ACCIDENT REPORT

Report on the investigation of the fatal accident

while boarding the tug

Millgarth

at the north oil stage

Tranmere Oil Terminal, Birkenhead, England

on 27 January 2019

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

VERY SERIOUS MARINE CASUALTY REPORT NO 15/2019 DECEMBER 2019

Extract from

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2012 – Regulation 5:

"The sole objective of the investigation of an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012 shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

NOTE

This report is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

Bramley	-	Bramley-Moore Dock
CCTV	-	Closed Circuit Television
cm	-	centimetre
COSWP	-	The Code of Safe Working Practices for Merchant Seafarers
DSC	-	Digital Selective Calling
Essar	-	Essar Oil UK Limited
GPS	-	Global Positioning System
gt	-	gross tonnage
ISM	-	International Safety Management
kg	-	kilogramme
kts	-	knots
LSA	-	Life-Saving Appliances
m	-	metre
MCA	-	Maritime and Coastguard Agency
MFR1	-	*Marine Fire Rescue 1*
MGN	-	Marine Guidance Note
MOB	-	Man Overboard
OCIMF	-	Oil Companies International Marine Forum
PLB	-	Personal Locator Beacon
SB	-	Sula Bedriftsteneste AS
SMS	-	Safety Management System
STCW	-	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978, as amended (STCW Convention)
Svitzer	-	Svitzer A/S
Svitzer UK	-	Svitzer Marine Limited
t	-	tonne
VTS	-	Vessel Traffic Service

TIMES: all times used in this report are UTC unless otherwise stated.

SYNOPSIS

At 1749 on 27 January 2019, Ian Webb, the chief engineer on board the tug *Millgarth*, fell into the River Mersey from the north oil stage at the Tranmere Oil Terminal at Birkenhead, England. He had released *Millgarth*'s mooring lines and was attempting to re-board the tug. His lifejacket inflated automatically on entering the water and his crewmates were able to recover him alongside the tug within 5 minutes. The crew were unable to lift the chief engineer out of the water because he had quickly become incapacitated in the cold water and lost consciousness. He was recovered at 1811 by the crew of rescue boat *Marine Fire Rescue 1*; he had suffered cardiac arrest and could not be revived.

The weather conditions were poor and the chief engineer had tried to board *Millgarth* via an oil stage fender. The investigation concluded the following sequence of events probably occurred:

- The chief engineer fell through the gap between the fender and the oil stage while attempting to board the tug.

- The chief engineer suffered cold water shock followed by cardiac arrest within minutes of falling into the cold water.

It also concluded that:

- Concerns regarding safe access to and from Svitzer tugs at the Tranmere oil terminal had been raised at the safety committee meetings and during company inspections many times prior to this accident.

- Svitzer and Essar Oil UK did not formally identify and evaluate the shared risks associated with access to and from an unmoored tug or discuss how these could be mitigated.

Following the accident:

- Essar Oil UK has conducted a joint risk assessment with Svitzer on the use of the Tranmere Oil Terminal.

- The Maritime and Coastguard Agency has issued instructions to its surveyors to ensure that inspections of manoverboard recovery equipment and manoverboard drills are witnessed at biennial inspections.

- Svitzer has reviewed manoverboard recovery equipment across its global fleet and manoverboard drills within its European region.

On 14 June 2019, the MAIB carried out a preliminary examination of a non-fatal man overboard incident on *Svitzer Victory*. Due to the similarity of this incident with the fatal accident on *Millgarth*, the Chief Inspector of the MAIB issued an urgent safety recommendation to Svitzer A/S, Denmark, concerning the safe conduct of tug access and egress.

This report makes further safety recommendations to Svitzer A/S regarding the dissemination and closure of audit findings, attendance at manoverboard drills and the use of manoverboard recovery equipment. Both Svitzer A/S and Essar Oil UK have been recommended to ensure that a thorough assessment of site-specific risks leading to an agreed method statement of work is completed for all the locations where shared risks are identified.

Millgarth

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *MILLGARTH* AND ACCIDENT

SHIP PARTICULARS	
Vessel's name	*Millgarth*
Flag	UK
Classification society	Lloyd's Register
IMO number	9144122
Type	Azimuth stern drive tug
Registered owner	Svitzer Marine Limited
Manager(s)	Svitzer Marine Limited
Construction	Steel
Year of build	1997
Length overall	32.72m
Registered length	29.01m
Gross tonnage	374
Minimum safe manning	3
Maximum bollard pull	61.41t

VOYAGE PARTICULARS	
Port of departure	Not applicable
Port of arrival	Not applicable
Type of voyage	Internal waters
Cargo information	Not applicable
Manning	4

MARINE CASUALTY INFORMATION	
Date and time	27 January 2019, at 1749
Type of marine casualty or incident	Very Serious Marine Casualty
Location of incident	Tranmere Oil Terminal, Merseyside, England
Place on board	Not applicable
Fatalities	1
Damage/environmental impact	None
Ship operation	In port
Voyage segment	Unmooring
External & internal environment	Wind NW 41 to 47kts, 1.25 to 2.5m swell, water temperature 4°C, ebbing tide (high water at 1559, low water at 2247), dry
Persons on board	3

1.2 NARRATIVE

At 0354 on 26 January 2019, the harbour tug *Millgarth* and two other tugs, *Svitzer Bidston* and *Svitzer Stanlow*, assisted the oil tanker *Eagle Klang* to moor alongside the south stage of the Tranmere Oil Terminal on the River Mersey, England **(Figure 1)**. Once the mooring operation was complete, *Millgarth* berthed alongside the oil terminal's north stage and assumed the role of stand-by tug for *Eagle Klang*. The other two tugs were released and left the terminal. The tug was moored port side to with a head line, breast line and stern line.

At 0330 on 27 January, *Millgarth*'s stern line parted; the swell on the river was 1-2m and the wind was north-westerly gusting to 50 knots (kts). The crew re-moored the tug and doubled up the stern lines, but at 0830 they both parted. The master decided to leave the oil terminal and moved *Millgarth* to a more sheltered berth at the Isle of Man Landing Stage on the Liverpool side of the river **(Figure 2)**.

Figure 1: Aerial view of Tranmere Oil Terminal (**inset:** end view of north stage)

Reproduced from Admiralty Chart 3490-1 by permission of HMSO and the UK Hydrographic Office

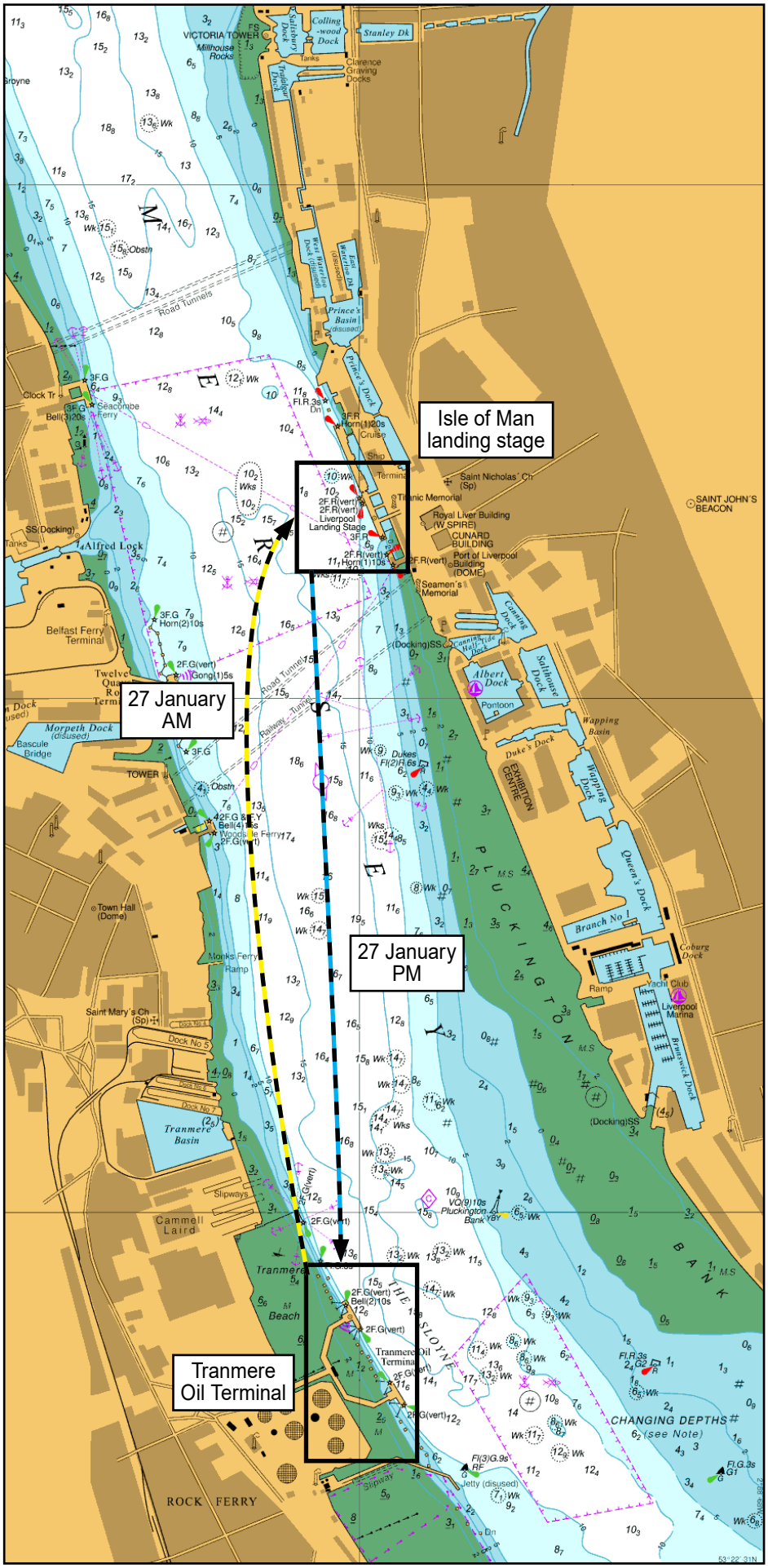

Figure 2: Movements of *Millgarth* on the day of the accident

At 1330, *Millgarth* was tasked to assist *Eagle Klang* away from the south stage, and was on station next to the tanker within 10 minutes. The wind speed had reduced from earlier in the day, but the pilot assigned to the tanker aborted the sailing due to the weather. *Millgarth* was then manoeuvred alongside the north end of the north stage and made fast port side to with a head line, breast line and two stern lines. The main tow line was used for the head line. During this operation *Millgarth* made heavy contact with the north stage and damaged one of its timber over-riders[1].

At 1730, *Millgarth*'s master received instructions to assist the ferry *Stena Mersey* to its berth in Liverpool. With the aid of the automatic identification system he confirmed that *Stena Mersey* would arrive at the rendezvous point at 1800. He informed the crew and asked them to be ready to let go the lines at 1745. Tranmere Oil Terminal was not informed of *Millgarth*'s departure. At 1748, as recorded by the closed circuit television (CCTV) system, *Millgarth*'s chief engineer, Ian Webb, opened the tug's forward bulwark access gate and stepped from the deck of the tug onto the north stage **(Figure 3)**. He was wearing a full set of personal protection equipment including a helmet, safety boots, high visibility jacket and auto-inflating lifejacket with a personal locator beacon (PLB) and crotch strap fastened.

Figure 3: Oil stage steps and *Millgarth*'s bulwark access gate
(photograph taken during post-accident reconstruction)

The chief engineer let go the lines one by one beginning with the two stern lines, and then walked forward on the oil stage to release the remaining lines. *Millgarth*'s mate and assistant engineer recovered and stowed the lines on deck. Once the stern and breast lines were released, the master moved the tug forward by 2 to 3m to take the tension off the head line and the chief engineer released it from the bollard **(Figure 4)**. He then walked back towards the tug's bulwark gate, which was now aligned with the centre of the oil stage's northern-most fender.

[1] The over-riders were lengths of timber fitted along the edge of the oil stage to prevent entanglement of mooring lines.

