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ANY OTHER BUSINESS

Enclosed space fatalities aboard ships for the period 2000 to 2024

Submitted by IBTA

SUMMARY

Executive summary:	This document provides an updated summary of research carried out into all reported enclosed space related fatalities across all ship types for the 25-year period from 2000 to 2024. It aims to support the provisions of the *Revised recommendations for entering enclosed spaces aboard ships* (resolution A.1050(27)), as amended, and to help address time pressures inherent in the shipping industry.
Strategic direction, if applicable:	Not applicable
Output:	Not applicable
Action to be taken:	Paragraph 15
Related documents:	CCC 10/INF.32 and CCC 10/WP.10

Introduction

1 The annex of this document includes a true-scale enclosed space fatality report and provides an analysis of fatalities in enclosed spaces on ships for the period 2000 to 2024.

2 The research aims to identify the number of such fatalities during this period, key trends and lessons to be learned. This document updates previous reports on enclosed space fatalities submitted by IBTA to CCC 5, 6, 7, 8, 9 and 10.

Enclosed space fatalities for the period 2000 to 2024

3 At least 1,010 ship and shore workers were found to have lost their lives in the 25-year period between 2000 and 2024 in enclosed spaces aboard vessels covered by the SOLAS Convention.

4 These fatalities were due to asphyxiation, toxic gas poisoning, explosion, fire, fumigant poisoning, falls, engulfment, struck-by/crush, burn, electrocution and drowning accidents in cargo spaces, adjacent spaces and non-cargo enclosed spaces of ships of all types at sea and in ports worldwide.

5 The average number of fatalities in enclosed spaces has declined from a maximum five-year rolling average of 57 deaths per year to an average of 50 deaths per year for the period 2020 to 2024. The highest annual number was in 2019, with 72 enclosed space fatalities identified.

6 The number identified to date for 2024 is at least 29. The reasons for this very welcome downward trend are unclear, but may in part be due to increased awareness on board and ashore due to the high levels of publicity that these accidents have generated in recent years.

7 The increasing number of legal actions in courts in many jurisdictions against ship operators, masters and port operators charged with failing to meet their safety responsibilities may also be a factor.

Cargo and non-cargo-related fatalities

8 Cargo-related hazards on tankers, bulk carriers and general cargo ships were responsible for 564 (56%) of the 1,010 fatalities. In total, 315 fatalities (31%) were related to the carriage and handling of solid bulk cargoes subject to the IMSBC Code, its predecessor the BC Code, and the Grain Code. The remaining 249 (25%) were liquid bulk cargo-related on tankers.

9 Of the 446 non-cargo-related fatalities, tankers, bulk carriers and general cargo ships accounted for 280, with the remaining 166 occurring on all other ship types. Maintenance and hot work activities on board by crew members, and also involving shore workers in ship repair yards and drydocks accounted for the highest proportion of these fatalities.

Ship and shore worker fatalities

10 Of those who died, 700 (69%) were crew members, and 310 (31%) were shore workers.

11 Document CCC 10/INF.32 (IBTA) identified a range of factors in these accidents, including:

.1 inadequate compliance and enforcement of enclosed entry procedures, the IMSBC Code and other regulations and industry guidelines, the provision of cargo health and safety information to ship and shore workers, training, ship design and equipment, and other factors; and

.2 the deadlines imposed either directly or indirectly by the "utmost urgency" clause typically contained in the most widely used charterparties. Time pressure is a widely recognized factor in many of the fatalities that occur in enclosed spaces, particularly in cargo spaces during cargo loading, discharge and subsequent hold and tank cleaning operations.

12 The wide-ranging amendments to the 2011 *Revised recommendations for entering enclosed spaces on ships* (resolution A.1050(27)), that are expected to be adopted this year, will address many of these issues, if implemented and enforced as intended.

13 It would therefore be helpful if the "utmost urgency" clauses in charterparties could be clarified or qualified by a safety clause that would incorporate the relevant recommendations in the updated version of A.1050(27). The aim of the clause would be to oblige the shipper, charterer, ship operator, master and load/discharge terminals to cooperate in the sharing of information and the agreement of a safety plan for the cargo to be carried, loaded, unloaded, as well as the cleaning down of cargo tanks or holds on completion, as applicable.

14 No cargo is so urgent or so important that it cannot be transported safely.

Action requested of the Sub-Committee

15 The Sub-Committee is invited to note the number of fatalities, trends and various contributory factors identified in this document in the context of the A.1050(27) recommendations, as amended, and to encourage other industry organizations to incorporate those recommendations in their own guidelines, codes and contracts of carriage by sea, as appropriate.

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ANNEX

TRUE SCALE OF ENCLOSED SPACE FATALITY ABOARD SHIPS REPORT

VISTRATO
enhancing bulk terminal operations

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True Scale of Enclosed Space Fatalities aboard Ships

Kevin Cribbin, Master Mariner, FCIS, G. IOSH - Technical Director, Vistrato Limited.

