

**SUB-COMMITTEE ON
IMPLEMENTATION OF IMO
INSTRUMENTS
2nd session
Agenda item 6**

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DRAFT TEXT OF LESSONS LEARNED FROM MARINE CASUALTIES

1 FATALITY

Very Serious Marine Casualty: Man overboard resulting in loss of life

What happened?

A large containership was at sea, rolling gently to about 5 degrees. The bosun decided (without being instructed, or requesting permission) to use the 'ship's gantry crane to shift some steel pipes from the deck to the engine-room. He climbed into the crane [trolley or basket] to remove the safety pins that stopped the trolley from moving while the ship was at sea. As soon as the bosun removed the pins, the trolley began to move in an uncontrolled manner towards the ship's side with the bosun in it. The trolley hit the end stops on the gantry, but they failed to stop the trolley, which, along with the bosun, fell into the sea. Man overboard procedures were initiated and search and rescue operations were launched, but the bosun was not recovered and was presumed dead.

Why did it happen?

The bosun used the crane without permission of an officer and against the advice of the Able-Seaman who was assisting him.

The crane was being used at 5 degrees, its design angle of heel limit.

The safety mechanisms, which should have prevented the crane trolley from leaving the gantry, catastrophically failed.

What can we learn?

Lifting appliances should not be used without the appropriate permissions required in the ship's safety management system.

All lifting operations should be subject to planning, risk assessment and supervision.

- Lifting operations when a ship is moving in a seaway should be approached and planned/risk assessed with **extreme caution**.

Who may benefit?

Shipowners, operators and crews.

2 FATALITY

Very Serious Marine Casualty: Fall from height in a ballast water tank

What happened?

An officer, safety officer and crew member were proceeding to exit a ballast water tank. They had just completed an air quality inspection of the tank prior to its undergoing maintenance. The crew member, who was to be the last person to exit the tank, was about 1 metre from the exit when he lost his grip and fell approximately 10 metres. Although the crew member was treated in the tank, he succumbed to his injuries 2 hours later. It took 4 hours to cut an escape hatch by which the crew member could be recovered from the tank.

Why did it happen?

- The design of the tank's access prevented the immediate removal of the injured crew member from the inside of the tank.
- Fall arrestors, lanyards and safety harnesses were not being used, nor were there any brackets or strong points for securing safety equipment.
- The crew member was carrying a gas detector (which he wore around his neck and which lay on his stomach) and a rope while climbing the ladder. As he tried to untangle the gas detector, he lost his grip and fell.

What can we learn?

- Hazard and rescue assessments should be carried out prior to entering a confined space.
- Safety procedures should be established and followed for use of ladders. These should include keeping hands free at all times and using appropriate means for hoisting and lowering of tools and equipment.
- Tank entrance design should accommodate the possibility of evacuating an injured person.
- The importance of proper safety harness and its use.

Who may benefit?

Shipowners, operators and crews.

3 GROUNDING

Very Serious Marine Casualty: Grounding resulting in loss of life

What happened?

A general cargo ship proceeded to an anchorage to wait for the passing of adverse weather to pass. The following day, the weather conditions worsened and the ship started to drag anchor. Using the main engine, the master weighed anchor, then let go both the port and starboard anchors, but the ship continued to drag anchor towards a breakwater. The ship eventually grounded on the breakwater, damaging its hull. It then flooded, sank by the stern, and ended up on the sea bed with its bow above the water. Eleven of the 19 crew members on board lost their lives.

Why did it happen?

- The ship anchored on a lee shore
- There was no protection from the wind and sea in the anchorage area, and the ship's anchored position was upwind of the breakwater.
- The master considered that letting go both anchors with 8-9 shackles of anchor cable would be sufficient to maintain the ship's position.
- The weather conditions were such that the ship was unable to maintain its position using anchoring equipment.
- There was no consideration of preparing to abandon the ship before it was too late to do so, and the crew were left to defend for themselves.

What can we learn?

- The dangers associated with anchoring on a lee shore where high winds are forecast and the need to be familiar with the ship's anchoring capabilities and limitations.
- Be prepared for the possibility that weather conditions may be worse than forecasted.
- Vessel operators need to plan in advance the taking of other measures, including: engaging the main engine, manoeuvring to reduce the load on the anchoring equipment, weighing anchor and proceeding to sea.
- Ensure that preparations for an abandonment have been taken as early as possible to allow for an orderly evacuation from the ship.

Who may benefit?

