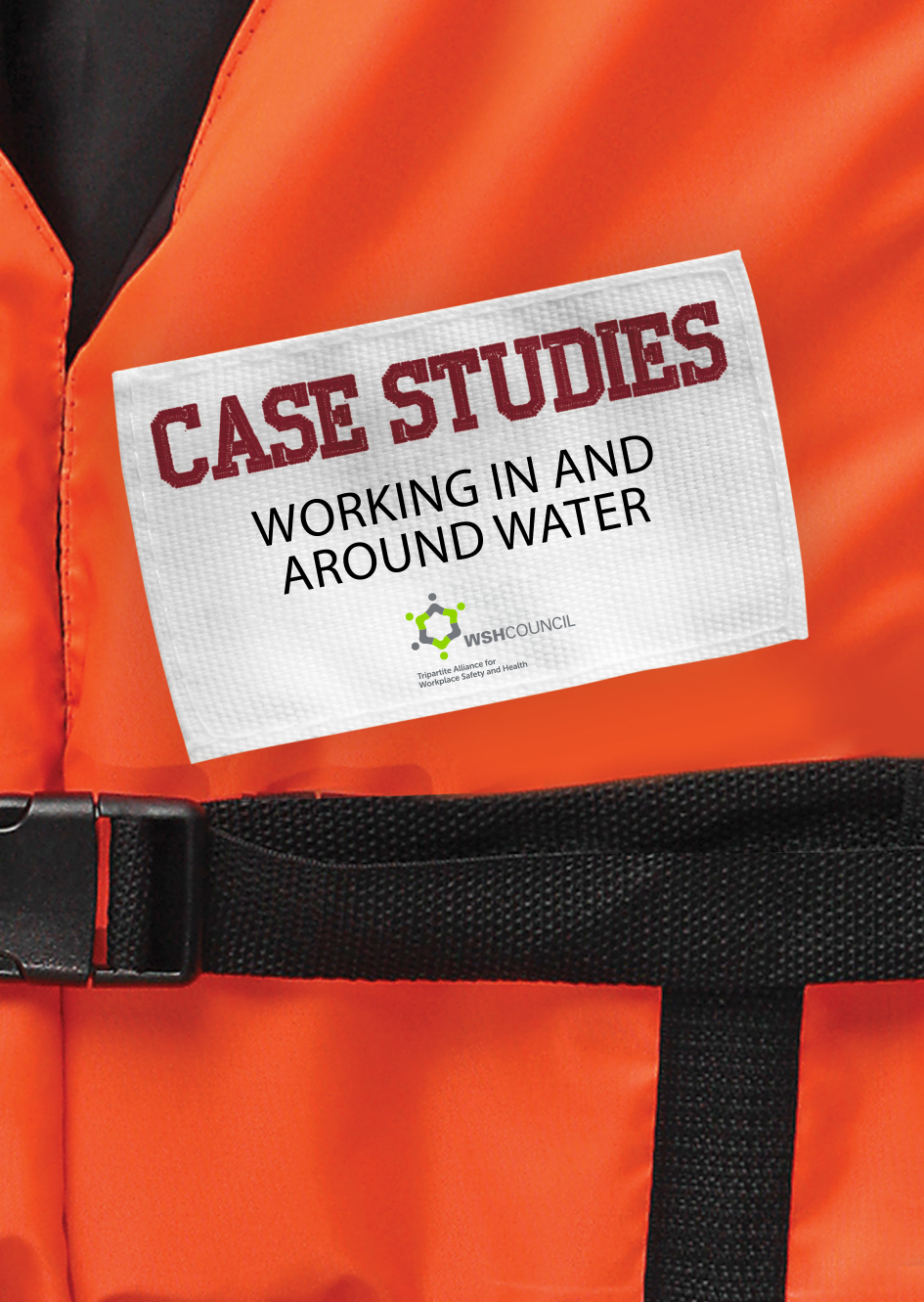

CASE STUDIES
WORKING IN AND AROUND WATER
WSHCOUNCIL
Tripartite Alliance for Workplace Safety and Health

Year of Issue: 2022

FOREWORD

Our workers are our greatest and most valuable asset. They deserve a safe and healthy working environment, and to return home to their families at the end of the workday. Over the past few years, the marine industries see about 300 injuries per year. We must stay committed in reducing these injuries by integrating safety and health into our daily operations and building a culture of safety.

It is with the above in mind that the Workplace Safety and Health (WSH) 2028 vision came to be, with the target to reduce and sustain Singapore's workplace fatality rate at less than 1.0 per 100,000 workers by 2028. One of the strategies to achieve this is the strengthening of a company's WSH ownership among top management and workers. With the shared responsibility between top management and workers, we will be able to achieve a good culture of safety and health at work.

To raise WSH awareness and reiterate the importance of strengthening WSH ownership at all levels, the Workplace Safety and Health Council (Marine Industries) Committee[#] has compiled a case studies booklet for working in and around water. This booklet has been developed in collaboration with stakeholders including the Ministry of Manpower, the Maritime and Port Authority of Singapore and the National Maritime Safety at Sea Council. The case studies include scenarios like movement of persons from one vessel to another, transport via barges and mooring operations. Learning points are shared in the sections on observation and findings, causal analysis, and recommendations.