Background

1 Arising from concerns over the continuing loss of life of ship and shore workers in the cargo holds of ships loading/discharging solid bulk cargoes in ports and terminals worldwide, Vistrato, as an associate member of the International Dry Bulk Terminals Group (DBTG/IBTA) undertook to research all reported accidents and identify the underlying trends. IBTA initially submitted data to IMO on ship and shore worker fatalities in cargo holds during the handling of solid bulk cargoes and then subsequently extended it to assess the true scale of cargo-related and non-cargo-related loss of life in enclosed spaces on ships of all types.

Data sources

2 This analysis is based on information derived from the IMO GISIS marine casualties and incidents database, flag and coastal State marine accident investigation reports, and P&I Club, MARS, MAIIF and other publicly available industry and reputable media sources. Every effort has been made to ensure that accident data from different sources is not duplicated.

3 This report provides overall trends in enclosed space fatality numbers since 2000, but does not take account of the growth in the global fleet or to the numbers of seafarers, port or shipyard workers involved in working in enclosed spaces on ships.

Introduction

4 The research examines both ship and shore worker fatalities due to asphyxiation and/or toxic gas poisoning, explosion, fire, fumigant poisoning, falls, engulfment, struck-by/crush, burn, electrocution and drowning accidents in enclosed spaces, including cargo spaces, adjacent spaces and non-cargo enclosed spaces of ships at sea, in ports and shipyards worldwide.

5 It covers fatalities inside all spaces that meet the current definition in A.1050(27) for enclosed spaces as well as spaces that are not currently considered as enclosed, e.g. elevator shafts, hawse pipes, bilges, windlass electrical rooms and ventilation trunks. It also includes fatalities in crew accommodation and in engine rooms as a result of fumigant leaks from cargo holds, as well as accidental leaks from ships' CO_2 fire-extinguishing systems.

6 All fatalities within enclosed spaces are included, including falls inside cargo holds and tanks, but falls into a space, e.g. from hatch coamings, hatch covers, open manholes or external walkways into cargo or other spaces, are not included.

7 Fatalities arising from engine-room fires and explosions, electrocution, high-pressure steam and hot oil releases, struck-by falling objects and falls are also not included, unless they occurred in, or in connection with, an enclosed space, tank or boiler. However, it is clear that the number of these engine-room accidents is significant and seems to be increasing. The data analyses cargo-related fatalities and non-cargo-related fatalities on bulk carriers and general cargo/multipurpose ships carrying solid bulk cargoes separately. Cargo and non-cargo-related accidents on tankers are also considered separately.

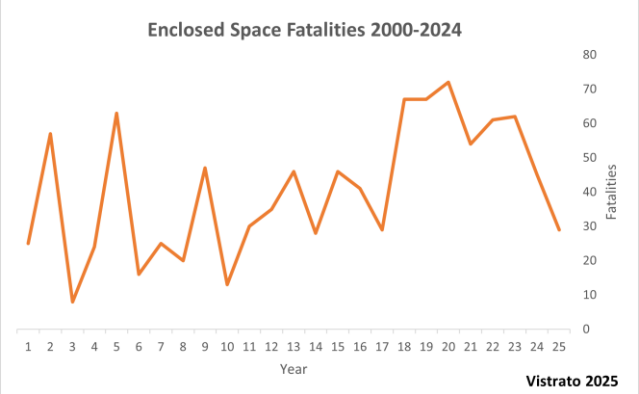
8 Fatalities on containerships, offshore, reefers, ro-ro, passenger vessels and dredgers are also included. Fatalities on livestock carriers, car carriers, ice breakers and commercial yachts are included as "Others" in the tables.

9 Injuries to personnel are not included, although it is clear that many hundreds of people have suffered life-changing injuries in enclosed and adjacent spaces on ships. The total number of dead and injured is estimated as averaging some 200 per year, if not more. The enormous financial costs arising from these deaths, injuries, explosions and fires are also not included.

10 It is not possible to include any measure of the human suffering caused by each of these tragedies.

Total enclosed space fatalities for the period 2000 to 2024

11 At least 1,010 ship and shore workers lost their lives in enclosed spaces between 2000 and 2024 on ships covered by the SOLAS Convention. The average loss of life is 40 fatalities per year for the 25-year period.

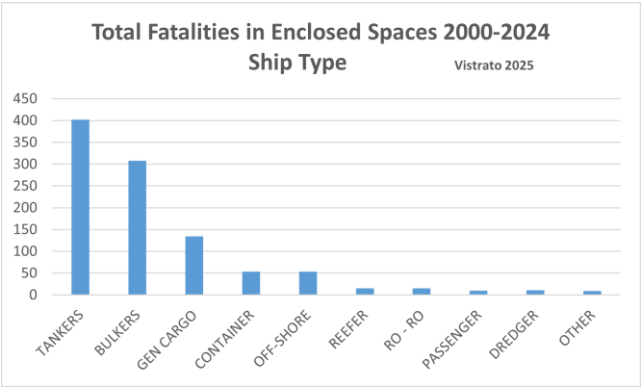


12 The worst year on record was 2019 with 72 fatalities.

13 The total loss of life for the last 5 years from 2020 to 2024 is 250, averaging 50 deaths per year, but is now showing a significant downward trend, with at least 29 fatalities reported to date for 2024.