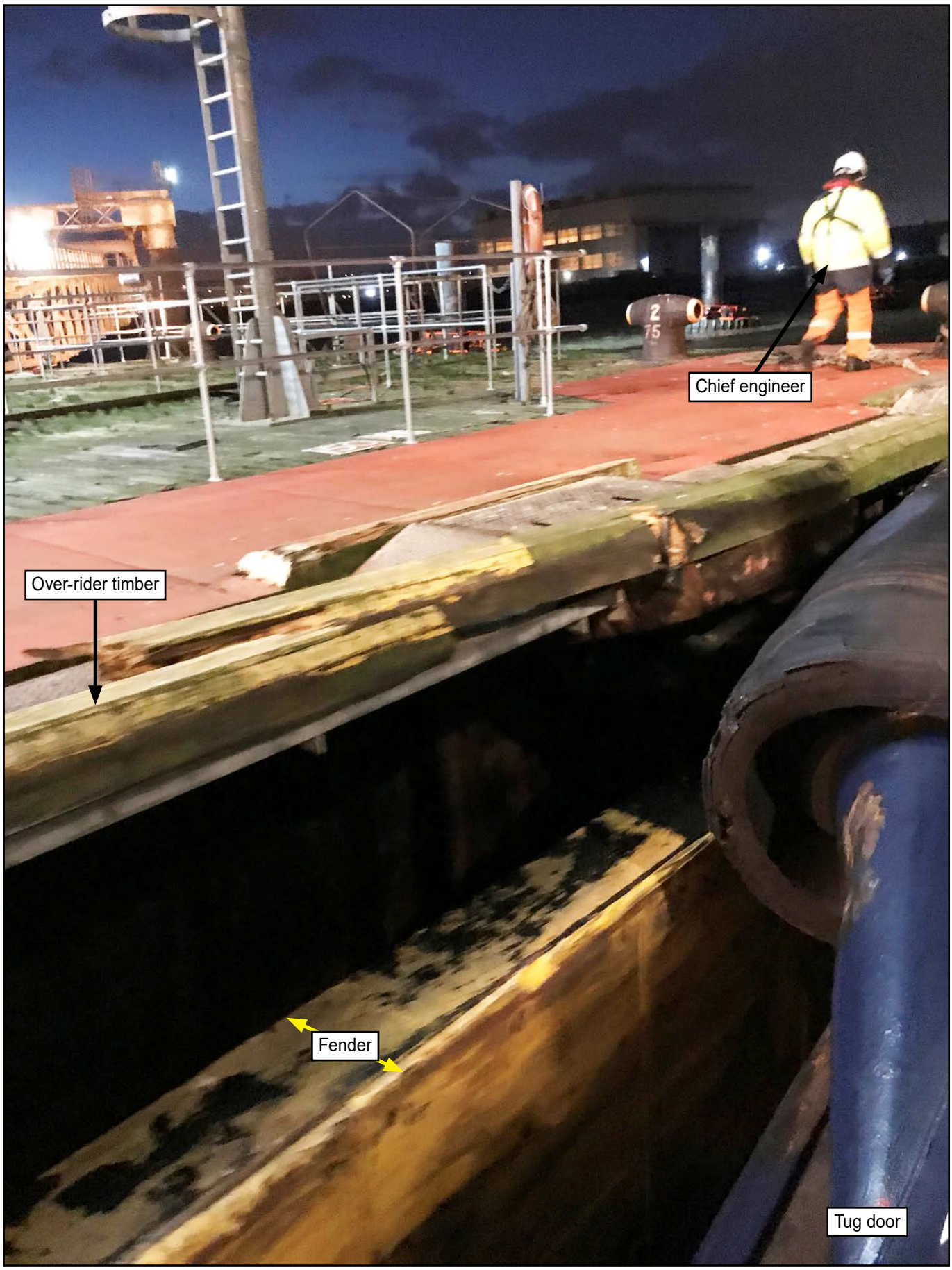

Figure 4: Chief engineer on north oil stage about to release the head line
(photograph taken by a crew member to record damage caused to over-rider timber)

At about 1749, the chief engineer stepped over the damaged over-rider and, crouching down, lowered himself onto the top of the fender. As he did so, he fell backwards, through the gap between the oil stage and the fender, into the river. His lifejacket inflated and he started to drift clear of the oil stage and tug with the ebbing tide.

On seeing the chief engineer fall into the water, *Millgarth*'s master immediately moved the tug away from the oil stage and alerted Mersey vessel traffic service (VTS) of the accident using very high frequency radio. The chief engineer was floating on his back about 5m off *Millgarth*'s port bow with his head out of the water and arms and legs outstretched. The assistant engineer tried to throw him a rope, but the wind blew it back on board. The mate then threw a lifebuoy with a lifeline attached and, after several attempts, managed to get it close to the casualty, who put an arm through it. The two crewmen then used the attached line to pull the chief engineer to the foot of the tug's port side rescue ladder and gate, which were located approximately midships, aft of the main access gate **(Figure 5)**. He had been in the river for approximately 5 minutes and was able to hold on to the recessed ladder, but was unable to climb up.

The master came down from the wheelhouse and asked the crew to get the manoverboard (MOB) rescue-sling, which was stored on the bulkhead on the starboard side of the main deck **(Figure 6)**. The crew positioned the rescue-sling under the chief engineer's arms and tried to lift him using its aluminium telescopic extension pole. They managed to pull him out of the water to his waist level but were unable to lift him further. The master left the two crewmen in charge and went back into the wheelhouse to control the vessel. He maintained communication with Mersey VTS, who informed him that the rescue boat *Marine Fire Rescue 1* (*MFR1*), based at the port's Pier Head Landing Stage in Liverpool, was on its way.

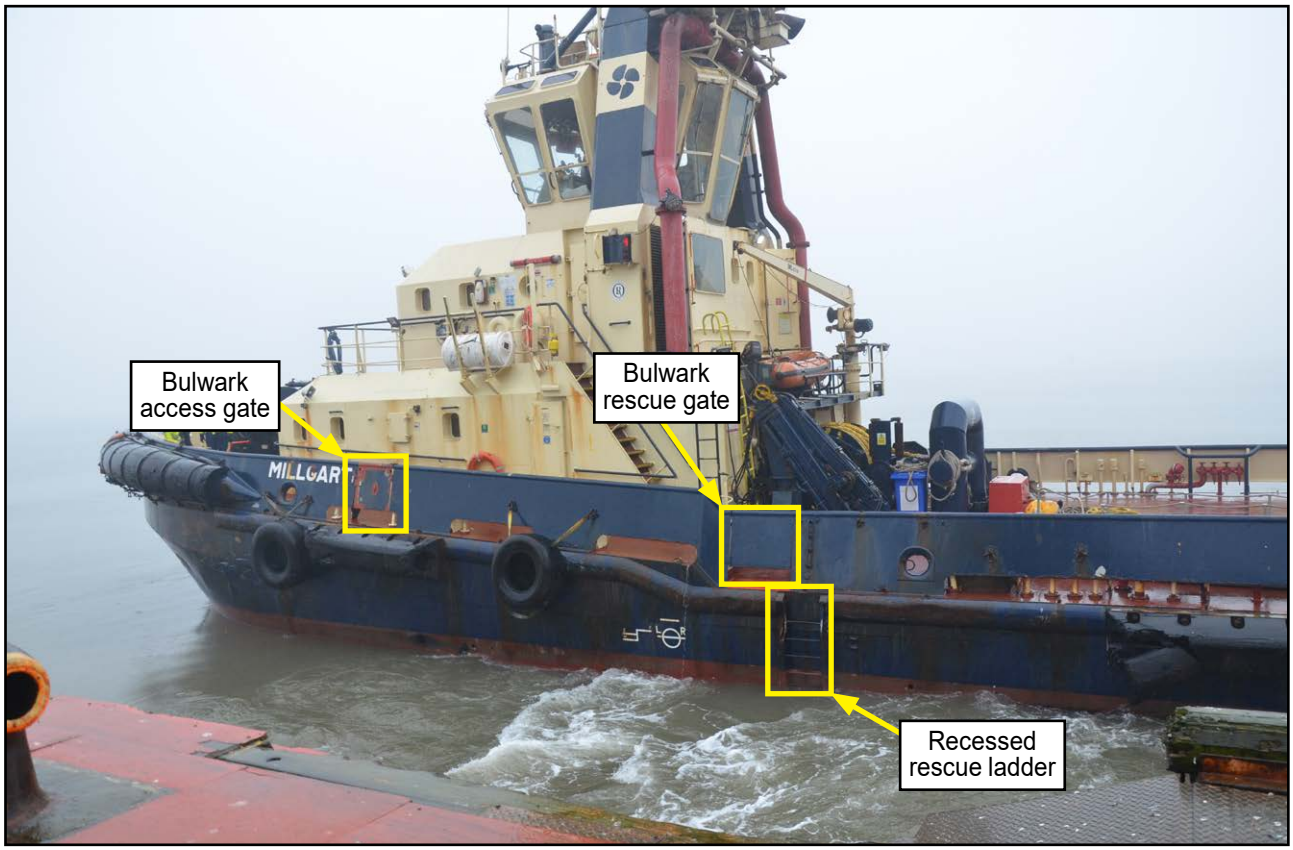

Figure 5: Access and rescue gates

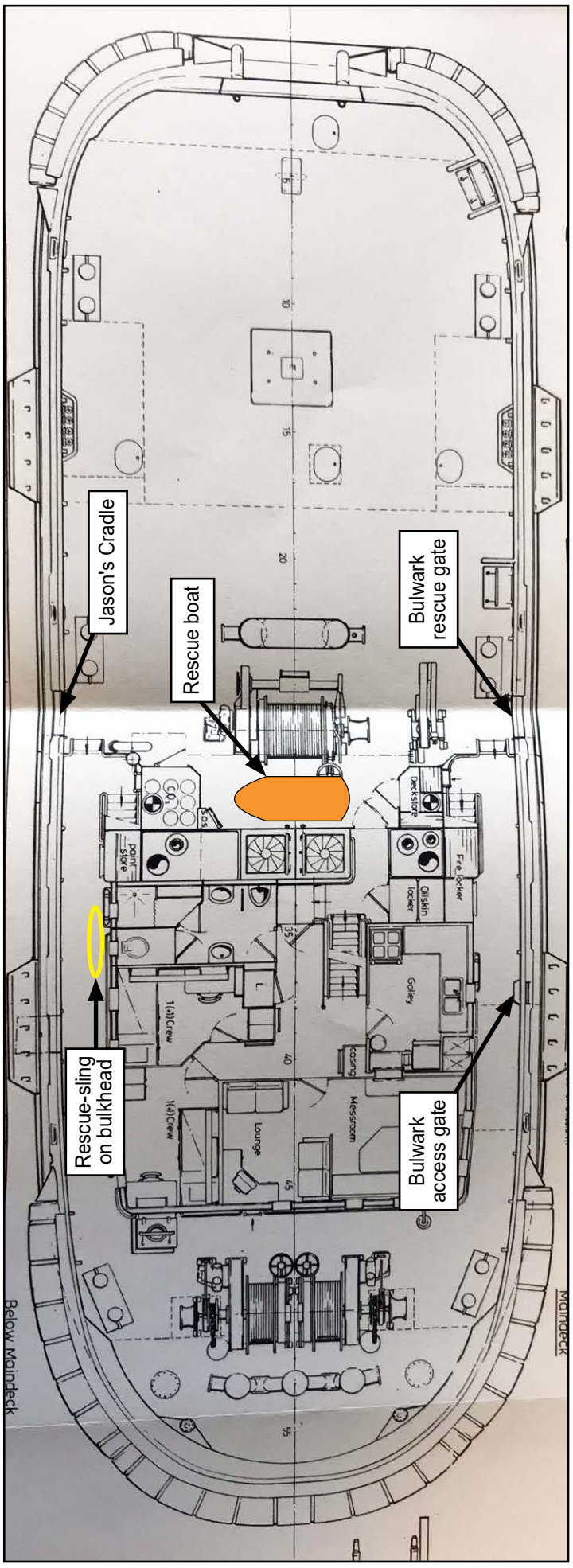

Figure 6: General arrangement

Meanwhile, the mate, apprehensive of losing the chief engineer, climbed down to the first rung of the ladder and held him with one hand. However, he was unable to sustain this position and climbed back on deck. Both crewmen held on to the pole of the rescue-sling with its eye under the casualty's arms. The chief engineer was conscious and groaning, but did not speak. About 5 minutes later, he went limp and slipped from the eye of the rescue-sling. The master switched on the searchlight and kept it trained on the chief engineer in the water as he manoeuvred the tug.

The crew then went to the starboard side of the tug to prepare the tug's Jason's Cradle. They flipped the cradle across the starboard rescue gate and hooked it up to its winch. By that time, the flashing blue lights of *MFR1* were seen approaching and the crew abandoned their efforts with the Jason's Cradle.