We urge you to share these case studies during in-house WSH trainings and toolbox meetings in your organisations. We also encourage you to share them with your industry counterparts, contractors, and sub-contractors for their learning as well. Together, we can make our workplaces safe and healthy for all workers.

Prof Chan Eng Soon
Chairman
Workplace Safety and Health Council
(Marine Industries) Committee

[#]The WSH Council (Marine Industries) Committee comprises representatives from the government agencies, unions and associations.

CONTENTS

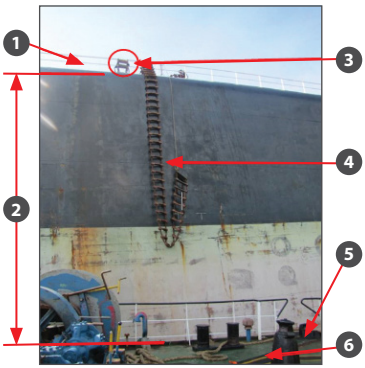
CASE 1

WORKERS FELL FROM HEIGHT AFTER ROPE LADDER BROKE

Description of Accident

Bunkering operations were in progress between a bulk carrier and a bunker vessel. The Injured was climbing up a rope ladder from the bunker vessel to board the bulk carrier when the Deceased descended the same ladder from the bulk carrier to board the bunker vessel at the same time. The rope ladder broke and caused both men to fall.

The Deceased landed on the forecastle deck of the bunker vessel, while the Injured struck against the same deck before falling into the sea. Both men were rescued by a passenger craft in the vicinity and sent to the hospital, where the Deceased passed away.



Photograph shows the height from the main deck of bulk carrier to the forecastle deck of bunker vessel.

1. Bulk carrier main deck.
2. Height measured about 12m.
3. Remaining rope ladder after accident.
4. Emergency Ladder (rigged after the accident).
5. Deceased landed somewhere here.
6. Bunker vessel forecastle deck.

Observations and Findings

Man

- Both men did not notice each other when using the rope ladder at the same time. Both were also not wearing life jackets at the time of the accident.

Method

- There were no means of control and communication when using the rope ladder. According to the International Convention for the Safety of Life at Sea, an accommodation ladder shall be used in conjunction with a pilot ladder whenever the freeboard is more than nine metres (the freeboard between the two vessels was more than 12 metres).

Material

- The rope ladder had degraded due to wear and tear.

Causal Analysis

Evaluation of loss	• One fatality and one injury.
Accident type	• Fall from Height.
Failure of WSHMS	• Failure to maintain rope ladder regularly, failure to verify its integrity prior to usage, and lack of communication and control on its use.

Lessons Learnt and Recommendations

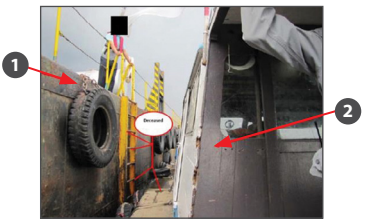
Risk assessment	• Conduct a risk assessment (RA) to mitigate all risks associated with the usage of rope ladders on board vessels. Recommended risk control measures should include providing safe access on the vessels and the donning of personnel flotation devices.
Safe work procedures	• Establish a safe work procedure (SWP) for using the rope ladder and communicate the SWP to all levels. The climb up a rope ladder should not exceed nine metres. An accommodation ladder should be used in conjunction with a pilot ladder whenever the freeboard is more than nine metres.
Work planning	• Ensure that only one person is using the rope ladder at any one time. Work should be planned to minimise the need to travel between vessels.
Equipment and tools	• Check rope ladders on board vessels on a regular basis to ensure that it is in good condition. Inspection of equipment should include, but not be limited to, wear and tear of side ropes, missing wedges and damages on the steps.
Coordination and communication	• Establish proper work coordination and communication prior to and during work execution.
Training	• Provide adequate safety and health trainings, including in-house trainings, to generate awareness of the hazards associated with the work activity and specific work environment.

CASE 2

WORKER FELL INTO SEA WHILE ATTEMPTING TO CLIMB LADDER TO BOARD A BARGE

Description of Accident

The Deceased was on a launch boat attempting to climb a ladder to board a barge when he lost his balance and fell into the sea. The Deceased was rescued and taken to the hospital where he passed away.



Photograph showing the launch boat parked beside the barge for the workers to climb up the ladder.

1. Barge.
2. Launch boat.

Observations and Findings

Man

- The Deceased was under medication for flu, which could have caused him to be drowsy. He was wearing an inflatable life jacket which had activated after he fell into the sea.

Environment

- The rocking of the launch boat due to rough sea conditions could have contributed to the Deceased losing his balance when climbing the ladder.

Causal Analysis

Evaluation of loss	• One fatality.
Accident type	• Slips, Trips & Falls.