Fatalities by ship type

14 In summary, the highest number of enclosed space fatalities occurred on tankers, with a total of 402 deaths. This was followed by 308 deaths on bulk carriers and 134 on general cargo ships.



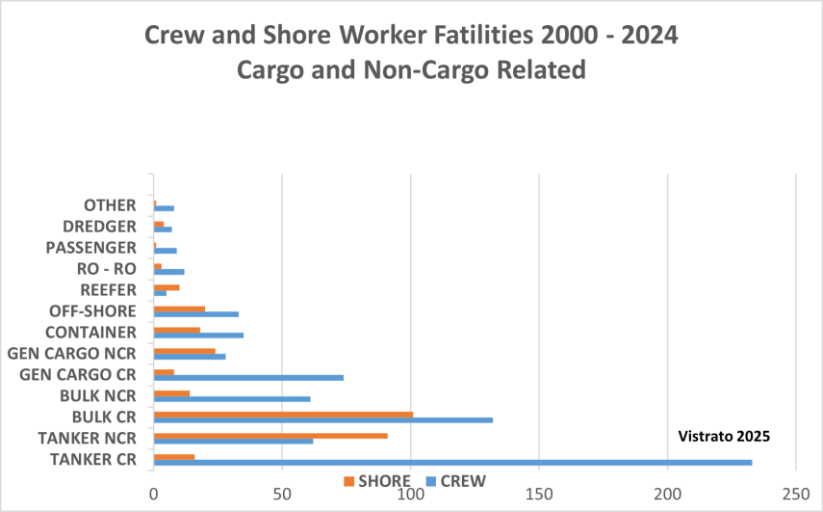
15 There were 53 deaths on both containerships and offshore vessels. Ro-Ro and reefer ships had 15 deaths each, together with 11 on dredgers, 10 on passenger ships and a total of 9 deaths on other vessel types, including car carriers, livestock carriers and commercial yachts.

16 It is also clear that smaller ships are more likely to be involved in these accidents than larger ships, particularly owing to the leakage of cargo gases from cargo spaces into adjacent accommodation, forecastle working areas and electrical switch rooms, ballast tanks and void spaces.

17 The annex of this report provides more detailed information on fatalities on different ship types.

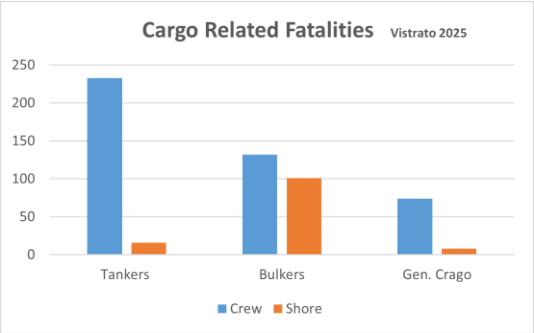
Crew and shore worker fatalities

18 Of the 1,010 fatalities identified, crew members accounted for some 700 (69%), with 310 shore workers (31%) also losing their lives while working in enclosed spaces on ships.



Cargo-related fatalities

19 Cargo-related hazards were responsible for 564 (56%) of the 1,010 fatalities on tankers, bulk carriers and general cargo ships.

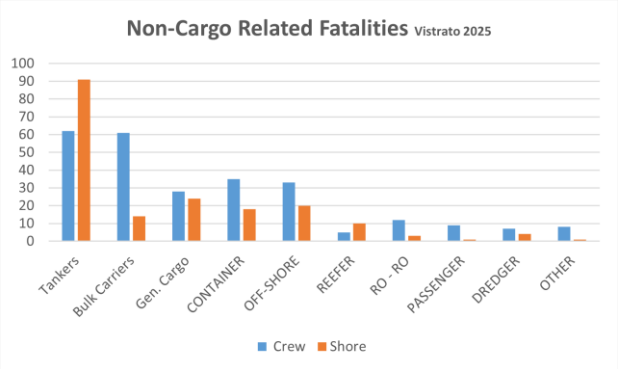


20 In total, 315 fatalities were related to solid bulk cargoes on bulk carriers and general cargo ships, of which 206 were crew and 109 were shore workers. These occurred during the shipping of cargoes subject to the IMSBC Code, its predecessor the BC Code, and the Grain Code, and amounted to 31% of all enclosed space fatalities on ships since 2000.

21 The remaining 249 occurred during the shipping of liquid bulk cargoes on tankers, amounting to 25% of all such fatalities.