MFR1 arrived on the scene at 1811 and its crew pulled the chief engineer alongside. Initially they attempted to lift the casualty onto the rescue boat's stern platform, but were unable to lift his weight out of the water. One of the rescue crew then made a tethered entry into the water and helped to recover the chief engineer onto the boat. He showed no signs of life and the crew started cardio-pulmonary resuscitation as the boat was taken to Pier Head Landing Stage.

MFR1 arrived at the Pier Head Landing Stage at 1818, where it was met by an ambulance crew who took over from the rescue boat's crew and continued resuscitation attempts. At 1904, the chief engineer was declared deceased on arrival at Liverpool University Hospital.

1.3 POSTMORTEM EXAMINATION RESULTS

The postmortem examination report stated that the cause of death was cardiac arrest due to cold water immersion. Toxicological tests revealed no traces of alcohol or drugs, either prescribed or recreational.

1.4 ENVIRONMENTAL CONDITIONS

It was dark at the time of the accident, the wind was north-westerly gale force 8 with wind speeds gusting between 41 and 47kts. The river was rough with wave heights between 1.25 and 2.5m and the water temperature was 4°C. The tide was ebbing, with the high tide having peaked 2 hours earlier. The visibility was good and it was not raining.

1.5 CREW

1.5.1 Manning

Millgarth was usually manned by three crew: a master, mate and chief engineer. When standing-by oil tankers on the Tranmere Oil Terminal the tug carried an extra crew member as the crew was required to maintain watches to provide 24-hour cover. On the day of the accident, the extra person was an assistant engineer. All four crew members were UK nationals.

The tug had two crews – 'top watch' and 'bottom watch' – who worked a 7 days on/7 days off rota, changing over on Thursday mornings. Crew changes were typically made at Bramley-Moore Dock (Bramley), but occasionally other locations including Tranmere were used. *Millgarth*'s crew was top watch, and had joined the vessel in Bramley on 24 January.

1.5.2 Chief engineer

The chief engineer, Ian Webb, was 62 years old. He began his career in the Merchant Navy on ocean-going vessels, but he had been employed by Svitzer Marine Ltd (Svitzer UK) or its predecessors for the last 36 years. He held an STCW III/2 (unlimited) chief engineer's certificate of competency.

The chief engineer was 1.73m tall and weighed 78kg. He was in good health and was not on any prescribed medication. He was a member of Svitzer UK's Liverpool tug fleet safety committee and had a reputation among his colleagues for being safety conscious. At Tranmere, he usually went ashore to handle the tug's mooring lines.

1.5.3 Master and other crew members

The master was 32 years old and had been employed by Svitzer UK since 2004. In December 2015 he obtained an STCW II/3 Master (Tug) certificate of competency, limited to tugs under 500gt within 30 miles of a safe haven on the coast of the UK and Ireland. He had been one of *Millgarth*'s masters since 2016.

The mate was 24 years old. He held an STCW II/1 Officer of Watch Deck certificate of competency and had been employed by Svitzer UK on *Millgarth* for 2 years. He started his sea career on bulk carriers, where he spent approximately 4 years before joining Svitzer UK.

The assistant engineer was 51 years old. He held an STCW III/1 certificate of competency with an III/3 endorsement, Engineer Officer of the Watch with Second Engineer less than 3000kW near coastal voyages. He had 12 years' experience on tugs and had been employed by Svitzer UK for 6 years.

1.5.4 Hours of work and rest

In accordance with the Merchant Shipping (Maritime Labour Convention) (Hours of Work) Regulations 2018, *Millgarth*'s crew were required to have 10 hours' rest in any 24-hour period, with a minimum of 6 continuous hours within these 10 hours. *Millgarth*'s crew had the option of living on board during their 7-day duty period.

According to the tug's hours of rest records, *Millgarth*'s crew had received in excess of the minimum rest required by the regulations during the days leading up to the accident. The chief engineer had stayed on board *Millgarth* during the duty period and had worked 4 hours on Thursday 24 January, 8 hours on Friday, 10.5 hours on Saturday and 6 hours on Sunday.

1.6 *MILLGARTH*

1.6.1 General

Millgarth was an Azimuth stern drive harbour tug and was built in Poland in 1997. It was owned and operated by Svitzer UK and was certified by the Maritime and Coastguard Agency (MCA) as a Class IX[2] tug. *Millgarth* had relocated from London to Liverpool in March 2014.

[2] Class IX - tugs and tenders that go to sea but not on long international voyages.

1.6.2 Life-saving appliances

The mandatory life-saving appliances (LSA) requirements for Class IX tugs under 500gt are set out in *the Merchant Shipping (Life-Saving Appliances For Ships Other Than Ships Of Classes III To VI(A)) Regulations 1999*. In accordance with the regulations, *Millgarth* was equipped with a rescue boat (with dedicated winch), two 10-person inflatable liferafts (one on each side of the boat), four lifebuoys (two with smoke signals and light, and two with 18m buoyant line), 14 emergency use lifejackets and ten immersion suits.

In addition to the mandated LSA, *Millgarth* was equipped with two MOB recovery devices: a Jason's Cradle with dedicated winch and davit, and a rescue-sling. This equipment was fitted to satisfy conditions set by the MCA in 2003 when it permitted a reduction in the tug's minimum manning levels from four to three. The conditions included:

- Crew wearing lifejackets with PLBs.
- Carriage of MOB equipment that is readily available, regularly checked for condition and maintained in accordance with manufacturer's instructions.
- Risk assessments to be carried out on board and periodically reviewed.
- New crew members to be familiarised with the MOB recovery equipment prior to sailing.

1.6.3 Rescue-sling

The rescue-sling carried on board *Millgarth* was manufactured by the Norwegian company Sula Bedriftsteneste AS (SB). It was designed to help rescue a casualty from the water and could be used as a stand-alone piece of safety equipment or as part of the full SB rescue system, which included a rescue davit and winch. The SB rescue-sling was one of two similar types of MOB recovery devices carried on board all Svitzer tugs in Liverpool.

The SB rescue-sling was attached to a 12mm plaited polyester line and was clipped to a 1.2m long open-ended aluminium frame to form an open loop **(Figure 7a)**. The frame was attached to a 1.7m telescopic pole that could be extended to 4m **(Figure 7b)**. The procedure for recovering a person from the water was:

1. Place the frame holding the sling around the person, either from the feet up or head down.
2. Position the sling under the person's arms.
3. Pull the line and push the frame to tighten the sling.
4. Remove the frame.
5. Pull the person to the side of the vessel.
6. Haul the person on board.

Millgarth did not have dedicated SB davits or winches **(Figure 7c**); the primary purpose of the SB rescue-sling was to help guide the MOB into the Jason's Cradle.

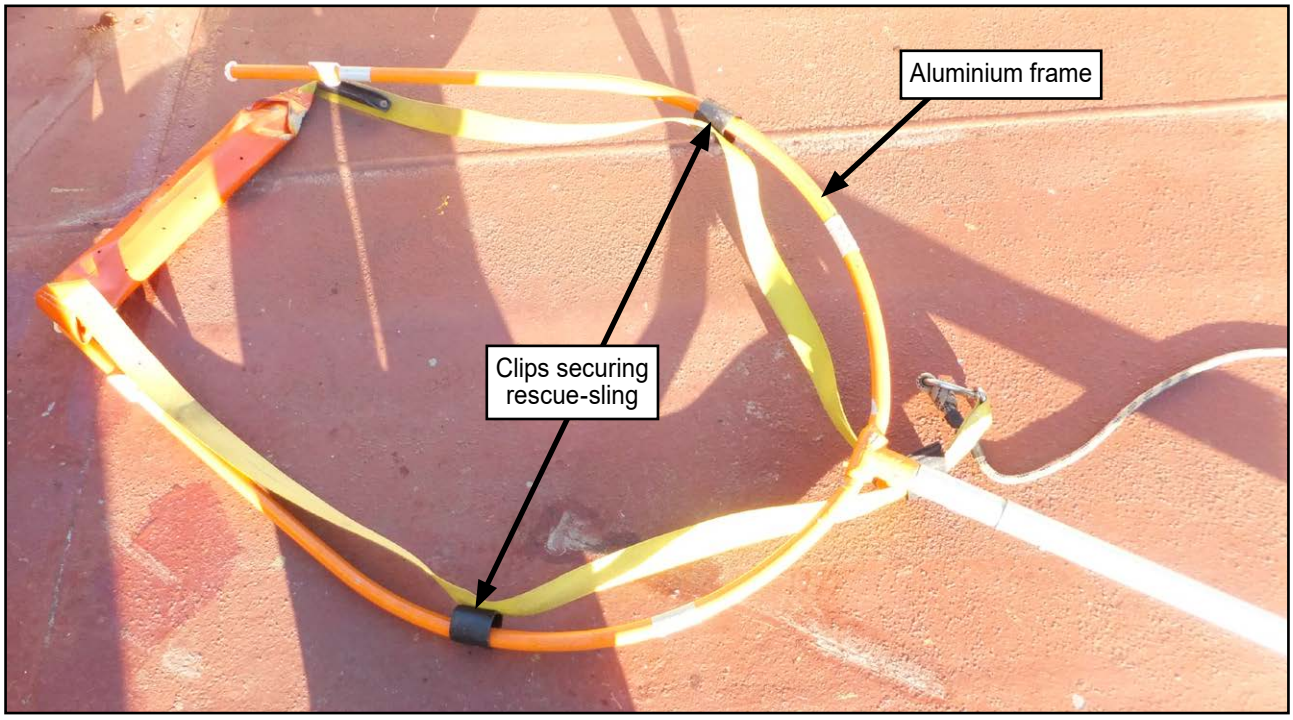

Figure 7a: SB rescue-sling

Image courtesy of I C Brindle & Co Ltd

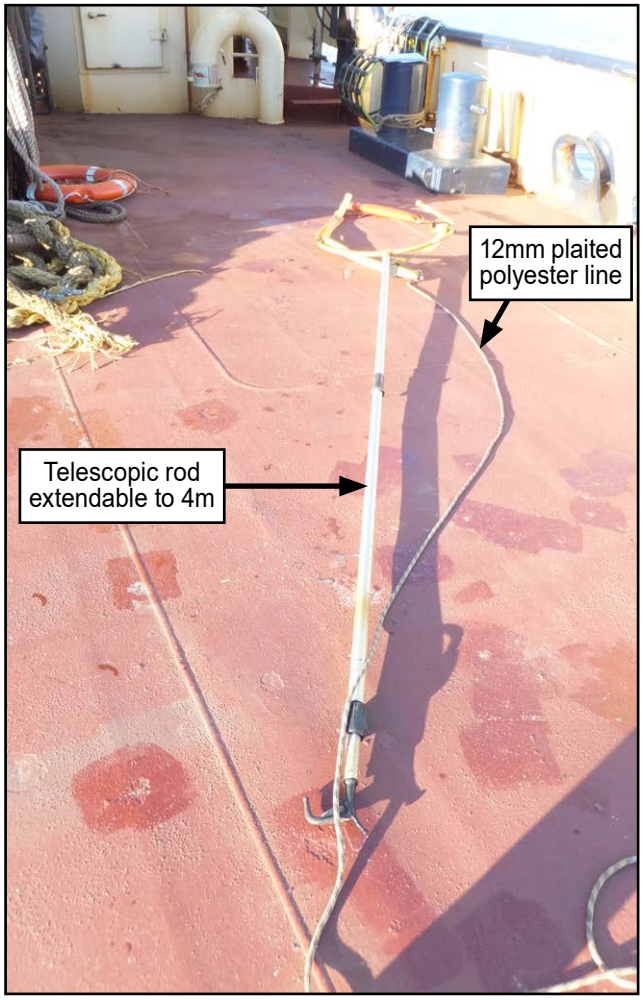

Figure 7b: SB rescue-sling with extended handle

Figure 7c: SB rescue-sling in use

The manufacturer's instructions for the stowage and maintenance of the SB rescue-sling were posted on the bulkhead close to its stowed position. These instructions recommended that the rescue-sling be load tested to 450kg every 3 years. It also stated that it should not be stored fully assembled with the sling and its plastic clips attached to the frame as the condition of both could deteriorate when exposed to the elements.