Shipowners, operators and crews.

4 FATALITY

Very Serious Marine Casualty: Crew member hit by swinging crane hook

What happened?

A stevedore was using ship's cargo crane and grab to load cargo onto the ship. Upon completion of his daily shift, he left the crane with the grab connected and the boom in

the horizontal position, and then disembarked. Later, the chief officer arranged for two crew members to disconnect the grab from the crane to place it in its designated stowage position on the starboard side. While one crew member was on the deck disconnecting the grab from the crane hook, the other crew member was operating the crane from the crane's cabin to facilitate the grab disconnection. During the course of the work, the weather deteriorated and the ship encountered a heavy swell, causing it to roll and pitch. While the hook was being hoisted by the crane, it swung and crashed into the lower half of the operator's cabin. The crew member inside the operator's cabin was badly injured and taken to hospital, where he was declared dead upon arrival.

Why did it happen?

- No risk assessment was conducted before the job was carried out. The crew were not familiar with the crane operating procedures.
- Despite receiving a forecast of deteriorating weather, the ship's crew proceeded with the crane operation, ignoring the hazard.
- No precautions were taken to avoid the hook swinging as a result of the ship rolling and pitching in the heavy swell.
- The crane operator's cabin structure failed to provide sufficient protection to the operator inside.
- There were no specific instructions in the safety management system other than that the chief officer was to supervise the work on deck.

What can we learn?

- The importance of the risk assessment prior to work commencing.
- All crane operations should be closely monitored. Crane operations should be allowed during heavy weather.
- Crane operations should be covered in the ship's safety management system.
- Internal audits of all company ships should be carried out to ensure full compliance with the safety management system on the safe operation of cranes.
- Crane operating crew need to be fully briefed and familiar with operating limitations.
- The structure of a crane operator's cabin should be sufficiently reinforced or protected.

Who may benefit?

Ship builders, owners, operators, and crews.

5 FATALITY

Very Serious Marine Casualty: Stevedore struck by falling crane cabin panel.

What happened?

Two gangs of stevedores boarded the ship in to load granite blocks. The ship's cranes, operated by the stevedores, were used for lifting the cargo. Stevedores were also deployed to stow the cargo and unhook the cargo sling. While cargo loading was in progress, a crane cabin front view panel detached from its hinges and fell onto a stevedore, who was working in a cargo hold. The ship's emergency team was mustered to render immediate medical aid, and an ambulance was called. The victim was fatally injured and another stevedore in proximity received minor injuries.

Why did it happen?

- The hinges of the panel frame had badly corroded due to a lack of maintenance.
- A telescopic stopper, which had been provided to keep the panel in place at varied open positions, had been removed by the stevedore operating the crane. The stopper was substituted with a wooden plank to create a wider opening of the panel that increased ventilation and allowed a clear view of the cargo hold.
- The stevedoring company did not provide appropriate personal protective equipment for its employees for working in potentially hazardous areas.
- The ship's staff did not ensure that all equipment was in good working order and free of any defects.
- The ship's staff did not provide necessary information and instructions to stevedores about usage of ship's equipment prior to its use.

What can we learn?

- The ship's staff should provide safe ship gear and equipment to stevedores, ensuring that it is in good working order and free of any defects.
- The ship's staff should also provide necessary information and instructions to everyone working on board to ensure their safety while engaged in cargo handling operations. The safe working practices, the potential risks and the necessary safety measures while engaged in cargo handling operations must be provided.
- Due to the intense nature of the work of the crane operator, special care should be taken to ensure adequate ventilation of crane cabins so that the crane operator is able to carry out the work accurately and efficiently in optimum environmental conditions.
- Before putting any cargo gear in use, visual checks should be carried out to determine its serviceability. The manufacturer's pre-start and operation checklist for cargo cranes should be completed prior to cargo operations.
- Risk assessments must be reviewed and explained to all personnel involved in cargo operations. Where appropriate, when an additional risk assessment is necessary, this must be undertaken, documented and retained on record. Assessment must be sufficient and suitable.

- The stevedoring company should provide adequate personal protective clothing, such as safety helmet, safety shoes and safety harness, to its employees. Stevedores should undergo periodic training of safe working practices of various cargo operations.
- The stevedore team supervisor should meet with the ship's officer of the watch and obtain the necessary information and instructions to ensure the safety of his stevedores while they work on board the ship.
- The stevedores deployed on board ship must not tamper with cargo crane fittings or remove components. Instead, any malfunction or defects of the ship's cranes or other equipment in use by stevedores should be reported directly to the ship's crew.