Non-cargo-related fatalities

22 Some 446 deaths (44%) were non-cargo-related, with 280 occurring on tankers, bulk carriers and general cargo ships. The remaining 166 were on all other ship types:

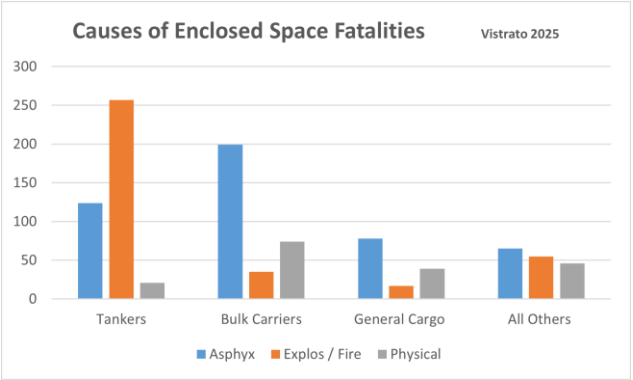


- Tankers: 153 (62 crew / 91 shore)
- Bulk carriers: 75 (61 crew / 14 shore)
- General cargo: 52 (28 / 24)
- Container: (35 / 18)
- Offshore: (33 / 20)
- Ro-Ro: (12 / 3)
- Reefer: (5 / 10)
- Passenger: (9 / 1)
- Dredgers: (7 / 4)
- Others: (8 / 1).

23 Most of the non-cargo-related fatalities occurred during routine maintenance and hot work activities, including a significant number on ships in shipyards and drydocks.

Causes of fatalities

24 It was found that 466 (46%) of all fatalities were caused by asphyxiation due to oxygen depletion and/or toxic gas poisoning. A total of 364 (36%) were due to explosion and/or fire and 180 (18%) were due to physical hazards in the space. Over 50% of those were due to falls.



25 Explosions and fires caused by flammable atmospheres were the main causes of the 402 enclosed space fatalities on tankers (64%) followed by asphyxiation/toxic gas (31%) and physical hazards (5%).

26 Asphyxiation/toxic gas was the biggest cause of the 308 deaths on bulk carriers (65%), followed by physical hazards (24%) and explosion/fire (11%). Asphyxiation/toxic gas was also the biggest cause of the 300 deaths on all other ship types (48%), followed by physical hazards (28%) and explosion/fire (24%).

Solid bulk cargoes involved

	Fatalities by Cargo		
	Asphyx	Explosion	Fire
Coal	54	6	1
Wood Prods	50		
Wood Chips	10		
Wood Pellets	8		
Grain	13		
Scrap	13		
Copper Conc	7		
Zinc Conc	6		
Seed Cake	6		
Pet Coke	5		
FM Borings	5		
DRI		8	
Zinc Ashes		6	

27 Coal caused at least 61 fatalities, followed by wood products – general, with 50 deaths. Excluding grain, all the cargoes involved in these fatalities are classified as group B, or group A and B, in the IMSBC Code, apart from scrap metal, which is classified as group C.

28 In addition to causing at least 13 fatalities due to oxygen depletion and/or toxic gas poisoning, there were also 30 fires with cargo described as scrap metal. Almost all these fires occurred during the loading of both bulk carriers and general cargo ships.

Gases involved

29 As well as presenting the risk of oxygen depletion, almost all the cargoes listed may also emit carbon dioxide, and also carbon monoxide.

30 Hydrogen gas was responsible for the DRI- and Zinc Ashes UN 1435-related explosions, with methane and/or hydrogen involved in the coal cargo explosions. It is noticeable that owing to the stringent precautions prescribed by the IMSBC Code and the iron metallics industry, there have not been any serious incidents with DRI cargoes in many years. It shows what can be done.

31 In summary, the most dangerous gases likely to occur with solid bulk cargoes are carbon dioxide (CO_2), carbon monoxide (CO), phosphine (fumigant gas), hydrogen and methane.

32 As the standard four gas detectors carried on every ship, as required by the SOLAS Convention, cannot detect CO_2 and may not be able to detect hydrogen, depending on the sensors fitted, it is not clear if every ship carrying cargoes liable to emit CO_2 and hydrogen actually carries an appropriate instrument for those gases, as also required by the SOLAS Convention and the IMSBC Code.

33 Hydrogen sulphide (H_2S) was responsible for many of the non-cargo-related toxic gas poisonings. It is said to be the most dangerous gas on the planet and can occur on every vessel in sewage and grey water systems, bilges, fuel oil systems, slop tanks, and on bulk carriers and general cargo ships in tanks containing HME hold wash water.