Lessons Learnt and Recommendations

Fitness for work	• Implement a system for employees on medication to notify their supervisors so that they can be excused from strenuous or high-risk activities such as the climbing of ladders.
Ladder	• Cover rungs with non-slip materials to improve one's grip/footing. Always maintain 3-point contact.
Pre-embarkation briefing	• Prior to embarkation/disembarkation, brief workers involved in boat-to-vessel or vessel-to-boat transfers on topics such as the method of transfer and use of personal protective equipment (e.g. anti-slip footwear and life jacket). Employers should also ensure that workers are physically fit for the transfer.
Favourable environmental condition	• Always observe the environmental/weather conditions. The ladder should not be used for vessel embarkation/disembarkation during adverse weather conditions (e.g. heavy rain, lightning, strong winds and choppy waters).
Personal protective equipment	• Provide adequate personal protective equipment (PPE) such as anti-slip footwear and life jackets, and ensure that workers always wear them while working near water bodies. In addition, employer should ascertain workers' ability to swim before deployment to reduce the risk of drowning should workers fall into the water.
Risk assessment	• Conduct a thorough RA to identify and mitigate any foreseeable risk that may arise during embarkation or disembarkation of vessels. The RA should cover, but not limited to, health of workers and a response plan for emergencies.

CASE 3

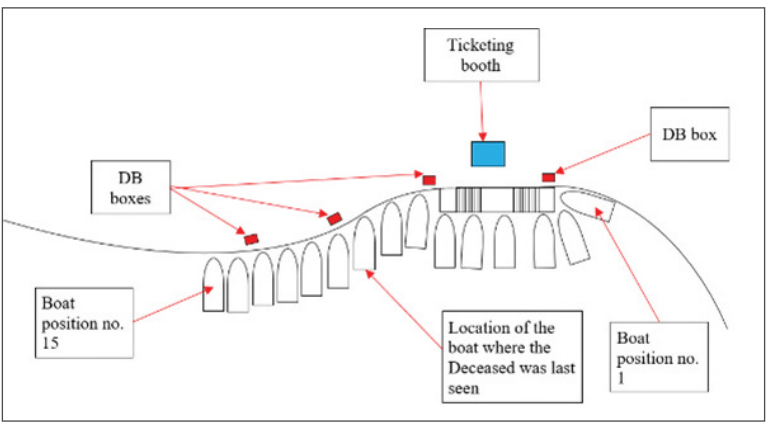
WORKER DROWNED AFTER FALLING INTO WATER

Description of Accident

The Deceased and a co-worker, who worked for a river cruise company, reported for their night shift duty to berth and charge the electric boats at the jetty. While the co-worker was doing his rounds, he saw the Deceased resting onboard a boat. About two hours later, the co-worker could not locate the Deceased. The police were notified after failed attempts to locate the Deceased.

The Deceased's body was found about 16 hours later, floating near the location of the boat where he was last seen.

The Deceased could have slipped and fell into the water when he was making his way from the boat back to land. He could either be climbing from the boat to the pathway or climbing from one boat to another to access the landing point located near the ticketing booth.



The location of the boat where the Deceased was last seen.

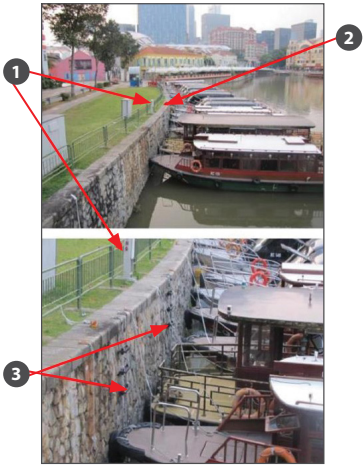
Observations and Findings

Man

- The Deceased did not know how to swim, was not wearing a life jacket, and fell into water.

Method

- The Deceased likely exited the work area through an unsafe path that exposed him to risks.

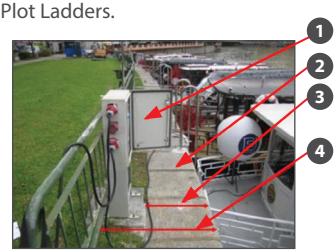


Photograph showing boats berthed at the Fort Canning Jetty, and the pilot ladders used by the employees to transfer between the boats and the pathway.

1. DB Box.

2. Pathway.

3. Plot Ladders.



Photograph showing the width of the pathway.

1. DB Box.

2. Pathway.

3. Pathway measured 0.7m.

4. Pathway measured 1.1m.

Causal Analysis

Evaluation of loss	• One fatality.
Accident type	• Drowning.
Failure of WSHMS	• Failed to ensure that employees don life jackets when working near water, no RA was conducted for the activities of berthing and charging of boats, no proper means of access or egress between boat and land, no measures to prevent employees from falling off the edge of the pathway into the water or onto the deck of boats.

