamaran?	0	0
2011	Avalon Tranquility	8339433	Inland cruise		Collision			0	
2011	Pella	8319081	RoPax	Jordan	fire (cargo space)		1230 /lifeboats	1	27
2011	Nordlys	9048914	RoPax	Norway	Fire (engine room)	207+55	lifeboats	2	0
2010	Deutschland	9141807	Cruise	Bahamas	fire (Engine Room)	365	in port, via gangway	0	0
2010	Lisco Gloria	9212151	RoPax	Lithuania	explosion	203+32	lifeboats and rafts	0	28
2010	Clipper Adventurer	7391422	Small cruise	Madeira	aground	128 + 69	All pax/?	0	0
2009	Royal princess	9584712	Cruise	Bermuda	Fire (engine room)	733+393	Standby at assembly stations but no evacuation	0	0
2009	Costa Romantica	8821046	Cruise	Italy	Fire (generator room)		No evacuation was needed.	0	0
2008	Mona Lisa	6512354	cruise	Bahamas	aground	811+327	All passengers + 23 crew/ naval vessels	0	0
2008	Princess of the Stars	8323161	roPax	Philippines	weather and shifting cargo	922		800+	
2008	Sea Wind	7128332	RoPax	Sweden	Fire (engine room)	11+28	All passengers /Helicopter	0	0
2008	Spirit of Glacier	8883563	Small cruise	USA	grounded	24+27	?	0	
2007	Sky Wonder	8024026	cruise	Malta	aground	1050+	?	0	0
2007	Spirit of Nantucket	8883563	Cruise	USA	Grounded	61+5	coastguard vessel	0	0
2007	Sea Diamond	7355260	Cruise	Greece	grounded	1153+391	Partly lifeboats?	2	
2007	Explorer	6924959	Expedition cruise	Liberia	holed (collision with iceberg)	91+63	lifeboat	0	0
2007	Island Explorer II	6407846	Passenger/general cargo	Maldives	grounded	52		0	
2007	Dipolog Princess	6924765?		Philippines	grounded	825	by coast guard vessel?	0	0
2006	Star Princess	9863120	cruise	Bermuda	fire (on balcony from discarded cigarette)	2690+1123	all in muster station but no abandonment, detailed decription of evac	1	17

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2006	Norwegian Crown	8506294	Cruise	Bahamas	grounded	1135+537	tender	0	0
2006	Al-Salam Boccaccio 98	6921282	RoPax	Panama	fire (car deck) --> sinking	1321+97	no order for evacuation was given,	1031	
2006	Queen of the North	6917267	RoPax	Canada	aground	59+42	All crew and pax/lifeboats and life rafts	2	0
2005	Oltenita	8888874	River Cruise	Romania	Fire (galley)	77 + 47(?)	Via bank	1	0
2004	Clipper Odyssey	8800195	cruise	Belgium	grounded	196 + ?	All pax / by local fishing vessels	0	
2004	Wilderness Adventurer	8978667	expedition Cruise	USA	Allision with packed ice, water ingress	67+		0	0
2004	Stena Nautica	8317954	RoPax	Sweden	human error --> collision	94+34	all/MES (port side after failure of starboard side MES)	0	0
2002	Joola	9019901	RoPax	Senegal	Overloading and lack of safety measures	580 (x3)		1863	
2000	Express Samina	6613548	RoPax	Greece	collision due to crew negligence	533		82	

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