34 Initial reports of enclosed space fatalities that occurred during 2024 include:

.1 Tankers: An ordinary seaman collapsed and died in a cargo tank after entering to carry out tank cleaning while it was still being gas freed. A crew member died in a cargo tank that was being cleaned while attempting to rescue a colleague who had collapsed owing to nitrogen leaking into the space from an adjacent tank. In another tank cleaning accident, four crew members died owing to high levels of carbon monoxide caused by excessive heating of the residual cargo. In yet another tank cleaning accident, a chief officer fell from a hold ladder and was killed. A shore worker died in an oxygen depleted slop tank.

.2 Bulk carriers: A shore worker was asphyxiated when he entered a cargo hold containing coal via the vertical ladder but then tried to exit via the Australian ladder trunk which had not been gas freed. Two more shore workers died when, without authorization, they opened a hold access hatch to a cargo hold containing coal that had been secured by the crew to prevent entry. A shore worker removing fumigant materials from cargo holds died in an enclosed ladder trunk owing to oxygen depletion/toxic gas exposure. Another shore worker was killed in a hold during cargo discharge when he was struck by a grab. Hours after a bulk carrier departed a load port, explosions in the two forward holds due to high methane gas levels from the coal cargo caused serious damage but no injuries.

.3 General cargo ships: Two crew members died owing asphyxiation/toxic gas poisoning in a cargo hold containing animal feed (seed cake).

.4 Offshore: A crew member on an oil rig died owing to exposure to hydrogen sulphide gas when inspecting a fuel tank.

.5 Ro-Ro ships: Two shore workers died on a ship in a shipyard when they were crushed in an elevator shaft.

.6 Passenger ships: A crew member died when crushed in a service elevator shaft.

.7 Others: A shipyard worker died in a fire during hot work in the hold of an ice breaker. A chief engineer was electrocuted in a ventilation duct on a commercial yacht.

.8 Containerships, reefers, dredgers, car carriers, livestock carriers: No enclosed space fatalities identified to date for 2024.

35 The above initial reports are typical of all the enclosed space fatalities that occurred during the period 2000 to 2024, and which continue to occur to this date, even if currently at a reducing rate.

Findings

36 At least 1,010 lives were lost in enclosed spaces on ships during the 25-year period from 2000 to 2024. Some 700 of these were crew members and 310 were shore workers. 564 fatalities were cargo-related on bulk carriers, general cargo ships and tankers. The highest proportions of deaths occurred during tank cleaning on tankers and during the discharge of solid bulk cargoes on bulk carriers and general cargo ships, as seen again in 2024.

37 The remaining 446 non-cargo-related fatalities occurred mainly during maintenance work by deck and engine crew members at sea and in-port, and in shipyards by both ship and shore workers. These were primarily due to inadequate risk assessments and failure to ensure proper isolation, drain down/ventilation as necessary, and lock-out/tag-out of the equipment.

38 The most common cause of death was asphyxiation and/or toxic gas poisoning (46%), with the highest proportion of fatalities happening in cargo space accesses and ladders. Explosion and fire accounted for 36%, with physical hazards responsible for 18% of fatalities.

Conclusions

39 Accidents that occur year after year during the same activities by the same groups of workers under the same circumstances are not random or unpredictable. They are entirely predictable, systemic failures arising, in part, from inadequacies in the *Revised recommendations for entering enclosed spaces aboard ships* (A.1050(27)), as adopted in 2011.

40 The draft amendments to the 2011 Revised recommendations that were agreed at CCC 10 aim to address these inadequacies. These amendments include a wide range of safety measures, including the systematic identification of hazards, assessment of risk and identification of control measures to be carried out jointly by the designated ship and shore representatives where shore personnel are required to enter a cargo space containing hazardous cargo. The new amendments also recommend that the ship operator should ensure that adequate time has been allowed for any planned enclosed space activity, and that undue time pressure, either explicit or implied, is avoided.

41 The typical charterparties used by ship operators and charterers currently do not include any provisions or time for these safety measures to be implemented. Instead, they commonly include clauses that place a strict legal obligation on ship operators and masters to complete voyages with "utmost urgency" or "utmost dispatch" without providing for any specific arrangements as to how this can be done while at the same time ensuring the safety of the crew members and shore workers responsible for handling the cargoes concerned.

42 Many of the issues raised in the ongoing debates about "time pressure" could be resolved if "utmost dispatch" clauses were qualified by a safety clause that would incorporate the recommendations in A.1050(27), as amended. The aim of this safety clause would be to oblige the charterer, ship operator, master and load/discharge terminals to cooperate in the sharing of information and the development of a safety plan for the cargo to be carried, loaded, unloaded, as well as the cleaning down of cargo tanks or holds on completion, as necessary.

ANNEX

Enclosed space fatalities by ship type 2000 to 2024

Tankers

1 Tankers had the highest number of enclosed space fatalities with some 402 deaths in enclosed spaces (40% of all such fatalities). Tanker crew members are most at risk during tank cleaning operations, when over 45% of all fatalities occurred, mainly due to explosions. Shore workers are most at risk during shipyard repair work, with 25% of fatalities. Small coastal tankers are the highest risk vessel type. More detailed numbers are as follows:

.1 Cargo and non-cargo-related: 249 fatalities were liquid bulk cargo-related, of which 233 were crew members and 16 were shore workers. Of the 153 non-cargo-related fatalities, 62 were crew and 91 were shore workers.