Lessons Learnt and Recommendations

Risk assessment	• Conduct a proper RA before any work commences, in particular for all activities on a boat or near a body of water to control any foreseeable risk that may arise during work. The RA should include slip, trip and fall hazards along access routes, falling hazards while getting on or off a boat, rescue plan in the event of emergencies, health condition of workers and assessment of workers' ability to swim.
Safe work procedures	• Establish proper safe work procedures for works near bodies of water.
Training and awareness	• Brief workers on the risk of working near bodies of water. Topics should include visibility while at work and the use of proper PPE such as anti-slip safety shoes.
Safe work environment	• Ensure that there are safe means of access to and egress from shore-to-boat or boat-to-shore, and when moving between boats. This can be achieved, for example, through the provision of a jetty and gangway.

Safe work environment (continued)	• Check access routes regularly to confirm that the walk path and the steps on the vertical ladder are in good condition and safe for use. Remove any visible contaminations (e.g. oil, mud) as soon as possible as these can lead to slip and fall incidents. • Provide adequate general and task lighting at specific work areas (e.g. the battery charging area in this case) on the boat and on shore. This is especially important for works carried out during hours of darkness and at times of reduced visibility. Use portable lamps or light-mounted headgear for task lighting at an outdoor location.
Worker training and communication	• Ensure workers undergo adequate safety and health training in relation to their specific roles and responsibilities and that they are aware of the hazards associated with the work activity and work environment. • Deploy workers who can swim for work on boats or near a body of water. • Conduct daily toolbox meetings prior to work commencement and shift-handover to communicate all relevant information and instructions concerning safety and health.
Worker supervision	• Closely supervise all workers who are new to the work activity or work environment until they are fully aware of the site-specific risks and are competent for the assigned task.
Emergency response	• Equip each boat with life-saving equipment (e.g. life buoy with rope) for use in the event of an emergency. Mount life-saving equipment at easily accessible locations along the shore where the boats are berthed.

CASE 4

WORKER FELL INTO SEA WHEN GANGWAY TIPPED OVER

Description of Accident

The Deceased stepped onto a gangway to disembark from a vessel back to the wharf after checking the lifting points of cargo onboard the vessel. The gangway tipped over the edge of the wharf and the Deceased fell into the sea together with the gangway. The end of the gangway was resting on the edge of the wharf, but it was not properly secured.

The Deceased was rescued but subsequently pronounced dead by attending paramedics on scene.

Photograph showing flat top barge — With cargo berthed at another location post accident.

1. Cargo such as dump trucks and containers
2. Edge of wharf
3. Starboard side board

Photograph showing the gangway which was involved in the accident.

Observations and Findings

Man

- Worker did not don life jacket when he started work.

Method

- Unsafe method to board and disembark from the vessel before the gangway was secured.

Causal Analysis

Evaluation of loss	• One fatality.
Accident type	• Slips, Trips & Falls.
Failure of WSHMS	• Failed to ensure that workers are only allowed on barge when the gangway is secured, failed to ensure that workers don life jackets when working near bodies of water, and safe work procedures were not established for stevedore operations.

Lessons Learnt and Recommendations

Risk assessment	• Conduct a thorough RA before any work commences. RA should identify falling into the sea as a hazard.
Safe work procedures	• Establish safe work procedures; they should include the following (non-exhaustive): - Secure the gangway properly at both ends, i.e. vessel and wharf side. - Maintain and check the gangway at regular intervals according to the maintenance regime to ensure it is in proper condition for use. - Ensure all moving parts are in good working conditions and are well greased. - There should also be at least one crew member (often referred to as the gangway watch) on board the vessel tending the gangway and observing passenger movement. The gangway watch would be able to initiate emergency response should an accident occur.
Work planning	• Do a thorough work planning before works start (e.g. gangway is secured). The owner, agent, master, or person-in-charge of a vessel must ensure that all railings and fencing of hatchways, accommodation ladders and gangways are of substantial construction, constantly maintained and kept in position during use.

CASE 5

WORKER FELL INTO SEA WHILE MOVING FROM VESSEL-TO-VESSEL

Description of Accident

The Deceased and a co-worker were tasked to repair an engine onboard vessel O berthed at a shipyard. They agreed to meet at the shipyard, but the Deceased arrived first and proceeded to the quay.

Holding a bag in his right hand, the Deceased crossed a gangway to board vessel F and proceeded to crossed over two more adjacent vessels G and H. In his attempt to cross over to vessel H, the Deceased stood on a fender tyre in vessel G and stepped across to a fender tyre in vessel H. When the Deceased reached the gunwale (the upper edge or planking of the side of a vessel) of vessel H, he slipped and fell through the gap between vessel G and vessel H.

A worker on another tugboat subsequently noticed the Deceased's body afloat at sea. The Deceased was brought to shore where he was pronounced dead.

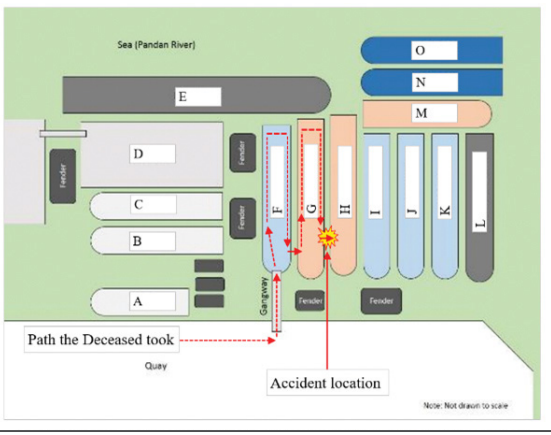


Illustration shows the path the Deceased took and the location of the accident.