In 2015, following a report of SB rescue-sling failures during routine MOB drills, the International Marine Contractors Association issued a product safety flash. The safety flash warned vessel operators not to leave the slings exposed to the elements, and reminded them to check their condition regularly and to test and replace them in accordance with the manufacturer's instructions.

The SB rescue-sling on board *Millgarth* was stored in its fully assembled condition and was not subjected to the 3-yearly load test. The crews had not been trained in the use of this equipment and operating instructions for its intended use were not available on board.

1.6.4 Jason's Cradle

Jason's Cradle is the trade name of an MOB recovery device manufactured by Land and Marine Products Limited and was designed for use on vessels with freeboards up to 5m. It is a non-collapsible scoop, one end of which is fixed to a rigid structure such as the bulwark. In operation, its free end is hooked onto a winch and then flipped over into the water. The casualty is positioned in the scoop and then heaved out of the water and recovered on board in a horizontal position using the winch **(Figure 8)**.

Except for *Svitzer Stanlow*, all the tugs in Liverpool were equipped with a Jason's Cradle.

1.6.5 Safety equipment certification and inspections

As *Millgarth* was less than 500gt, there were no international or national requirements for a formal Safety Equipment Certificate, and there was no requirement for an inspection scheme to check the safety equipment. At Svitzer UK's request, the MCA carried out 2-yearly inspections of all the tugs in the Liverpool fleet. It was agreed that defects found during these voluntary inspections would be dealt with as if they were statutory inspections.

The tugs' mandatory lifesaving, fire-fighting, navigation and communications equipment were checked, but not tested, during the MCA inspections. The MCA's Form 1102, *Record of Cargo Ship Safety Equipment*, was used for recording the inspections. *Millgarth* was last inspected by the MCA on 13 February 2018; its Jason's Cradle and SB rescue-sling were not listed on the form.

1.7 SVITZER

1.7.1 Company structure

Svitzer A/S (Svitzer), part of the Maersk Group, operated 447 vessels (344 tugs) in over 120 ports worldwide. The UK fleet comprised 68 tugs, seven of which were based at Liverpool.

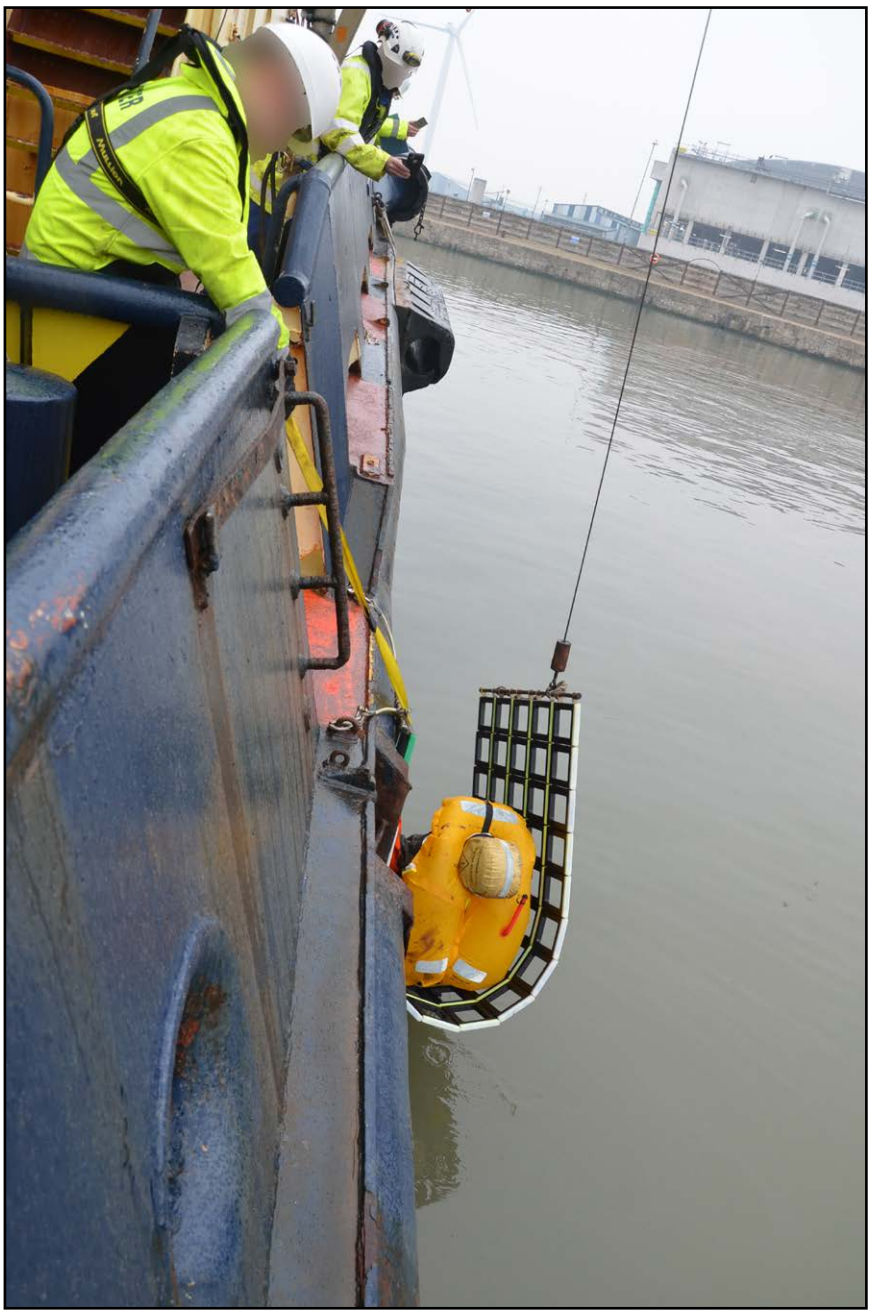

Figure 8: Jason's Cradle equipment being used during a drill

Svitzer was organised into four geographical regions, of which Europe was one. Each region had a Marine Standards Team responsible for delivering the group's health and safety policy. The Head of Marine Standards for each region reported to the Chief Operating Officer for that region with an additional line of reporting to Group Head of Marine Standards based at Svitzer's headquarters in Copenhagen.

Svitzer UK's operations were divided into two clusters: UK North and UK South. Each UK cluster had a Marine Standards Officer who reported to the Regional Head of Marine Standards for Europe as well as to the Port Manager of the relevant cluster. The Marine Standards Officers were also the Designated Person Ashore[3] for their clusters.

[3] As required by the International Safety Management Code, a person (or persons) designated by a company having direct access to the highest level of management in order to provide a link between the company and those on board.

1.7.2 Safety management

Most of Svitzer's tugs were under 500gt and were not required to comply with the International Safety Management (ISM) Code[4]. However, Svitzer had chosen to manage and operate all of them in accordance with the standards set out in the ISM Code. In addition, Svitzer had voluntarily adopted the Offshore Vessel Management and Self-Assessment programme for shore management and the Offshore Vessel Inspection Questionnaire for vessels, which had been developed by the Oil Companies International Marine Forum (OCIMF).

Svitzer's safety management system (SMS) was contained within its overarching Harmonised Management System, which was accessible electronically to the crew on board. The SMS was common to all the tugs in the fleet.

The SMS contained guidance on the procedures to follow in emergency situations and forms for logging activities such as onboard drills, audits, safety meetings and the reporting of hazardous incidents and accidents. The SMS contained generic guidance on the recovery of persons in the water and a procedure to follow when someone falls overboard. Paper copies of these documents were held on board *Millgarth*.

Svitzer used a Stop Card system to empower anyone involved with tug operations to stop an activity they considered to be dangerous. They also held regular health and safety committee meetings.

Svitzer UK required safety committee meetings at port level to be held quarterly and attended by two crew representatives and one or more representatives from shore management. The safety committee for the Liverpool fleet comprised four elected crew members (two masters and two chief engineers) and representatives from the local shore management team. The minutes of the meetings were uploaded to the Harmonised Management System, which automatically sent out email notices to Svitzer staff responsible for any actions to be taken. These individuals were also responsible for closing out the actions in the system.

Quarterly safety committee meetings were held throughout 2016 and 2018; however, only two meetings were held in 2017 and none were held in 2015. This was due to ongoing disputes and grievances between crew members and shore management.

1.7.3 Man overboard and the recovery of persons in the water

The general guidance contained in the SMS for the recovery of persons in the water explained that the recovery process has two distinct stages: bringing the person to the side of the tug, and getting the person on board. The guidance stated that, if weather conditions permit, the safest way to bring someone alongside is by using the tug's rescue boat. The guidance also advised that:

> *To the extent practicable, recovery of persons should be carried out in a horizontal, or near-horizontal ("deck chair") position. Recovery in a vertical position should be avoided whenever possible as it risks cardiac arrest in hypothermic casualties.*

The MOB procedure described in the SMS was as follows:

[4] The purpose of the International Safety Management (ISM) Code is to provide an international standard for the safe management and operation of ships and for pollution prevention.

1. Sound the alarm verbally/visually.

2. Transmit “MAYDAY” DSC[5] alert and mark MOB on GPS[6].

3. Muster crew and instruct as required.

4. Launch lifebuoy smoke float.

5. Post lookout. Direct searchlight.

6. Position vessel for rescue.

7. Deploy Jason’s Cradle/Mate Saver[7].

8. Prepare for first-aid.

9. Wherever possible, recover man in horizontal position.

10. Ensure casualty receives proper medical assistance.

11. Inform port Authority/Company management.

12. Keep log of all events.

13. This instruction assumes the MOB remains continuously in sight. If contact is lost commence a search pattern.

14. Take into account guidance on *recovery of persons in the water*.

1.7.4 Manoverboard drills

In accordance with Svitzer’s requirements, emergency drills, including MOB, fire, abandon ship and medical emergencies were carried out monthly on board *Millgarth*. The drills were recorded in the SMS and occasionally in the tug’s official logbook. Examination of the records showed that MOB drills had been conducted on board *Millgarth* on a monthly basis. All but one of the MOB drills recorded in the past 12 months had been conducted by the bottom watch crew. The top watch crew might have carried out MOB drills that had not been recorded because Svitzer UK only required one drill per tug to be recorded each month. The last recorded MOB drill for *Millgarth*’s top watch crew was carried out on 18 February 2018. On that occasion, the crew recovered a mannequin, which was thrown into the water in Bramley.

A month after the accident, MAIB inspectors observed an MOB drill conducted by *Millgarth*’s bottom watch crew at Bramley. The crew took about 18 minutes to recover the mannequin back on board using the SB rescue-sling and Jason’s Cradle. Key observations made were:

- The crew struggled to manoeuvre the mannequin into the cradle with the SB rescue-sling. The sling was not tightened, and the frame was not removed, so the mannequin kept falling back into the water.

[5] Digital Selective Calling (DSC) is a standard for transmitting pre-defined digital messages. It is a part of the Global Maritime Distress safety system.

[6] Global Positioning System (GPS) is a satellite-based radio navigation system.

[7] Mate Saver was the brand name of the other type of rescue-sling used on board Svitzer UK tugs.

- The sling eventually released itself from the frame and tightened around the torso of the mannequin. The crew then physically lifted the mannequin back on board.

- A further drill was conducted when the crew managed to guide the mannequin into the Jason's Cradle and retrieve it in much shorter time.

The MCA required an MOB drill to be completed in the presence of one of its surveyors every 2 years. The drills usually coincided with the tug's 2-yearly inspection regime. The last MOB drill witnessed on board *Millgarth* by an MCA surveyor was the one conducted by the top watch crew on 18 February 2018.

1.8 TRANMERE OIL TERMINAL

1.8.1 General background

The Tranmere Oil Terminal was built in 1960 by Royal Dutch Shell Co. as a crude oil reception facility for the Stanlow oil refinery at Ellesmere Port. The ownership of the terminal changed to Essar Oil UK (Essar) in 2011. Svitzer UK was contracted by Essar to assist visiting oil tankers in the river and during berthing and unberthing operations, and to provide stand-by tugs for the duration of the vessels' stay at the terminal.

1.8.2 Stand-by tugs

The terminal required one stand-by tug for vessels with a cargo-carrying capacity of less than 170,000t and two stand-by tugs for larger vessels. The purpose of a stand-by tug was to provide support in the event of a fire or pollution incident and to assist a berthed tanker in the event of high winds.

If a tanker was berthed at the south stage, the stand-by tug(s) made fast at the north stage and vice versa. Occasionally, when both stages were occupied by tankers, the stand-by tugs would make fast outboard of their designated tankers. The oil stages were manned by Essar contracted waterfront staff for the duration of a tanker's stay.