.2 Ship/shore: 295 (73%) were crew members and 107 (27%) were shore workers.

.3 Causes: 250 (62%) fatalities were due to explosions and fires, 120 were due to asphyxiation/toxic gas poisoning, and 32 were due to falls and struck-by accidents.

.4 In port/at sea/in shipyards: 154 fatalities on tankers occurred at sea, 131 in port, 99 on tankers in shipyards and drydocks, 18 N/A. Almost all the fatalities at sea occurred during tank cleaning operations.

.5 Locations on board: 249 (62%) of deaths occurred in cargo tanks and accesses, with 38 on deck, 30 in ballast, bunker and slop tanks, 18 in forecastle workspaces and electrical switch rooms, 11 in pumprooms, 5 in compressor rooms, and the rest in other spaces.

.6 Activities: of the 249 cargo-related fatalities, 181 (80%) occurred in cargo tanks during tank cleaning and inspection operations. The remainder occurred mainly during maintenance work, hot work and recovery of fallen objects from cargo tanks.

.7 Of the 153 non-cargo-related fatalities, almost all occurred during repair and maintenance activities, hot work and routine inspections. Of the 99 fatalities in shipyards 68 occurred in cargo tanks.

.8 Ship sizes[1]: of 338 fatalities on tankers where the ship size was reported, 109 occurred on coastal tankers, 55 on small tankers, 83 on medium sizes, 57 on large and 34 on very large tankers.

Bulk carriers

2 There were at least 308 fatalities (30% of all fatalities) in enclosed spaces on bulk carriers between 2000 to 2024. Ship and shore workers are most at risk during cargo unloading operations when at least 30% of fatalities occurred, while falls during hold cleaning amounted to 8% of fatalities. With at least 35% of all fatalities, cargo hold access ladders and trunks are the most dangerous places on a bulk carrier. More detailed numbers are as follows:

[1] Coastal: to 10,000 t dwt; Small: 10-25k dwt; Medium: 25-55k; Large: 55-160k; Very Large: > 160kdwt +.

.1 Cargo and non-cargo related: 233 fatalities (76%) occurred during the carriage of solid bulk cargoes covered by the IMSBC Code, and grain, of which 132 were crew and 101 were shore. Some 75 were non-cargo-related, of which 61 were crew and 14 were shore.

.2 Ship/shore: 193 (73%) were crew members and 115 (27%) were shore workers.

.3 Causes: 177 (57%) fatalities were due to asphyxiation/toxic gas poisoning, 35 were due to explosions (31) and fires (4), 42 due to falls, 22 due to fumigant poisoning, 19 due to crush and struck-by accidents, 10 due to engulfment, and 3 due to burns/electrocution accidents.

.4 In port/at sea/in shipyards: 98 fatalities on bulk carriers at sea, 180 in port, 16 in drydocks/shipyards and 14 N/A.

.5 Locations on board: 213 of deaths occurred in cargo holds, including at least 110 on or in cargo hold ladders and trunks, 27 in ballast, bunker and slop tanks, 12 in void spaces, 12 in engine-room spaces, 5 in bilges, 5 in elevator lift shafts, 4 in forecastle workspaces and electrical switch rooms, 2 in hawse pipes, and the remainder in other spaces.

.6 Activities: of the 233 cargo-related fatalities, 74 occurred during cargo unloading operations, 15 during loading, 26 during cargo sampling and inspections, 23 during hold cleaning, 14 due to entry to the wrong hold, 7 while recovering fallen objects from holds, and 22 during maintenance related to cargo operations. Non-cargo-related fatalities were mainly due to maintenance and hot work with 32 deaths, tank cleaning/inspection with 13, tank painting with 11 and shipyard works with 16.

.7 Ship sizes[2]: of 241 fatalities on bulk carriers where the ship size was reported, 151 occurred on geared handy class ships, 60 on panamaxes, and 30 on post-panamaxes and capesizes.

General cargo ships

3 There were at least 134 fatalities (13% of total) in enclosed spaces on general cargo ships between 2000 to 2024. More detailed numbers are as follows:

.1 Cargo and non-cargo related: 82 fatalities occurred during the carriage of solid bulk cargoes covered by the IMSBC Code, and grain, of which 74 were crew and 8 were shore. The remaining 52 were non-cargo related, of which 28 were crew and 24 were shore.

.2 Ship/shore: 102 (76%) were crew members and 32 (24%) were shore workers.

[2] Geared ships include handysize, handymax and ultramax bulk carriers, as well as forest product carriers between 20,000 and 65,000 t dwt. Normally classified as general cargo ships.