Observations and Findings

Man

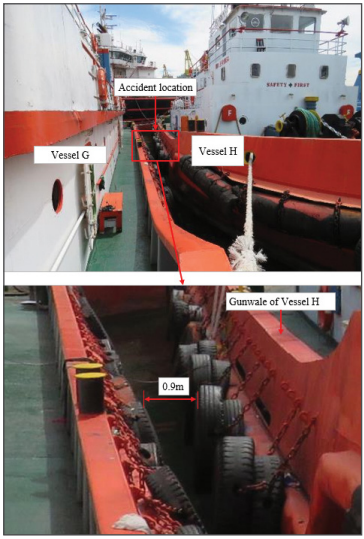
- Worker did not wear a life jacket.

Method

- No proper means of access was provided for persons to access to/ egress from vessel to vessel.

Environment

- The mooring and tide conditions could have caused the vessels to move away from each other.



Photographs show the accident location between the 2 berthed vessels.

Causal Analysis

Evaluation of loss	• One fatality.
Accident type	• Drowning.
Failure of WSHMS	• Failed to ensure safe access to and egress from vessel-to-vessel at the shipyard.

Lessons Learnt and Recommendations

Risk assessment	• Prior to the start of any work, conduct an RA to identify all hazards and risks involved, and establish and implement control measures and safe work procedures. RA must cover the possibility of falling into the water while working on a vessel, especially when moving from shore-to-vessel or vessel-to-shore, and when moving between vessels. Risk controls could include deploying workers who can swim and ensuring every worker uses a life jacket when working on the vessel or near water. Place workers who are unfamiliar with the work activity or the operating environment under immediate supervision until they are fully aware of the associated risks and are competent to perform their tasks.
Safe work procedures	• Develop safe work procedures for all work activities. Identify designated access points from vessel-to-vessel during the workplan. Workers should be made aware of specific onsite hazards and strictly adhere to the risk control measures, including wearing personal protective equipment (e.g. life jacket and safety boots).
Safe work environment	• Ensure that there is a safe means for access and egress when driving or walking from shore-to-vessel or vessel-to-shore, and while on the vessel. • As part of workplace housekeeping, check all access routes on a regular basis to confirm that the gangway and walkways are in good condition and safe for use. Remove any visible substance (e.g. oil, mud)as soon as possible as these can lead to slip and fall incidents. This is particularly dangerous if the fall occurs near a water body.

Safe work environment (continued)	• Remove tripping hazards where possible or, if not possible, make them clearly visible by marking them in bright colours and installing hazard signs near the location where a potential trip incident can happen.
Work planning	• Plan all routes to the vessel.
Equipment and tools	• All employees must wear life jackets when working near bodies of water.

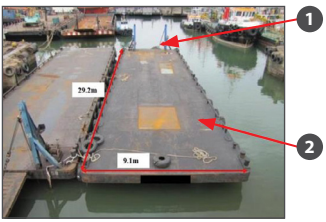
CASE 6

WORKER SEATED IN A LORRY LOADER FELL INTO SEA TOGETHER WHEN IT ROLLED OFF BARGE

Description of Accident

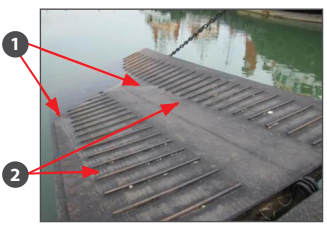
A barge transporting a lorry loader was being towed by a tugboat at sea when the lorry loader rolled off the barge into the sea. The Deceased was seated in the driver seat.

The lorry loader had completed its delivery to a Southern Island of Singapore and was on its way back when the accident occurred. The Deceased drowned, and his body was found two days later along the coastline of Jurong Island.



Photograph showing the barge involved in the accident.

1. The ramp at one end of the barge.
2. The barge involved in the accident.



Photograph showing the pair of slanting tyre marks and the skid marks over the edge of the ramp.

1. Skid marks over the edge of the ramp.
2. Pair of tyre marks slanting over the edge of the ramp.

Observations and Findings

Method

- The lorry loader was not effectively tied down onto the barge to prevent it from moving during the sea journey. The lorry loader's wheels were not chocked, and the hand brakes were not applied. The ramp was not raised and secured during the sea voyage.

Environment

- Sea conditions (e.g. choppy waters) could have contributed to the lorry loader moving when on the flattop barge.

Causal Analysis

Evaluation of loss	• One fatality.
Accident type	• Drowning.
Failure of WSHMS	• Lack of safety awareness, hazards not identified, no measures in place to prohibit workers or any persons from remaining within the lorry cabin during the sea journey, and failure to properly secure the lorry loader on the flattop barge.