Five of the seven Svitzer tugs, including *Millgarth*, met the criteria, including the requisite bollard pull, to function as stand-by tugs. *Svitzer Stanlow* was the regular stand-by tug for Tranmere until 9 January 2019 when it was withdrawn from service due to technical problems. *Millgarth* and *Svitzer Bidston* carried out stand-by duties from then, alternating every 24 hours. *Millgarth* had acted as a stand-by tug on 12 occasions between 1 January 2018 and the day of the accident. The top watch crew had been on board during four of them.

1.8.3 The oil stages

The north and south oil stages were almost identical 110m x 20m buoyant pontoons, connected to shore via articulated arms that moved with the tide, allowing the stages to be unaffected by tidal changes in the river. Each stage was protected by four steel fenders of hollow box construction, each 10.3m long, 1.52m high and 0.34m deep. They were attached to the stage using flexible rubber mounts. The back of each fender stood approximately 0.1m proud of the oil stage, and the drop between the top of the over-rider and the top of the fender was 0.78m **(Figure 9)**.

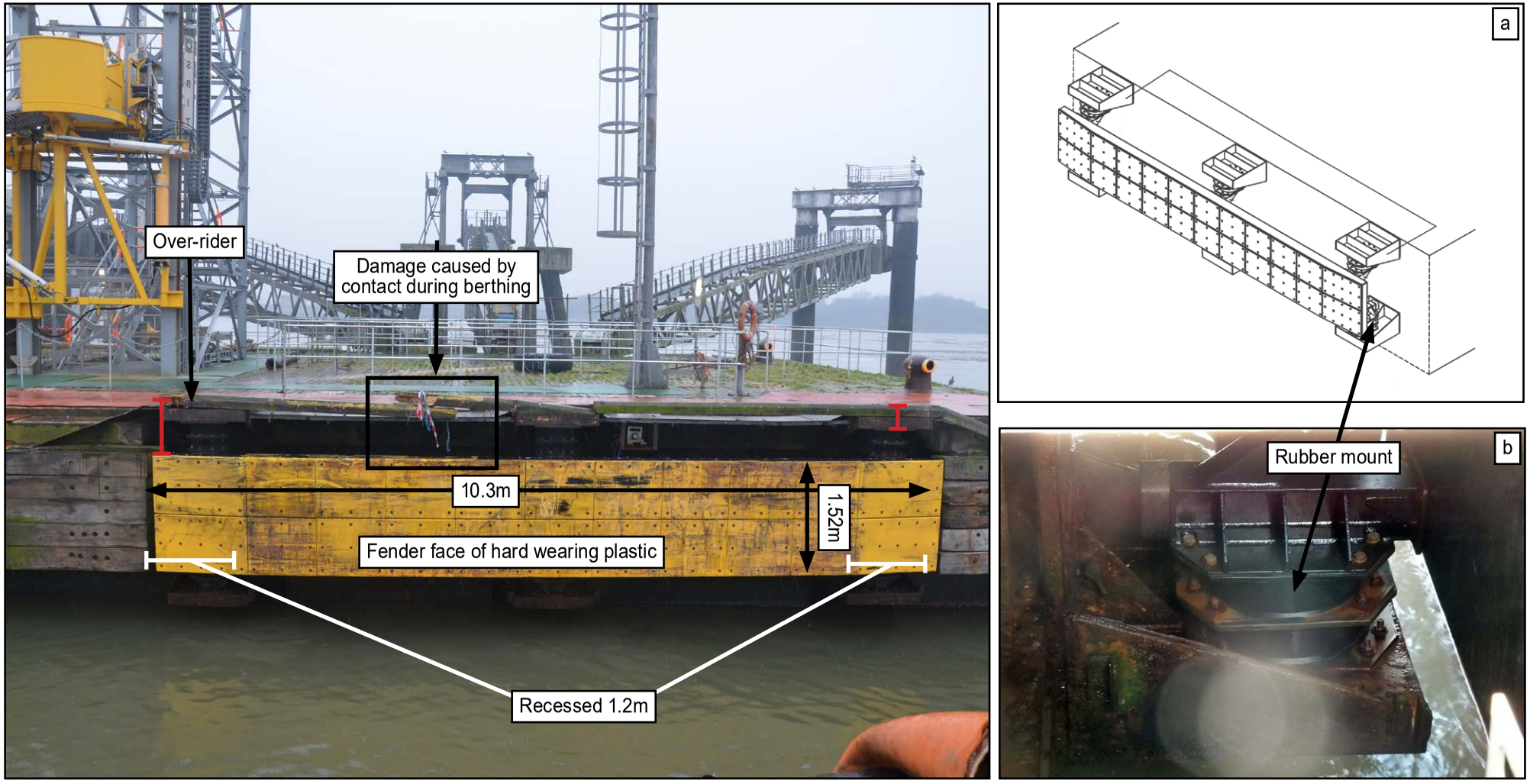

Figure 9: North oil stage fender (**inset a:** Isometric view and **inset b:** Rubber mount)

In 2014, hard wearing plastic panels were fitted to the face of the oil stage fenders, which removed the need for rubber fenders and allowed the tugs to sit closer to the stage. At that time, on the request of the tug crews, yellow non-slip paint was applied to the top of the fenders. Steps for accessing the oil stages from the tugs were located between each pair of fenders.

1.9 MEANS OF ACCESS AND MOORING OPERATIONS

1.9.1 General background

The means of access for the Svitzer UK tug crews at the Tranmere Oil Terminal was intended to be a level transfer, via the tugs' bulwark gates, onto the oil stage steps **(Figure 3)**. Like most berths on the river, the crews self-moored the tugs to the oil stages. The mooring method required one member of the crew to step across from the unmoored vessel onto the oil stage to receive lines and place them on the bollards. Similarly, a crew member would step across from the oil stage to the unmoored tug after letting go the last line.

It was common practice for the bulwark gates not to be lined up with the oil stage steps during berthing and unberthing operations and when the tugs were made fast alongside. This was due to the risk of the tug's bow fender contacting and causing damage to the over-rider timber. When this was the case, the crew often stepped onto the oil stage fender, which was approximately at *Millgarth*'s deck level, and climbed over the timber over-riders, when leaving the tug, and vice versa when boarding.

Oil tanker mooring operations were planned by the terminal's marine department and shore-side mooring gangs (linesmen) were used to handle the lines on the oil stages.

1.9.2 Svitzer UK risk assessments and procedures

The risk assessment in the SMS for mooring a tug and means of access was generic in nature and did not mention the Tranmere Oil Terminal or any other specific locations **(Annex A)**. The risks considered in the risk assessment for vessel access included:

- *Personal injury – transferring during arrival/departure,*
- *Personal injury – Dangerous access conditions, and*
- *Failure to comply with company procedures.*

The list of control measures for the risk of *Personal injury – transferring during arrival/departure*, included:

> *Crewmember transferring are not to proceed outside the bulwark untill the Master / OOW confirms that the vessel is calm alongside quay / other vessel.* [sic]

Personal injury during dangerous access conditions was assessed to be the highest risk to crew, and the controls to mitigate this included:

> *It is the Captains overall responsibility to assess the criterias for safe access.* [sic]

The list of control measures for the risk of *Failure to comply with company procedures* included the delivery of toolbox talks that should ensure all crew members are aware of their role and emphasise the use of the Stop Card if considered necessary. The risk assessment also referred to the company's *Access to and from vessel* procedure, which covered means of access in the following four scenarios:

1. *While a vessel is moored in a port.*

2. *Before mooring the vessel (as an example mooring lines need to be placed on the quay).*

3. *Transfer between two vessels moored together in port.*

4. *Transfer between two vessels in port where one is moored and the other is not moored.*

The procedure emphasised the need to take weather conditions into account, and defined several safe means of access, including level transfer via bulwark gates on to quayside steps. The definition did include the provision of handrails for quayside steps; the steps on the Tranmere stages did not have handrails.

The procedure recommended that alternative ways to avoid transfers between an unmoored vessel and quay should be considered. The suggested alternatives included:

1. *To get the first line on a bollard by using a boat hook or a heaving line.*

2. *Use linesmen from shore.*

3. *Request assistance from crew available in the port of operation.*

4. *Request another more appropriate quay if access is not good.*

In August 2003, Svitzer UK produced a written risk assessment titled *Liverpool Operation Generic Risk Assessments - 001. Accessing Tugs from Quay*, which was revised in July 2004 **(Annex B)**. Essar was unaware of this document. The risk assessment considered the generic risk of slips, trips and falls for the activity of accessing tugs from all quays in adverse weather conditions. It also considered the specific activities of:

- *Accessing tugs from Tranmere stages, and*

- *Landing personnel from tug to Tranmere/Princes jetty and lock walls* **(Figure 10)**.

The highest risk identified in 2004 was the risk of slips, trips and falls into the river/ lock when landing personnel from a tug to the Tranmere stages, Princes jetty and lock walls in *adverse weather, run of tide and large sea swell*. The control measures listed in the risk assessment included use of shore linesmen to assist with tying up. The control measures to reduce the risk of slips, trips and falls while accessing moored tugs from the Tranmere Oil Terminal stages included the use of a gangway and the rigging of a safety net.

Accessing tug from Tranmere stages	*Ice, snow, rain*	*Slips, trips and falls*	*3*	*2*	*6*	*Awareness of hazards. Gangway to be used. Safety net on gangway. PPE and Lifejacket.*	*2*	*2*	*4*
Landing personnel from tug to Tranmere/Princes jetty and lock walls.	*Adverse weather, run of tide and large sea swell*	*Slips, trips and falls in river/lock*	*3*	*3*	*9*	*Awareness of hazards. PPE to be used. Lifejacket to be used. Deploy man from ashore to assist with tying up.*	*1*	*1*	*1*

Figure 10: Extract from risk assessment at Tranmere in 2003

1.9.3 Tranmere Oil Terminal risk assessments and procedures

Essar's marine risk register **(Annex C)** contained 43 risks with their respective potential consequences, mitigating control measures and risk ratings. The risk register focused entirely on tanker operations and only made specific mention of tugs in the context of their availability to assist tankers. It did not consider the risks associated with tugs while on stand-by at an oil stage.

The document *Procedures for Vessels Bound to and from Tranmere Oil Terminal* contained detailed instructions for vessels mooring at Tranmere. However, all the procedures pertained to tankers, and varied depending on their size. The primary source of information was the Essar Tranmere Regulations document, which again contained extensive guidance for tankers and only referred to tugs in the context of their escort and stand-by roles.

1.9.4 Observations made during Svitzer UK safety committee meetings

During the safety committee meetings held in 2016, the tug crew representatives repeatedly raised concerns about access and egress to and from the tugs moored at the Tranmere Oil Terminal stages and other regular berths on the river. The ongoing discussions between Svitzer UK and Essar regarding the improvement of the oil stage and application of non-slip paint were recorded. The following was noted in the minutes of the January 2016 safety committee meeting:

> *Tranmere jetty new fenders have been painted but the wood adjacent to where the tugs tie up needs non slip treatment. still have yet to be done.* [redacted] *to speak with Essar. Princes stage – getting on and off at stage. When doing crew change at stage, crew have to stand on fendering, sometime wet and slippery. They are also very narrow. Suggestion of a motorised gangway.* [sic]

The minutes of the 21 April 2016 safety committee meeting noted:

> *Gangways. All tugs have been measured for lightweight gangways with rollers. This is ongoing.* [redacted] *asked what the procedure will be at the cruise terminal and whether it is still a requirement to jump ashore.* [redacted] *advised that it will be necessary to pin*[8] *the tug first, position the gangway and then lines ashore.* [redacted] *stated that he felt the cruise terminal will still be problematic as will Tranmere with regards to access / egress.* [sic]

The discussion regarding gangways continued, and one was made up for *Svitzer Stanlow*, with the intention of testing it on other tugs in the fleet. However, the fabricated gangway was found to be too heavy. Another gangway was tested on one of the tugs, and photographs of the arrangement were exchanged between the tug

[8] Pin: Keep the tug alongside by using its engines only.

and the Liverpool office **(Figure 11**). In May 2018 the project for supplying gangways to all the tugs in Liverpool was temporarily halted pending the imminent move of Svitzer UK's permanent mooring docks from Bramley to an alternative site.

Although technical superintendents and other management personnel visited *Millgarth* frequently, none of the staff employed at Svitzer UK's Liverpool office at the time of the accident had witnessed the operations at Tranmere.