Who may benefit?

Seafarers, shipowners, ship managers and stevedoring companies.

6 EXPLOSION

Very Serious Marine Casualty: Explosion of observation glass resulting in a fatality

What happened?

A bulk carrier was 3 months into its maiden voyage. An engineer on board was draining accumulated fluid from the main engine starting air receiver as part of a normal daily routine. The fluid drained into a drainage pot which was fitted with a toughened glass observation panel. The glass shattered and severely injured the engineer, who later died from the injuries sustained.

Why did it happen?

The observation glass and drainage pot were not fit for the purpose for which they were being used. The drainage pot was originally designed as an open-topped container with a drainage line leading to an appropriate bilge. During construction of the ship, at the request of the owner's representative, the drainage observation pot was modified by the shipbuilder to incorporate a toughened glass observation panel, the objective being to allow observation of the drainage without any splash-back. The modification could not withstand any significant build-up of pressure within the pot. The modifications were not submitted for classification society or flag Administration approval.

What can we learn?

- Compressed air can store a lot of energy, especially at the storage pressure found in main engine starting air receivers (30 bars in this case). It needs to be treated with the utmost respect. Significant back pressure can occur in small bore, lengthy condensate drainage lines, especially if, in the case of effluent from a starting air receiver, the drained fluid contains any emulsified lubricating oil.

- When making any design changes, an appropriate engineering analysis needs to be undertaken, especially for any modifications that effectively change an open drainage system into a pressurised closed one. Design validation and appropriate testing need to be undertaken. The classification society and flag Administration should be consulted and, if so directed, drawings submitted for approval.
- During the final stages of a ship's construction, vigilance is needed by all parties concerned to ensure that any deviation from approved arrangements are carefully and appropriately addressed and agreed. Agreed changes should be recorded.

Who may benefit?

Ship builders, owners, operators, classification society surveyors, and crews.

7 EXPLOSION

Very Serious Marine Casualty: Explosion in a fuel oil tank resulting in a fatality

What happened?

A bulk carrier was in port and had taken on bunkers. It was decided to completely drain a fuel oil settling tank because it contained fuel of poor quality. There was about 2.5 tons of heavy fuel oil in the tank. The flash point was said to be 82 degrees C. The tank exploded. Five crew members were injured; one subsequently died. There was significant damage to the engine room and machinery.

Why did it happen?

- The settling tank had been modified without approval of the flag Administration and Class Society. The original steam heating coils had been taken out of service and replaced with an internal electric heater, located 1.5 metres above the bottom of the tank. A second electric heater was fitted at a later date; this was located 0.7 metre above the tank bottom. These installations were not submitted to the classification society or flag Administration for approval. Both were equipped with automatic temperature control sensors which were located 1 metre above the tank bottom and set to maintain an oil temperature between 45-55 degrees C. However, these needed to be submerged in the fluid to function. No other protective devices were fitted to the heaters to shut off the current in the event that the heater coils were not submerged in oil.
- There was no low-level content alarm fitted to the tank, and the fuel level in the tank dropped below the level of one or both of the electric heaters without the engineers' knowledge. At the time of the explosion there was almost no fuel in the tank but the fuel heaters were still turned on. In such circumstances the temperature of the heater rod

surface could rise above the flash point of the fuel/air mixture and even to the point where the heating rod could rupture and cause an arc. The tank contained fuel oil vapour and air drawn down the vent pipe as the fuel was discharged. It was concluded that this mixture was ignited by one of the fuel heater rods.

□ There were no instructions on board for the electric fuel heating system and no information had been passed on to successive engineers.

What can we learn?

□ A full risk assessment should be made prior to undertaking any modifications to fuel systems. Drawings should be submitted to the classification society for approval. When modifications are made, after any necessary approval, records should be kept on board and any modifications to operating instructions should be incorporated into the ship's safety management system (SMS).

□ Consideration should be given within the SMS on how new crew members can be informed of any novel or unusual equipment installed in the ship, especially when it involves high-risk installations such as fuel systems.

□ Whenever intending to carry out tasks involving a deviation from established work procedures it is particularly important to do a full risk assessment prior to starting the task; all crew members carrying out the task should be fully briefed.

Who may benefit?

Shipowners, operators, crews, and surveyors.

8 FIRE

Very Serious Marine Casualty: Fire during hot work resulting in a fatality

What happened?