Lessons Learnt and Recommendations

Risk assessment	• Conduct an RA to mitigate all risks associated with the transport of vehicles and workers on board barges.
Safe work procedures	• Establish safe work procedures for transports on barges and communicate them to every worker. Safe work procedures should include positioning of loads on the barge to ensure that the weight is distributed evenly. The ramp should be fully raised up after securing the load. Any vehicles or moveable loads should be tied down and secured to prevent movements during transportation.
Work planning	• Ensure that there is adequate safety and health training in relation to operators' roles and responsibilities. Operators should be aware of the hazards associated with the work activity and specific work environment.
Equipment and tools	• Ensure that the vehicles have their brakes engaged and wheel chockes installed before any sea journeys.
Personal protective equipment	• Ensure workers are properly attired and equipped with the necessary personal protective equipment (e.g. anti-slip footwear and life jackets) for work at locations where there is a risk of falling overboard.

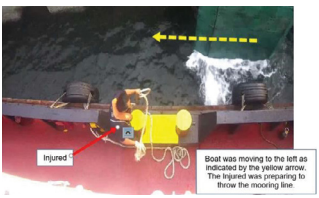
CASE 7

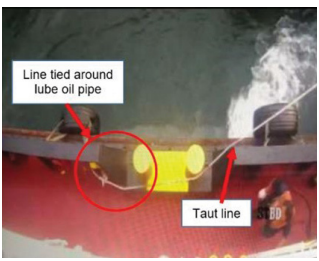
WORKER'S HAND STRUCK BY MOORING ROPE

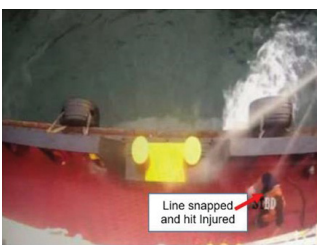
Description of Accident

The Tug Master (i.e. boat captain) of a tugboat was instructed to moor his tugboat at a terminal. The tugboat approached the berth and the Injured threw the mooring line over the berth bollard.

The Tug Master ("TM") then received a job request to un-berth a client vessel, and proceeded to move the tugboat away from the berth without notifying the Injured. The mooring line, with one end looped around the bollard and the other end tied to the lube oil pipe of the tugboat structure, became taut as the boat moved away from the berth. The line snapped from the tension and whipped the right hand of the Injured. The Injured was conveyed conscious to hospital. He suffered crush injuries to four of his fingers (thumb to ring finger) on his right hand; the index finger could not be re-attached.







Observations and Findings

Man

- Ineffective communication between the TM and the Injured.

Method

- The Injured had tied the mooring line to a structure that was not meant for mooring purposes, thus creating a snapback zone on the deck. The Injured had also assumed the boat was berthing and had thrown the mooring line to the berth bollard.

Causal Analysis

Evaluation of loss	• Worker lost index finger.
Accident type	• Struck by Moving Objects.
Failure of WSHMS	• Failure to follow safe work procedures.

Lessons Learnt and Recommendations

Risk assessment	• Communicate RA to all personnel. Brief all workers on the possible hazards and risks at the designated work area. Advise workers to stay away from hazardous areas especially if their work does not require them to be at that location.
Safe work procedures	• Brief all personnel on the safe work procedures, especially prior to any work. Workers should not moor the boat before the boat has berthed/or until explicit instructions has been given by the TM.
Coordination and communication	• Establish proper work coordination and communication prior to and during work execution. Provide radio communication devices (e.g. walkie-talkies) to enhance communication, particularly in noisy work environments.
Training and awareness	• All personnel must be adequately trained for the involved work. All workers must stay clear of tensioned lines, which pose as a potential hazard.
Fatigue management	• Boat captains and workers should be well rested before operations. Allow short breaks to be taken during the workday to relieve fatigue. This will ensure that boat captains and workers are alert and able to fully concentrate on their tasks.

CASE 8

BOATMAN CAUGHT IN-BETWEEN BOAT CABIN AND MOORING DOLPHIN

Description of Accident

The Deceased was securing his mooring boat to a mooring dolphin (a concrete structure built into seabed and extends above water surface to provide mooring point(s) for vessels). He was standing outside his cabin when a wave hurled the mooring boat towards the mooring dolphin. The boat started rocking and the Deceased's head was pinched between the boat cabin roof and mooring dolphin. He was conveyed to hospital where he passed away.

Photograph showing the mooring boat.

Photograph showing the mooring dolphin.

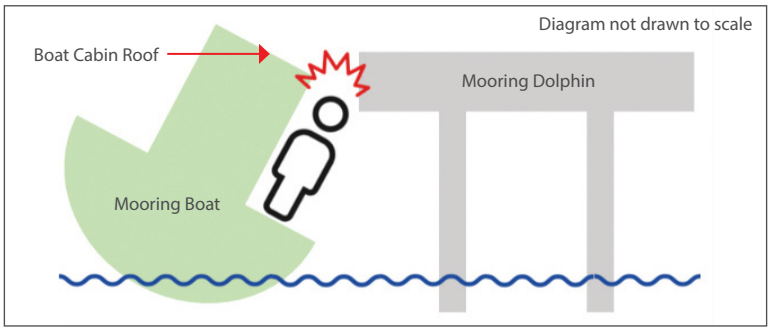


Illustration of how the accident had occurred.