.3 Causes: 62 (47%) fatalities were due to asphyxiation/toxic gas poisoning, 16 due to fumigant poisoning (12%), 17 were due to explosions (13) and fires (4) (13%), 22 due to falls (17%), 13 due to crush and struck-by accidents, and 4 due to electrocution.

.4 In port/at sea/in shipyards: 50 fatalities on general cargo ships at sea, 73 in port, 5 in drydocks/shipyards and 6 N/A.

.5 Locations on board: 87 deaths occurred in cargo holds, including at least 25 on or in cargo hold ladders and trunks, 14 in forecastle spaces, 11 in cabins and accommodation due to fumigant poisoning, 10 in ballast tanks, 6 on deck, and the remaining 5 in other spaces.

.6 Activities: of the known activities in progress in 82 cargo-related fatalities, 21 occurred during cargo unloading operations, 8 during hold inspections, 6 during hold cleaning, 16 during routine maintenance work, 6 during hot work. Of the 16 fumigant-related fatalities, 11 people died in their cabins and 5 while inspecting ballast tanks adjacent to cargo spaces under in-transit fumigation.

4 Of the known activities in the 52 non-bulk cargo-related fatalities, 16 died while loading/unloading non-bulk cargo, 8 during routine maintenance, 8 in shipyard accidents, 7 during hot work and 6 while handling tween-deck pontoons.

Offshore

5 There were at least 53 fatalities in enclosed spaces on offshore vessels, MODUs and FPSOs between 2000 to 2024. More detailed numbers are as follows:

.1 Ship/shore: 33 were crew members and 20 were shore workers.

.2 Causes: 18 fatalities were due to asphyxiation/toxic gas poisoning (15 crew and 3 shore), 31 due to explosions (17 crew and 14 shore), 2 due to fire (2 shore), 2 due to falls (1 crew and 1 shore).

.3 At sea/in port/shipyard: 21 people died at sea, 16 in shipyards, 14 in port and 2 N/A.

.4 Locations on board: 10 fatalities in oil rig legs, 9 fatalities in a pump-room, 7 in cargo tanks, 7 in ballast tanks, 3 in a chain locker, 3 in a boiler, 1 in an oil tank, 1 in a fresh water tank, 1 in a slop tank, 1 in a sewage tank and 10 N/A.

.5 Operations in progress: There were 16 fatalities during repair work in shipyards, 12 during routine maintenance, 3 during hot work, 3 during tank inspections (inc. 2 possible hydrogen sulphide knockdowns), 1 tank cleaning, and 18 N/A. There were also three near-miss accidents related to hydrogen sulphide gas (two sewage related and one in a ballast tank).

.6 Vessels involved: 22 fatalities were on MODUs, 18 on FPSOs, 12 on offshore supply vessels, 1 N/A.

Containerships

6 There were at least 53 enclosed space fatalities on container ships. More detailed numbers are as follows:

.1 Ship/shore: 35 of those who died were crew members and 18 were shore workers.

.2 Causes:

.1 Asphyxia/toxic gas poisoning: some 17 (14 crew and 3 shore) died owing to asphyxia/toxic gas poisoning, including 7 owing to accidental releases of CO_2, 6 in pipe tunnels, including 3 owing to H_2S from sewage and 3 owing to exhaust gas from a portable pump, 2 in a bilge, 1 owing to a gas leak from an ISO container in a cargo hold and 1 in a main engine (scavenge air receiver).

.2 Explosion/fire: There were 12 fatalities (10 shore and 2 crew) due to explosions, including 1 crew member due to a gas leak from a container in a hold, 1 fatality in a boiler explosion and 10 shipyard workers during hot work in a bunker tank.

.3 Falls: There were 17 fatalities (12 crew and 5 shore) due to falls, including 12 fatal falls in cargo holds, 1 in a ballast tank, 2 in an elevator shaft, 1 in an engine-room duct and 1 in a funnel stack grating collapse.

.4 Struck-by/crush: there were six deaths due struck-by or crush injuries (all crew members), four in elevator shafts, one in a cargo hold and 1 in a main engine crankcase.

.3 At sea/in port/shipyard: 11 fatalities occurred at sea, 24 in port and 18 on ships in shipyards.

.4 Location on board: 15 died in cargo holds, 10 in a bunker tank, 7 in CO_2 rooms, 6 in a pipe tunnel, 6 in elevator shafts, 3 in main engine housings, 2 in a bilge, 1 in a boiler, 1 in a ballast tank, 1 on deck and 1 in a funnel stack.

.5 Operations in progress: 52 fatalities during routine maintenance and inspection activities, including 7 during work on CO_2 systems, 10 during bunker tank maintenance, 5 crew and 1 shore worker died during elevator maintenance, 6 while working in pipe tunnels, 9 during inspection/ maintenance work in cargo holds, 3 during cargo loading, 5 during main engine maintenance, 1 during boiler maintenance and 1 during a ballast tank inspection.