Figure 11: Ramp used in gangway trial

1.9.5 Means of access review

In November 2016, the Head of Marine Standards for Europe commissioned a safety assessment of the means of access to tugs in the European region. This assessment was instigated following a fatal accident on board the tug *Svitzer Moira* in December 2015 [Section 1.12.1], and its aim was to identify location-specific concerns and implement corrective actions as required. Svitzer UK's Liverpool office misinterpreted the requirement and understood it to be an audit of the activities, and not an exhaustive survey. Therefore, many berths, including Tranmere, were not assessed at the time. The following comment was recorded against Liverpool:

> *Crew transfers suspended at the passenger terminal within the river, until tugs are fitted with portable gangways. Reducing the risks of falling when standing on fixed shore fenders. A prototype gangway is being trialled for fleet suitability and will be retrofitted locally. Tugs on standby at Tranmere had raised safety concerns about slippery walkways. These have been power washed with non-slip applied. Access / egress on the permanent berths satisfactory with acceptable levels of light.*

1.9.6 Observations made during safety management system audit

During an ISM internal audit of *Svitzer Stanlow*[9], conducted while the tug was berthed at the Tranmere Oil Terminal on 4 October 2017, the auditor remarked 'No' to the following question:

> *Is a safe means of access provided, including, where appropriate, provision of a gangway, accommodation ladder, pilot ladder, safety net, lifebuoy, and line?*

He made the following observation:

> *Means of access was achieved by use of the Bulwark Gate. Whilst there was no substantial height difference between the vessel and the jetty, the way the vessel had been lined up with obstructions on the jetty meant it was necessary to traverse approximately 1.5m outside the vessel bulwark to reach the gate.*

The follow-up action was noted as:

> *Ensure when mooring the vessel to line the Bulwark Gate up with the jetty, with consideration for obstructions, in such a way that access can be easily achieved.*

The action was recorded with a due date of 31 October 2017. The observation was closed out on 18 January 2018 with the following remark:

> *Due to berth design unable to berth alongside with gateway lining up. Suggest cut new door in bulwarks. At next berthing measurements will be taken by crew and inform* [redacted]

Subsequently, it was established that cutting a new door would interfere with the fire deluge system[10] on *Svitzer Stanlow*, and no further action was taken. The observation in the audit report remained with the 'completed' status. This issue, highlighted on *Svitzer Stanlow*, was not applicable to all stand-by tugs in Liverpool **(Figure 12** and **inset)**.

1.10 RECONSTRUCTION OF THE UNMOORING OPERATION

On 28 February 2019, a reconstruction of *Millgarth*'s position in relation to the oil stage on the day of the accident was carried out. The terminal's linesmen made fast the vessel with one head line, a breast line and two stern lines. The tug gate was aligned with the steps on the oil stage **(Figure 13a)**. Subsequently, the vessel was moved 2 to 3m ahead with the help of its engines and was maintained in position for approximately 10 minutes. During the reconstruction there was a light north-westerly wind, the river was calm and the tide was ebbing. The following observations were made:

- It was possible to make fast *Millgarth* to the bollards on the oil stage with the tug access door aligned with the oil stage steps. It was noted that the mooring lines posed a trip hazard on the access steps **(Figure 13a)**.

[9] *Svitzer Stanlow* is different in design and layout to *Millgarth*.

[10] Fire deluge system: A system designed to provide a curtain of water around the periphery of the tug to protect it during fire-fighting operations on other vessels.

- When the tug door was aligned with the steps, there was little or no air gap between the tug fender and the steps on the oil stage. It was possible to step directly onto the oil stage steps from the tug's deck without having to step onto the tug fenders.

- When the vessel was moved ahead 2 to 3m, the tug door was aligned with the non-slip paint on the top of the fender and the damaged section of the timber over-rider **(Figure 13b)**.

During the reconstruction, the oil stage camera of the terminal's CCTV system was placed in approximately the same position as during the accident. This allowed additional positional comparisons to be made.

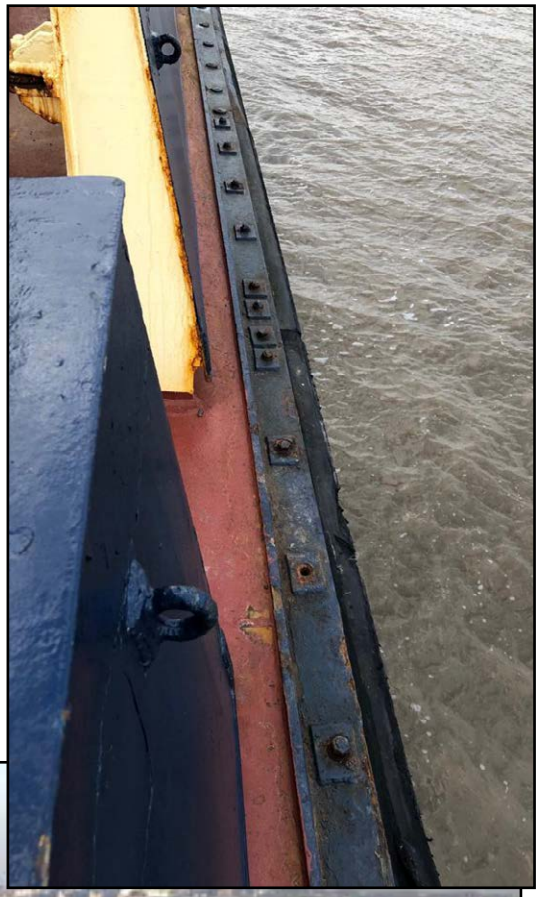

Figure 12: *Svitzer Stanlow* (**inset:** *Svitzer Stanlow*'s 'rubber iron' outside the bulwark)

Figure 13: Reconstruction (**a:** tug gate aligned with the steps, **b:** approximate location of *Millgarth* when chief engineer attempted to board)

1.11 REGULATIONS AND GUIDANCE

1.11.1 Mooring operations

Detailed guidance on safe working practices during mooring operations on board merchant ships has been provided by the MCA in its Code of Safe Working Practices for Merchant Seafarers (COSWP) and by OCIMF in its book, Effective Mooring – Fourth Edition. These publications largely focus on the hazards associated with accidents on mooring decks, tugs and quaysides due to parting lines, equipment failures and line handling. There is little reference to smaller vessels and the additional dangers associated with self-mooring.

The Port of London Authority's (PLA) *Code of Practice for the Safe Mooring of Vessels on the Thames 2010* included a section on self-mooring operations. The PLA's Code of Practice warned that mooring vessels using only members of the vessel's crew is potentially dangerous, and advised that:

> *Self-mooring should only be attempted following formal risk assessment by the Berth Operator, as required by the Management of Health and Safety at Work Regulations 1999.*

The PLA also stressed that the master of the vessel, who authorises self-mooring, remains responsible for the safety of his crew.

1.11.2 Means of access

The MCA provided guidance on the measures that shipowners and employers are expected to take in order to provide a safe means of access on UK ships in its Marine Guidance Note (MGN) 533(M) *Means of Access*[11]. Similar guidance for fishing vessels and small vessels was provided in its MGN 591(M+F) *Provision of Safe Means of Access to Fishing Vessels and Small Vessels in Ports*.

MGN 533(M) replaced the statutory duties set out in *The Merchant Shipping (Means of Access) Regulations 1988*, which were revoked in 2015. The 1988 regulations explained that:

> *When access is necessary between ship and shore, and the ship is not secured alongside, the employer and master shall ensure that such access is provided in a safe manner.*

This text was not included in MGN 533(M), Amendment 1 or MGN 591(M+F).

MGN 591(M+F) stated that:

> *Risk assessments must be carried out in accordance with Regulation 7 of the Health and Safety Regulations. The person responsible for providing safe means of access should, as required, by regulations made under both the Merchant Shipping Act (MSA) and the Health and Safety at Work etc. Act (HSWA), carry out a risk assessment to:*
>
> > *i. consider the health and safety of all seafarers and other workers requiring access to and from the vessel arising in the normal course of their duties or activities;*

[11] MGN 533(M) was replaced with MGN 533 (M), Amendment 1 on 17 January 2019.

ii. identify in accordance with regulation 5 of the Health and Safety at Work Regulations any potential hazards; and

iii. implement appropriate safety precautions to mitigate the risk to an acceptable level. Failure to do so could result in potentially dangerous situations occurring.

The MGN included the following hierarchy for means of access, starting with the safest:

- *gangway between a fishing vessel or small vessel, and a quay, quay steps, quay wall or pier;*
- *stepping directly (short step, level access) between a fishing vessel or small vessel, and a quay, quay steps, quay wall, pier or pontoon;*
- *fixed ladder from a quay, quay wall, pier or jetty;*
- *portable ladder between a fishing vessel or small vessel and a quay, quay wall, pier or jetty.*

With regard to stepping directly between a vessel and a quay, quay steps, quay wall, pier or pontoon, MGN 591(M+F) stated that this is acceptable provided vessels are securely moored so that any gap between them is minimal and users can step across without needing to jump.

The COSWP also provided guidance on safe access to and from a vessel. It explained that it should be an integral part of ensuring a safe working environment on board as required by the Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997, regulation 5(2)(e)[12]. COSWP also listed a hierarchy of preferred options to access small vessels; the list was similar to that provided in MGN 591(M).

Guidance for port operators on access and egress to vessels was provided by Port Skills and Safety[13], with support from the Health & Safety Executive, in its publication SIP014 *Guidance on Safe Access and Egress in Ports*. With regard to access to small ships, the guidance document stated:

Good co-ordination and co-operation is vital when accessing small craft to make sure that access and egress can be done safely and without risks to health. One way of doing this is to have regular meetings with users, including employees and other stakeholders. The level of cooperation and coordination needed will depend on the nature of the access/egress and the risks involved. Consideration should also be given to issues such as: adequate lighting, maintenance, prevailing conditions, housekeeping, etc. **(Annex D)**

It was apparent from Svitzer UK's 2016 health and safety committee meeting minutes that Svitzer UK and Essar had discussed means of access and that Essar had taken action aimed at improving safety.

[12] Regulation 5(2)(e) - maintenance of all places of work in the ship in a condition that is, so far as is reasonably practicable, safe and without risk to health.

[13] Port Skills and Safety was set up in 2002 as a joint venture between the UK Major Ports Group and the British Ports Association to improve safety standards in the industry.

1.12 SIMILAR ACCIDENTS

1.12.1 *Svitzer Moira*

On 29 December 2015, the chief engineer of the 29m tug *Svitzer Moira* was fatally injured after he fell from his vessel as it was being manoeuvred alongside an unmanned tug in Royal Portbury Dock, Bristol. The MAIB investigation concluded that the engineer probably fell while transferring to the unmanned tug before *Svitzer Moira* had come fully alongside. The investigation report[14] listed the actions taken by Svitzer UK as follows:

- *Issued Safety Flash No. 08/2015 to its fleet:*
    - *Safe access/egress must always be established and confirmed prior to any crewmember moving between vessels or between a vessel and the quayside.*
- *Initiated the following measures:*
    - *To review, and revise if/as necessary, the safe systems of work, risk assessments and training provided for Mooring and Unmooring, Access and Egress, and Movement of Unmanned Units.*
    - *To implement behavioural safety training and a Master's responsibility course; to re-emphasise to crews the consequences of not following safety procedures.*

No recommendations were made in the report, based on the actions already taken by Svitzer UK and the Bristol Port Company. Following the coroner's inquest into the death of *Svitzer Moira*'s chief engineer, the coroner wrote to Svitzer UK expressing his concern that, despite inspections and audits having taken place before the engineer's death, they did not identify unsafe behaviour and prevent the accident. The coroner instructed Svitzer UK to:

> *… provide details of the current arrangements for ensuring all crews follow the procedures of the safety management system as well as details of relevant current inspection, audit and assurance processes in place.*

Svitzer UK responded with a letter supported by 12 documents to substantiate the points raised in the letter. The letter stated:

> *The Marine Standards Group concluded, following their review* [of SMS procedures]*, that the procedures remained adequate and, if followed by masters and crews, will enable the safe movement of unmanned tugs…*

The letter then listed several actions and barriers to prevent these violations. These included:

- Random inspection of tug movements by local management, monthly performance scorecard to spot trends on each vessel, based on internal and external audits.