Observations and Findings

Man

- The boatman was not wearing his safety helmet at the time of the accident.

Environment

- The sea condition had caused the mooring boat to rock, which resulted in the boatman's head getting caught in-between the boat's cabin and the mooring dolphin.

Causal Analysis

Evaluation of loss	• One fatality.
Accident type	• Caught In/Between Objects.
Failure of WSHMS	• Inadequate RA to mitigate the risk of the waves and currents caused by choppy waters. RA also did not state the safe distance requirement to which the mooring boat should keep from the mooring dolphin.

Lessons Learnt and Recommendations

Risk assessment	• Conduct a thorough RA to identify and manage any foreseeable risk that may arise during both routine and non-routine mooring operations. • Consider vessel-related factors (e.g. the size and type of vessel, impact of a passing vessel) and environmental factors (e.g. wind, tidal conditions) when conducting the RA. • Communicate the RA (including all identified hazards and control measures) to all workers and relevant parties.
Safe work procedures	• Establish and implement safe work procedures for vessel berthing operations. • Include the safety distance that mooring boats should keep during mooring activities, e.g. between mooring boats and mooring dolphins during standby and passing of mooring lines to jetty line-handlers, and between mooring boat and vessel when picking up mooring lines.
Coordination and communication	• Conduct safety briefings in the native language(s) of the workers before all operations. • Provide information and/or access to information on tidal stream and/or weather conditions to boatmen, especially when the weather is unfavourable.
Competency and training	• Ensure all boatmen have been adequately trained to perform their roles and hold the relevant qualifications and/or licences.
Personal Protective Equipment (PPE)	• Ensure all mooring crew such as the boatmen and line-handlers are wearing the necessary PPE (e.g. life jacket, safety helmet, safety glasses, safety boots and hand gloves) when on board the mooring boat.

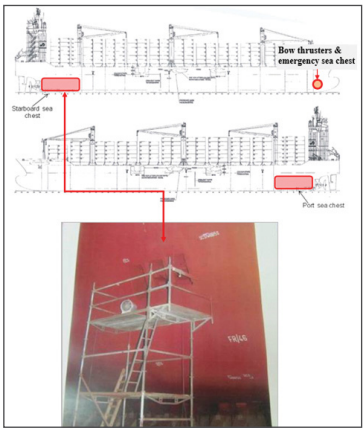
CASE 9

WORKER DIED DURING DIVING WORKS AT SEA CHEST

Description of Accident

A diving company was engaged to carry out underwater survey works for a vessel. The works included cleaning the gratings of the vessel's sea chests by using a scrapper to scrap off barnacles and taking photographs to document the works that were being carried out at the starboard and port sea chests.

While taking photographs at the starboard sea chest, he was suddenly pulled towards the pipe orifice inside the starboard sea chest. The Deceased was motionless when rescued by his co-divers and was subsequently pronounced dead by attending paramedics. The Deceased was using a recreational SCUBA (Self-Contained Underwater Breathing Apparatus) set while carrying out commercial diving.



Photograph shows the starboard sea chest of the vessel and other work locations involved while vessel at docked at a dry dock.

Observations and Findings

Man

- Absence of a diving supervisor to supervise the diving operation.

Method

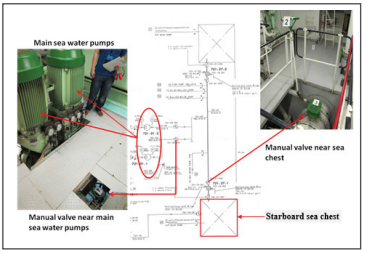
- A dive plan was not prepared and agreed upon by all parties involved in the diving operation prior to the commencement of the dive. These include means of communication with divers, operational safety, initial emergency response procedures and evacuation protocol.
- No lifelines were attached to the divers to haul them to the surface if necessary.

Machine

- The starboard main sea water pump was not powered off before allowing divers to commence working.

Environment

- Minimal visibility underwater due to murky waters.



Photograph shows the piping and instrumentation diagram and location of the manual valves and main sea water pumps.

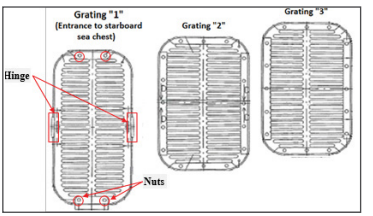


Illustration shows the entrance to the starboard sea chest via grating "1".

Causal Analysis

Evaluation of loss	• One fatality.
Accident type	• Drowning.
Failure of WSHMS	• Inadequate RA and safe work procedures, and lack of training, emergency response procedures and safety awareness.