Ro-Ro ships

7 There were 15 fatalities in enclosed spaces on Ro-Ros and car carriers, of which 10 were crew members and 5 were shore workers. More detailed numbers are as follows:

.1 Ship/shore: 10 of those died were crew members and 5 were shore workers.

.2 Causes:

.1 Asphyxia/Toxic gas poisoning: six crew members died owing to asphyxia/toxic gas poisoning, including two due to a CO_2 release and four due to hydrogen sulphide poisoning, one from a sewage system and three from bunker fuel.

.2 Explosion: Three died in an explosion on a Ro-Ro in a shipyard, including two shore workers and one crew member.

.3 Fire: One crew member died in a fire on a ship in a shipyard.

.4 Fall: One crew member died in a fall from an unguarded tween deck.

.5 Struck-by/crush: three crush fatalities in elevators shafts, including one crew member and two shore workers. Another shore worker was crushed in a bow thruster related accident.

.3 At sea/in port/shipyard: There were three fatalities at sea, five in port and seven on ships in shipyards.

.4 Location: two died in engine rooms, three in/near a bunker tank, one in a void space, one in a 'tween deck, three in elevator shafts, one in or near a bow thruster and four N/A.

.5 Operations in progress: There were seven fatalities in shipyards, six during maintenance activities and two due to a CO_2 release in an engine-room.

Passenger ships

8 There were 10 fatalities in enclosed spaces on passenger ships. More detailed numbers are as follows:

.1 Ship/shore: nine of those who did were crew members and one was a shore worker.

.2 Causes:

.1 Asphyxia/toxic gas poisoning: five people died owing to asphyxia/toxic gas poisoning. Three engine crew members and one shore person owing to hydrogen sulphide poisoning from sewage systems, and one crew died owing to oxygen depletion in a ballast tank.

.2 Struck-by/crush: there were three fatalities due to crush injuries in elevator.

.3 Burns: two crew members died owing to enclosed space related steam releases.

.3 At sea / in-port / shipyard: two died at sea and eight on ships in port.

.4 Location: three died in a pipe tunnel, one in a ballast tank, three in lift shafts and two on engine-room steam systems. One shore visitor died owing to H_2S gas poisoning in a toilet cubicle.

.5 Operations in progress: nine died during maintenance activities, one N/A.

Reefer ships

9 There were 15 fatalities in enclosed spaces on reefer ships. More detailed numbers are as follows:

.1 Ship/shore: 5 of those who died were crew members and 10 were shore workers.

.2 Causes:

.1 Asphyxiation/toxic gas poisoning: eight fatalities, including three crew and five shore.

.2 Explosion: one crew member died in a compartment during hot work.

.3 Fire: four shore workers died in the hold of a ship in a shipyard.

.4 Electrocution: one crew member was electrocuted in a forepeak tank.

.5 Fall: one shore worker died in a fall from a 'tween deck.

.3 At sea/in port/shipyard: eight persons died on ships in port, three on ships at sea and 4 in a shipyard.

.4 Location: 13 died in cargo holds, 1 in a forepeak and 1 N/A.

.5 Operations in progress: six died during cargo handling operations, four died during inspection/maintenance work, four in a shipyard and one during hot work.

Dredgers

10 There were 11 fatalities in enclosed spaces on dredgers. More detailed numbers are as follows:

.1 Ship / shore: seven of those who died were crew members and four were shore workers.

.2 Causes:

.1 Asphyxiation/toxic gas poisoning: four shore workers and two crew died owing to asphyxia.

.2 Drowning: four crew members died owing to drowning in cargo holds.

.3 Crush: one crew member died owing to crush injuries.

Other ship types

11 There were at least nine fatalities in total in enclosed spaces on livestock carriers, car carriers, ice breakers and large yachts. More detailed numbers are as follows:

.1 Ship/shore: eight of those who died were crew members and one was a shore worker.

.2 Livestock carriers: two crew member fatalities in enclosed spaces on livestock carriers.

.3 Car carriers: five crew members died on car carriers.

.4 Ice breaker: one crew member died during hot work in a cargo hold.

.5 Yacht (SOLAS): one crew member electrocuted in a duct during maintenance work.

.6 Causes:

.1 Asphyxia/toxic gas poisoning: five fatalities, four due to CO_2 releases and one due to toxic gas in a feed bin.

.2 Fire: one crew member died in a fire in a cargo hold during hot work.

.3 Electrocution: one crew member electrocuted in a ventilation duct.

.4 Engulfment: one crew member died in a feed bin.

.5 Crush: one crew member crushed by cargo in a cargo hold.

.7 At sea/in port/shipyard: three crew died on ships at sea, two in port and four in shipyards.

.8 Locations: three died in cargo holds, three in engine rooms, two in feed bins, one in a ventilation duct.

.9 Operations in progress: four died in shipyards, three owing to an engine-room CO_2 release and one during hot work; two during routine work, one during maintenance, one owing to a fire, one while securing cargo.

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