[14] MAIB Report 19/2016: fatal accident while manoeuvring *Svitzer Moira* alongside an unmanned tug, Royal Portbury Dock, Bristol, 29 December 2015

- Local port management visits to vessels to check compliance with the SMS.
- Svitzer UK's Marine Standards Group audits lasting up to 8 hours to include the inspection of a vessel's operations.
- External audits by Lloyd's Register (the vessel's classification society) and the MCA.

The MAIB reviewed the actions taken by Svitzer UK during the period between the fatal accidents on board *Svitzer Moira* and *Millgarth*. Most of the actions listed in the letter to the coroner were fully implemented, with the following exceptions:

- No random inspections of tug operations were undertaken while tugs were berthed at the Tranmere Oil Terminal.
- Although visits by local management to the vessels took place regularly, the visits were not recorded in the SMS after June 2018. In the eight management visit reports in 2018, the following remarks were made:
  - *General feeling of crew's attitude towards safety (based on observation and dialogue with Crew):*
    - **Reactive** *(Safety is important, we do a lot when we have an incident). [Six of the eight reports contained this remark]*
    - **Calculative** *(We have systems in place to manage all hazards). [Two of the eight reports contained this remark]*
  - *Crew's feeling about onshore management's commitment to safety (based on observation and dialogue with Crew):*
    - **Weak**. *[Four of the eight reports contained this remark]*
    - **Indifferent**. *[Four of the eight reports contained this remark]*
- The ability to generate live on-line monthly performance reports for spotting trends on each vessel was lost in 2017 when the ownership of the software company responsible for the Harmonised Management System changed hands.

1.12.2 *Svitzer Victory*

On 14 June 2019, two shore employees from Svitzer UK's Immingham Dock office, a marine superintendent who had recently joined the company, and an Operations Assistant employed by Svitzer UK for over 10 years, went on board *Svitzer Victory* to witness an MOB drill. On completion of the drill, the tug came alongside another moored Svitzer tug and was in the process of making fast. During this process, the marine superintendent stepped across as the gap between the tugs closed. When the Operations Assistant tried to step across, the gap started opening up, and he fell into the water. The Operations Assistant was successfully rescued by the crew of *Svitzer Victory*. The MAIB conducted a preliminary examination of this accident.

SECTION 2 - ANALYSIS

2.1 AIM

The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

2.2 FATIGUE

Review of *Millgarth*'s activities and the hours of rest records leading up to the time of the accident provided no evidence to suggest that fatigue was a contributory factor in this accident.

2.3 THE ACCIDENT

The chief engineer suffered a cardiac arrest and died after falling from an oil stage fender into the River Mersey. He was alive and functioning for several minutes after he entered the river, but he could not be recovered before he lost consciousness and stopped breathing. In this section of the report the reasons why the chief engineer fell into the water and subsequently died will be analysed. The reasons why he could not be recovered on board and the underlying factors that might have contributed to the accident will also be discussed.

2.4 ENTRY INTO THE WATER

The chief engineer went onto the oil stage to release *Millgarth*'s mooring lines. It was apparent from CCTV footage that the tug's chief engineer used the oil stage steps to climb ashore. Once the stern and breast lines were let go, the tug was moved 2-3m forward to slacken the head line, which was the last line ashore. Consequently, the access door was roughly aligned with the middle of the oil stage's northernmost fender. In order to re-board the vessel, the chief engineer stepped over the broken timber over-rider and down approximately 60cm on to the top of the oil stage fender.

The environmental conditions at the time were severe, and as the chief engineer attempted to board the tug, he would have been buffeted by the strong prevailing wind and *Millgarth* would have been moving on the waves. Although it was not raining at the time, both the fender surface and the oil stage were wet due to spray from the river. It was also apparent, from witness accounts, that the chief engineer had crouched down as he stepped over the timber over-rider. This suggests that he might have been holding on to the broken over-rider, in the absence of any other suitable handhold.

It was unclear what caused the chief engineer to fall off the fender; it is most likely that he simply lost his footing and slipped on the wet surface. The likelihood of this was significantly increased by the strength of the wind. However, as he fell between the fender and the oil stage, it is also possible that he was knocked off the fender by the tug as it rode the waves; particularly as earlier in the day the tug had struck the over-rider during a mooring operation in similar weather conditions.

Regardless of the mechanism by which the chief engineer fell into the water, it is clear that attempting to board the unsecured tug via the oil stage fenders was an extremely dangerous work practice. This was particularly so in the poor weather conditions and in the dark.

2.5 LOSS OF LIFE

Having entered the water, the chief engineer's lifejacket deployed immediately, maintaining his airway clear of the water. The crew did not lose sight of him at any stage, and he was able to help himself by holding onto the lifebuoy thrown to him and, once alongside the tug, the ladder. The chief engineer's postmortem report stated that the cause of death was cardiac arrest due to cold water immersion.

The human body's typical reaction to immersion in cold water (less than 15°C) is normally considered in four stages:

Stage 1 - Cold water shock

Cold water shock takes place within the first 30 seconds to 2 minutes, and is generally associated with a gasp reflex as the body comes into contact with the cold water, along with hyperventilation and a dramatic increase in heart rate and blood pressure. If the head goes underwater during this stage, the inability to hold one's breath will often lead to water entering the lungs in sufficient quantities to cause death. The increased heart rate and blood pressure can result in cardiac arrest, especially if the casualty has an existing cardiovascular condition. Panic can cause the hyperventilation to continue even after the initial physiological effects have subsided.

Stage 2 - Cold incapacitation

Cold incapacitation usually occurs within 2-15 minutes of entering the water. The blood vessels are constricted as the body tries to preserve heat and protect the vital organs. This results in the blood flow to the extremities being restricted, causing cooling and consequent deterioration in the functioning of muscles and nerve ends. Useful movement is lost in the hands and feet, progressively leading to the incapacitation of arms and legs. Unless a lifejacket is worn, death by drowning occurs as a result of impaired swimming.

Stage 3 - Hypothermia

Hypothermia occurs when the human body's core temperature drops below 35°C (it is normally about 37°C). Depending on circumstances, this can occur after 30 minutes. The body's core temperature can continue to drop even after the casualty has been recovered from the water if the re-warming efforts are not effective.

Stage 4 - Circum-rescue collapse

Circum-rescue collapse can occur just before, during or after rescue due to a variety of mechanisms that result in unconsciousness or death. Collapse just before rescue may occur when a casualty relaxes mentally resulting in, among other things, a sudden drop of stress hormones, possibly leading to drop in blood pressure.

It was not possible to establish when the chief engineer suffered cardiac arrest or if he suffered a series of cardiac arrests. However, the water temperature in the river was 4°C and therefore the risk of early cardiac arrest due to cold water shock was high. It was also apparent that the chief engineer suffered cold incapacitation due to immersion in the 4°C water, rendering him incapable of climbing the rescue ladder within 5 minutes of entering the water.

2.6 EMERGENCY RESPONSE

The crew witnessed the accident, and the initial emergency response on board appeared to be timely and effective. The alarm was raised immediately, the crew never lost sight of the casualty and were able to bring him alongside within minutes. However, having brought the chief engineer alongside with the aid of a lifebuoy and line, the crew were unable to recover him on board. The local rescue craft *MFR1* was on scene within 22 minutes of the chief engineer entering the water, but by that time it was too late.

The primary means for recovering a person from the water on board *Millgarth* was its Jason's Cradle, which was positioned on the starboard side of the vessel. For this reason, the MOB procedure in the SMS advised masters to *position the tug for rescue*. This step was not followed. Instead, the casualty was brought to the port side of the tug and the crew attempted to pull him out of the water using the SB rescue-sling. This might have been a deliberate decision based on the proximity of the casualty to the oil stage, the prevailing weather and tidal conditions and the risk of losing sight of him, or simply the consequence of the crew's instinctive reaction to throw a lifebuoy and line from the port side of the deck to the casualty as quickly as possible.

The crew successfully looped the rescue-sling under the chief engineer's armpits, but did not tighten it around his chest or remove its aluminium frame. Instead, they tried to use the aluminium pole to lift him out of the water. After about 5 minutes, the chief engineer lost consciousness and slid out of the device. If the rescue-sling had been tightened correctly and the frame removed, it would still have been extremely difficult, if not impossible to haul the chief engineer on board using the rescue line without the aid of a dedicated winch and derrick. However, the line could have been used to pull the casualty around to the starboard side of the tug and position him in the Jason's Cradle.

Another option was to launch the tug's rescue craft. However, given the environmental conditions and the number of crew on board, it would have been an extremely difficult and hazardous method of recovery. It was notable that the professional rescue crew of *MFR1* had to deploy a crew member into the water to recover the casualty, despite being on a boat designed to facilitate such recoveries.

2.7 EMERGENCY PREPAREDNESS

In order to minimise the consequences of a marine accident, a vessel and its crew need to be prepared to deal with a variety of emergency situations. Vessels are prepared through design and the provision of LSA and other safety equipment. Vessel owners and operators prepare their crews by providing them with guidance and procedures, and through the delivery of training. To ensure training has been effective and emergency procedures are fully understood, ships' crews should conduct realistic emergency response drills on a regular periodic basis.

Millgarth was well equipped for MOB recovery. It had a Jason's Cradle, SB rescue-sling, rescue craft and four lifebuoys. The rescue craft and lifebuoys were mandatory requirements for a Class IX tug under 500gt. The Jason's Cradle was fitted to allow *Millgarth* to be operated with a crew of three, and the rescue-sling was provided to help manoeuvre and position a casualty in the cradle. It should be noted that there were four crew on board at the time of the accident. The crew were also provided with PFDs that had PLBs attached; one was being worn by the chief engineer when he fell into the water.

The chief engineer's PFD inflated automatically as designed and helped keep his airways clear of the water. This should have provided the time necessary to recover him on board well before the onset of hypothermia and loss of consciousness in most circumstances. However, this accident clearly demonstrated the difficulty of recovering a partially or totally incapacitated casualty from the water, especially under extreme environmental conditions, and the importance of conducting regular and realistic emergency drills.

The SMS contained guidance for the recovery of persons in the water and an MOB recovery procedure. Svitzer required the MOB recovery drills to be conducted monthly and to be logged. The MOB procedure focused on the recovery of persons from the water using the Jason's Cradle and rescue-sling, and records showed that drills had been conducted monthly on board *Millgarth*. Despite this, the MOB procedure was not followed, and it was apparent that the crew did not know how to use the rescue-sling.

Millgarth's crew was not trained in the use of the rescue-sling, and it was also evident that the equipment was not being stowed, maintained, or tested in accordance with the manufacturer's recommendations. During the MOB drill witnessed by the MAIB on 28 February 2019, 5 weeks after the accident, the crew were still untrained in the use of the device and continued to use it incorrectly. The SB rescue-sling, although not a mandatory LSA, was a critical piece of safety equipment, and *Millgarth*'s crew should have been trained and well-practised in its use.

Svitzer's Liverpool fleet conducted MOB recovery drills in the benign conditions within the sheltered basin of their permanent moorings at Bramley. Most of the drills recorded in *Millgarth*'s log were conducted by the tug's bottom watch crew, and the records indicated that its top watch crew had not done an MOB recovery drill for nearly a year. The importance of conducting regular and realistic emergency drills cannot be over emphasised, and was evident that this was not the case for all crew members. Svitzer's method of recording drills provided assurance that monthly drills were being carried out on each of its tugs, but did not provide assurance that all crew members were participating regularly in them. A requirement for each watch to conduct and record monthly drills would provide increased assurance and would undoubtedly increase levels of emergency preparedness across the Svitzer UK fleet.

2.8 SAFETY EQUIPMENT INSPECTIONS

At Svitzer UK's request, the MCA carried out biennial safety equipment inspections on board *Millgarth* and the other tugs in the Liverpool fleet. It also witnessed MOB recovery drills at the same time. The safety equipment listed on the MCA's inspection form (Form 1102) was limited to the LSA mandated for a Class IX tug under 500gt, which did not include the Jason's Cradle or rescue-sling.

The MOB recovery equipment on board *Millgarth* was in good working order. However, the SB rescue-sling was not being maintained in accordance with the manufacturer's instructions or being used properly. This had not been identified during any of the MCA inspections.

It is not reasonable to expect MCA surveyors to be familiar with the operation of - and maintenance requirements for - all types of safety equipment. It is the responsibility of vessel owners, operators and masters to ensure their crew are competent and proficient in these areas. Nevertheless, the inclusion of the tugs'

MOB recovery equipment on the MCA's safety equipment inspection form would almost certainly increase the levels of scrutiny given to less familiar items such as the rescue-slings.