A general cargo ship was loaded with large machinery and metallic construction material. The cargo in the lower hold had been secured with wooden blocking and bracing using ropes, wires and turnbuckles. Securings on hatches and tween deck also included welded items.

At the discharge port, workers from ashore were contracted to cut off the lashings and securings. They were instructed by the ship's officer for the job, but a hot work procedure was not conducted in accordance with the ship's safety management system, and a hot work permit was not issued.

Some hours later, as the work went on, smoke was discovered coming from the hold. Though firefighting efforts were initiated quickly, the fire lasted for many hours and caused much damage. Three shore workers were injured, and another was later found deceased in the hold.

Why did it happen?

- The lack of a hot work permit procedure meant that no one had done a proper risk assessment for the work.
- The presence of shore workers may have confused the ship's officers, not realising that it was their responsibility to supervise shore workers as well as crew members.
- There was flammable material in the lower hold.

What can we learn?

- Ship's officers are responsible not only for supervising crew members, but also for shore workers conducting work onboard the ship. Flammable material should be kept in appropriate compartments. The location and proximity of compartments containing flammable matter to hot work areas should be taken into account when hot work permits are issued.
- Fulfilment of hot work permit procedures should include a safety assessment, making it easier to handle the risks identified.
- A ship's safety management system is not just a paperwork exercise; it is done to ensure the safety of the ship and crew.

Who may benefit?

Shipowners, operators, crews and shore workers.

9 ENGINE FAILURE

Very Serious Marine Casualty: Engine failure and grounding resulting in ship loss

What happened?

Although the chief engineer was concerned about high exhaust gas temperatures, a dry cargo ship departed for a long trans-ocean voyage. After a couple of weeks, the exhaust gas temperature increased and, consequently, the engine speed was reduced. Eventually the engine was stopped for detailed inspection and investigation. This revealed broken rings on almost all of the pistons and also determined that the fuel injectors did not work properly. The ship was adrift for several days while the engine crew worked on the problem. Many attempts were made to start the engine again, but it would not start.

Meanwhile, there was ongoing correspondence between the ship and the management company. After a few days, the master was informed that tug assistance had been ordered. At about the same time, the ship was approaching the shore and could drop anchor. When the tug arrived, the weather had become worse and attempts to connect the towing gear were unsuccessful. The ship started to drag anchor and later grounded. The crew eventually abandoned the ship by helicopter.

Another tug tried to connect to the ship, and succeeded. However, the ship was not allowed to stay within the exclusive economic zone, and finally sank some 100 miles off the coast in a water depth of 1000 metres.

Why did it happen?

- The investigation did not confirm the exact cause but suggested that the quality of bunkers, together with a permanent shortage of new fuel injectors and other spare parts, had a significant impact.
- The actions of the master were professional and adequate. However, as problems increased, there seems to have been too much time spent on communication with the company and too many parties were involved in decision-making. This caused the master to not fully appreciate the risks of the situation.
- The engine crew had not fully appreciated that the outcome of the situation relied on their completing the work efficiently.

What can we learn?

- Concerns and suspicions should be taken seriously and investigated satisfactorily before departing port.
- An adequate stock of spare parts should be kept on board, especially when concerns have been raised.
- Proper equipment and, in this case, proper quality of bunkers are essential for a safe voyage. If money is saved by using lower quality products, actions should be taken in advance to be able to handle problems that may consequently arise.
- Focus should be kept on the important issues. The master, being at the scene, should be given the support necessary to reflect and validate the situation on site frequently. This validation should then guide how the engine crew should plan their job.
- The importance of internal crew communications.

Who may benefit?

Shipowners, operators and crews.

10 GROUNDING

Very Serious Marine Casualty: Grounding leading to ship loss

What happened?

A bulk carrier was loading coal. Once loaded, the ship prepared to depart shortly before lunchtime with a pilot and a training pilot on board. All communications between the pilot and tug masters were in their native language. All communications between the crew were in their native language, which differed from that of the pilot and the tug master. The master, who was experienced and had been working on the ship before,

had returned from leave the day before. He felt comfortable enough to agree to the pilot disembarking before the ship had passed the breakwaters.

The ship was proceeding at about 8 knots when the engine was put to full ahead. The ship, still being in the channel, started to deviate slightly to starboard. The master ordered hard to port. The ship lost some speed and started to turn to port. The efforts to keep the course in the channel were unsuccessful, and the speed decreased even more. Then banging was heard, the steering alarm sounded and the rudder stopped responding (due to broken steering gear).