Lessons Learnt and Recommendations

Risk assessment	• Conduct an RA before starting work to mitigate all risks associated with working at the sea chest. Identify site-specific hazards and put in place control measures to reduce all risks associated with the work activity. For example, shutting down the main sea water pumps (with lock-out and tag-out procedures) can be a control measure to mitigate the risk of divers being trapped by suction from the sea chest. Additional risk controls could be for divers is to get clearances before diving and to have a diver's attendant to be on standby in case of emergencies.
Safe work procedures	• Establish safe work procedures. • The diving contractor should be aware of hazards arising from the diving operation, such as water intakes or discharge points causing suction or turbulence, or that propellers, anchor wires and equipment are liable to start operating automatically. • Ensure that a lifeline is attached to a diver, which could be used to haul the diver to the surface and for diver/tender signalling. • Establish an effective communication method between all parties in operation, especially when a diver encounters danger underwater and rescue actions are required.

Work planning	• Prepare and have all parties involved in the diving operation agree upon a dive plan. The dive plan should address the following aspects of the diving operation: - The method of performing the task; - The duties of each person involved; - The diving equipment, breathing gases and their quantities; - Specific hazards and the methods used to address them; - An emergency response plan, with access to key personnel, displayed at the dive site or dive control panel; - Step by step procedures to be used, including the planned bottom time and decompress profiles; and - Safe deployment and recovery of the diver and standby diver.

CASE 10

WORKER DROWNED AFTER DIVING INTO SEA TO RETRIEVE OXYGEN CYLINDER

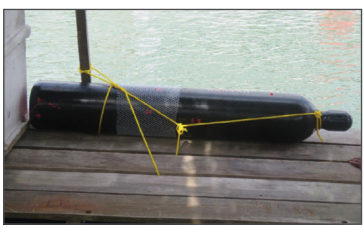
Description of Accident

Two fish farm workers were transferring an oxygen cylinder weighing 51.8kg from their land-based farm to their sea-based farm using a speed boat, when the cylinder fell into the sea. Five workers from the sea-based farm, including the Deceased, decided to retrieve the fallen cylinder. Two of the five workers remained on the pontoon attached to the sea-based farm while the other three workers including the Deceased volunteered to free-dive to look for the cylinder.

The three workers had tied a nylon rope around their waist as an emergency line. After two failed attempts to find the cylinder, two of the workers rested on the pontoon while the Deceased insisted on making a final attempt. Two minutes later, the workers pulled up the nylon rope as the Deceased had not resurfaced. However, the rope had come loose and was no longer attached to the Deceased.

Two workers then dived into the sea to look for the Deceased but were unable to locate him. Another company staff who was passing by joined in the search. He did a few free dives and saw the Deceased lying on the seabed with the Deceased's left arm pinned under the head of the oxygen cylinder. The worker was unable to retrieve the Deceased's body. SCDF arrived but could only retrieve the cylinder as they were unable to find the Deceased. The Deceased's body was eventually found the following day.

Photograph of the coastal farm



Photograph of the oxygen cylinder that had fallen into the sea

Observations and Findings

Man

- The Deceased had likely removed the emergency rope tied to his waist in an attempt to secure the oxygen cylinder on the seabed.

Method

- Unsafe method of carrying out free driving. The oxygen cylinder should have been secured during the transfer. Workers should not attempt to retrieve the cylinder alone, as he would have to lift the 51.8kg cylinder alone while holding his breath and without any visibility aids.

Environment

- Underwater sea conditions (e.g. strong currents, etc) could have caused the Deceased to be exhausted.

Causal Analysis

Evaluation of loss	• One fatality.
Accident type	• Drowning.
Failure of WSHMS	• RA and safe work procedures were not established. Failure to develop procedures to help deal with emergencies that may arise at work.

Lessons Learnt and Recommendations

Risk assessment	• Do a proper RA before any work commences. In the case of fish farming, the assessment should cover, but not limited to, work activities such as transfer of materials between boat and platform, work areas on the farm where cleaning, transfer of animals, and feeding are being carried out, and access/egress on the farm.
Safe work procedures	• Establish proper safe work procedures before any work commence.

Work planning	• Develop a procedure that deals with emergencies that may arise at work and establish recovery plan should materials dislodge during transportation.
Equipment and tools	• Secure equipment being transported before the vessel moves.
Safe securing of materials	• Provide proper securing equipment to workers so that they can secure the materials safely. • Indicate clearly the safe working load of all securing equipment and check that they are suitable for the intended application. • All securing equipment should be subjected to regular inspection in accordance with manufacturers' recommendations. • Establish a method for securing the materials and communicate it to all relevant workers.
Worker training and communication	• Ensure workers undergo adequate safety and health training in relation to their specific roles and responsibilities and that they are aware of the hazards associated with the work activity and work environment. • Conduct daily toolbox meetings prior to work commencement and shift handover. Such meetings provide the opportunity for all relevant information and instructions concerning safety and health to be communicated. • Provide workers the means to check with employers and/or occupiers on the safest course of action in the event of any incident, such as falling of objects into water. In such incidences, workers should not act on their own accord.

Published in August 2022 by the Workplace Safety and Health Council in collaboration with the Ministry of Manpower.