The ship had stranded on a sandbank at the side of the channel just outside the breakwaters, and cracks in the hull were soon discovered. The ship then broke in two. Fuel oil was removed and the ship was eventually sunk offshore.

Why did it happen?

- When planning the voyage, the increased draught due to the ship's movements caused by the swell, was not taken into account.
- The ability to manoeuvre a ship is considerably reduced when under-keel clearance is below half the ship's draught. Bank interaction also negatively affects a ship's manoeuvrability.
- The actions of the master, such as his request for full speed and full rudder angle, increased the loss of control of the ship, since the ship was moving in a narrow channel with little clearance underneath and at the sides.
- The pilot disembarked the ship before the ship left the channel increases risk..

What can we learn?

- Allowing the pilot to leave before the ship has reached the pilot station may impact on navigational safety.
- Masters and officers of the watch should be aware of the impact of bank interaction and squat I when increasing speed and manoeuvring in shallow and/or confined water.
- Dealing with several nationalities may be difficult. A working language, understood by the master, pilot and bridge team should be agreed prior to pilotage. If necessary, the IMO Standard Maritime Communications Phrases should be used..

Who may benefit?

Shipowners, operators, crews and pilots.

11 EXPLOSION

Very Serious Marine Casualty: Explosion in cargo area resulting in loss of life

What happened?

A 38,000 dwt product oil/chemical tanker was loading methanol. On completing first foot loading in all scheduled tanks, full loading commenced into 1P, 2P & S, and 6P & S tanks. When the quantity loaded into 6P & S tanks had reached 800 tons in each tank, loading was switched from 6P & S to 5P & S tanks, in line with the loading plan. At 0230 and about 30 minutes after this loading switch took place, an AB on deck reported a fire at the 1P tank P/V valve. The ship contacted the terminal and the loading was stopped. The delivery valves closed on 1P and 2P & S tanks within 7 minutes of the fire being reported. Shortly afterwards, there was an explosion in tanks 1P and 2P & S followed by explosions in tanks 5P & S and 6P & S. Five crew members lost their lives and the ship became a constructive total loss (CTL).

Why did it happen?

- CCTV footage showed that a lightning strike caused a fire at the 1P and 2 P & S tank P/V valves. The International Safety Guide for Oil Tankers and Terminals (ISGOTT) 5th Edition Para 26.1.3 – Electrical Storms advises "*When an electrical storm is anticipated in the vicinity of a tanker or terminal the following operations must be stopped, whether or not the ship's cargo tanks are inerted: handling of volatile petroleum, handling of non-volatile petroleum in tanks not free of hydrocarbon vapour.*" Similar – but not identical – advice can be found in the ICS Tanker Safety Guide (Chemicals). Although the ship's SMS reminded officers to monitor the weather conditions and stop the operation in the event of an electrical storm, this storm took the ship's crew by surprise. The P/V valves and associated flame arresters did not prevent the passage of flame into the tank (Note MSC/Circ.677 Revised Standards for the Design, Testing and Location of Devices to Prevent the Passage of Flame into Cargo Tanks in Tankers para 1.2.7 states "*These Standards do not include consideration of sources of ignition such as lightning discharges...All cargo handling, tank cleaning and ballasting operations should be suspended on the approach of an electrical storm.*").
- The cargo tanks were neither inerted nor purged with nitrogen prior to loading as neither the ship nor the loading berth had nitrogen-inerting capabilities.
- Closed-loop loading of methanol was not adopted at the terminal. Loading in this manner would have resulted in methanol vapours being returned to the terminal, rather than being vented through the P/V valves.
- While there can be no certainty that either inerting prior to loading or closed-loop loading with vapour return to the terminal would have prevented fire in the event of a sudden electrical storm hitting the ship, they may well have limited the consequences.

What can we learn?

- Weather should be monitored per ISGOTT and ICS for electrical storm activity when loading/discharging cargoes involving flammable vapours, especially in tropical areas prone to severe electrical storms.

- Both the terminal and the ship should have procedures in place requiring the immediate stoppage of cargo operations in the event of an electrical storm and describing the procedures to be followed; these need to take into account the terminal/ship interface and the respective responsibilities of the terminal and ship's personnel.

- Ship/Shore Safety Checklists set out in the ISGOTT and ICS guides should be carefully followed before and during cargo operations.

Who may benefit?

Ship and terminal operators.