2.9 TUG MOORING AND UNMOORING OPERATIONS AT TRANMERE OIL TERMINAL

In common with their operations at many berths, both within Liverpool and worldwide, Svitzer tugs going alongside at Tranmere moored without the assistance of shore linesmen. This practice of self-mooring is not restricted to tugs and is not an uncommon practice in small vessel operations.

Self-mooring operations usually involve crew crossing between an unsecured vessel and a quay, pier, pontoon or other vessel. This can be an extremely hazardous evolution that can often be avoided by methods such as the lassooing of bollards, use of boat hooks and the pre-rigging of lines ashore. Similarly, mooring lines can be rigged in a manner such that they can be released from the deck of a vessel in an emergency.

The chief engineer's attempt to board *Millgarth* via the fenders in the prevailing weather conditions, when it was unsecured, was unnecessarily dangerous. The reasons why an experienced chief engineer, who was evidently a champion of safety among his peers, accepted the risk are unclear. The south oil stage was manned at the time and alternative means of mooring and unmooring could have been put in place. However, as seen in many occupational accidents, unnecessarily hazardous work activities can often become the norm if not monitored and controlled.

The MCA had provided detailed guidance and advice in its MGNs and COSWP on means of access to vessels berthed alongside [Section 1.11]. However, it provided no additional guidance for getting on and off small vessels, such as *Millgarth*, during self-mooring operations. The regulations and guidance regarding safe access to vessels are not suspended for the purposes of self-mooring, and similar levels of safety need to be met. Self-mooring is a hazardous practice and, if it cannot be avoided entirely, then it may only be attempted following formal risk assessment by both the vessel and berth operators.

2.10 RISK IDENTIFICATION

2.10.1 Svitzer

Concerns regarding safe access to Svitzer tugs at several locations in Liverpool, including Tranmere, had been raised and discussed repeatedly during safety committee meetings between 2016 and 2018. The issue had also been raised during an internal ISM audit on board *Svitzer Stanlow* in October 2017 when the auditor assessed the means of access at Tranmere to be unsafe because the tug's bulwark gate did not align with the oil stage steps.

In 2003, Tranmere was the subject of a site-specific risk assessment, during which the hazards associated with means of access and getting on and off unmoored tugs were identified. The control measures listed in the risk assessment included the use of shore linesmen and the rigging of gangways.

The risk assessments in place at the time of the accident were generic in nature and did not mention the Tranmere Oil Terminal. However, the generic risks associated with getting on and off a tug during arrival and departure and in poor weather were assessed. The risk assessments recognised that whenever a vessel was not secured alongside there would always be movements due to the surrounding conditions, which made access to unmoored vessels inherently more dangerous than to moored vessels.

Svitzer's procedure for accessing a vessel suggested alternative means for mooring that did not require crew to leave the vessel. One of the recommendations was again to use linesmen. Despite this, the tugs at Liverpool never employed them, and there was clear evidence that crew regularly accessed the moored and unmoored tugs via quayside fenders. This was particularly the case at Tranmere.

The means of access review conducted by Svitzer UK in 2016, following the fatal accident on board *Svitzer Moira* [Section 1.12.1], was supposed to trigger the conduct of site-specific risk assessments at all its regular moorings across the European region. Svitzer's Liverpool office misinterpreted this requirement and it completed just one site-specific risk assessment: the passenger terminal berth at Liverpool. The process identified the specific hazard of shore fenders as a means of access and the risk of crew falling into the water. Crew transfers at the berth were prohibited unless a dedicated gangway was rigged. However, the identification of the unsafe practices adopted by tug crews berthed at the passenger terminal did not prompt a wider review of other sites where similar problems were known to exist.

Unlike ocean-going vessels, the operations of Svitzer tugs at Liverpool were localised and the conduct of site-specific risk assessments, reviewed by shore management during visits on board at these sites, could easily have been achieved. A site-specific risk assessment at Tranmere would almost certainly have identified similar risks to those found at the passenger terminal in Liverpool, and might well have prompted the introduction of controls that would have prevented this accident.

2.10.2 Essar

Essar's risk assessment for its marine operations at the Tranmere Oil Terminal was limited to activities related to tanker operations. Tugs were only mentioned in the risk assessment in reference to their role in escorting tankers in and out of the terminal and standing-by duties during cargo discharge. The terminal and its oil stages were always manned when tankers were alongside, and tanker operations were continuously monitored through CCTV cameras. However, the activities of the tugs and their crews were not monitored or controlled by the terminal staff.

Essar's application of non-slip paint to the fenders following the tug crew's concerns regarding slippery surfaces, was a reactive local decision. However, it had the effect of legitimising the tug crews' hazardous practices at the terminal. There is a clear need for Essar to assess the means of access for tugs moored on its oil stages.

2.10.3 Shared risk

There was a clear separation of assets between Svitzer UK and Essar, and the expectations on both parties were defined in a legal contract. However, neither Svitzer UK nor Essar had recent, site-specific risk assessments for the operation of tugs at Tranmere. On no occasion did the two organisations formally identify and evaluate the shared risks or discuss how these could be mitigated.

Identifying the shared risk across two disparate organisations can be challenging because it can be difficult to accurately define the boundaries of these risks, apportion them appropriately and manage them. It is a complex task because a risk owner may not have control over the activities of the other party. Therefore, there is a natural reluctance to accept the responsibility. Neither Svitzer UK nor Essar had the authority to supervise or manage the effectiveness of the other. Both parties relied on the other to ensure the safe operation of the tug in the conduct of its contracted role to assist tankers calling at Tranmere and remain available, at short notice, to assist in an emergency.

Potentially, there are several situations where a lack of clarity of the roles and responsibilities of both parties could impact negatively. These include emergencies such as fire, pollution and failure of mooring lines. Unless a joint effort is made by both Svitzer UK and Essar to understand the risks covering all possible contingencies, the probability of an accident in the delivery of the service remains high.

2.11 LESSONS LEARNED FROM PREVIOUS FATAL ACCIDENT

This accident occurred 3 years after the fatal MOB accident on board *Svitzer Moira*. Following the *Svitzer Moira* accident Svitzer implemented a number of safety initiatives and reported that it had taken numerous actions aimed at preventing a recurrence of similar accidents. Svitzer's intentions and actions already taken were reported in Svitzer UK's internal investigation report, the MAIB investigation report and the letter sent by Svitzer UK to the coroner of Avon. The MAIB investigation into this accident established that in the period between December 2015 and January 2019, Svitzer carried out almost all these actions.

Though not required by extant regulations, Svitzer had invested in several voluntary initiatives for all its tugs. These included: adopting the ISM Code with its requirement for internal and external audits, complying with OCIMF quality standards, agreeing to a biennial inspection by the MCA, and maintaining its vessels in class with annual surveys by the classification society, Lloyd's Register.

Despite all the positive actions taken by Svitzer UK following the *Svitzer Moira* accident, this similar accident still occurred. Several of the factors that contributed to the death of *Millgarth*'s chief engineer highlighted weaknesses in the SMS. These included:

- The lack of site-specific risk assessments for its regular berths.
- The inadequate response to repeated concerns regarding access to the tugs at Liverpool.
- The incorrect closing out of an audit observation that identified hazardous practices on board one of the tugs due to misalignment of the tug access door with the oil stage steps.
- Not disseminating the safety lesson regarding the importance of aligning the tug access door with the oil stage steps.
- The lack of an immediate and wider investigation covering other berthing locations at Liverpool when crew were observed standing on fenders at the passenger terminal.

- Suspension of safety committee meetings due to disputes.
- Ineffective MOB recovery training and drills.

Svitzer's internal investigation into the accident on *Svitzer Moira* and this accident resulted in similar conclusions: the procedures to carry out the task safely were not followed by the crew. In the case of *Millgarth*, the tools used to verify the crew's compliance with procedures, audits and random inspections, clearly demonstrated that the controls required by the generic risk assessments were being ignored. Nevertheless, the multiple opportunities presented to learn the lessons from other berths, vessels, safety committee meetings and accidents were not taken, and little was done to understand why the procedures were not being followed.

The Svitzer investigation report stated that the unmooring procedure carried out on the day of the accident *provides a satisfactory level of safe access during 'normal' operating conditions*. This demonstrates that, even after this, further fatal accident, the dangers associated with inherently unsafe access procedures, specifically, standing on the shore fender, had not been recognised and addressed. The *Svitzer Victory* MOB incident in June 2019 demonstrates further the insufficient understanding of safe acccess procedures in the Svitzer fleet.

Millgarth's crew were carrying out an operation that they had performed successfully hundreds of times in the past, and sometimes during similar environmental conditions. To them, this had become a normal procedure, and they accepted the severe weather as being an integral component of the task they had to achieve. Disappointingly, the shore management had never visited Tranmere, so had very little appreciation of the hazards or the procedures being followed. While it is easy to conclude that the accident was caused by not adhering to correct procedures, the only way to prevent a recurrence is for Svitzer's management team to work with crews to gain an understanding as to why procedures are not being followed, and to then put in place agreed, appropriate procedures and ensure, through regular liaison, that these remain appropriate and are followed.

Despite regular and repeated reminders of the dangers associated with unsafe access to tugs in Liverpool, and in particular at Tranmere, Svitzer UK had not conducted site-specific risk assessments at Tranmere.

SECTION 3 - CONCLUSIONS

3.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. *Millgarth*'s chief engineer died because he fell into the River Mersey and could not be recovered before he lost consciousness and stopped breathing. [2.3]

2. The chief engineer was attempting to board the tug via an oil stage fender in poor weather conditions and most likely slipped on its wet surface. [2.4]

3. Accessing the tugs via the oil stage fenders at the Tranmere Oil Terminal was a common practice and was extremely dangerous, particularly in poor weather conditions. [2.4]

4. The chief engineer died of cardiac arrest due to immersion in cold water. The water temperature in the river was 4ºC and therefore the likelihood of early cardiac arrest due to cold water shock was high. [2.5]

5. *Millgarth*'s crew were unable to lift the chief engineer on board before he lost consciousness and drifted away because he had been recovered to the port side of the tug and its MOB recovery device was on the starboard side. [2.6]

6. The chief engineer could do little to help himself because he was suffering the effects of his cardiac arrest and cold water incapacitation. [2.6]

7. The chief engineer drifted away from the tug after he lost consciousness because the rescue-sling used to try to lift him out of the water had not been applied correctly. [2.7]

8. The crew had not been fully prepared to deal with the emergency situation, and were unfamiliar with the use of the tug's MOB rescue-sling. [2.7]

9. Concerns regarding safe access to and from Svitzer tugs at the Tranmere Oil Terminal and in Liverpool had been raised at safety committee meetings and during company inspections many times prior to this accident. [2.10.1]

10. The application of non-slip paint to the fenders following the Svitzer tug crews' concerns had the effect of legitimising the tug crews' hazardous practices at the terminal. [2.10.2]

11. Svitzer UK and Essar did not formally identify and evaluate the shared risks associated with access to and from an unmoored tug or discuss how these could be mitigated. [2.10.3]

3.2 SAFETY ISSUES NOT DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. The inspection of MOB recovery equipment during the MCA's biennial inspection of the Svitzer tugs and the conduct of MOB recovery drills, irrespective of the crewing levels, would help identify equipment defects and improve levels of competence. [2.8]

2. The *Svitzer Victory* accident in June 2019 further demonstrated the insufficient understanding of safe access procedures in the Svitzer fleet. [2.11]

SECTION 4 - ACTION TAKEN

4.1 MAIB ACTIONS

Following the preliminary examination of the manoverboard incident on *Svitzer Victory* on 14 June 2019, the Chief Inspector of the MAIB wrote to the Head of Marine Standards for Svitzer A/S. In this letter he expressed his concern that the incident on *Svitzer Victory* was very similar to the fatal accident on board *Svitzer Moira* in December 2015, and the issues of access and egress as highlighted by the fatal accident on *Millgarth* appeared to repeat themselves.

The following recommendation was issued to Svitzer A/S through the Chief Inspector's letter dated 21 June 2019:

2019/115 Take urgent steps to ensure that:

- *Tug access and egress are conducted in a safe and controlled manner.*
- *New employees are not permitted to go on board tugs without a proper safety induction.*

The recommendation was accepted by Svitzer A/S with an implementation date of 30 November 2019.

4.2 ACTIONS TAKEN BY OTHER ORGANISATIONS

Svitzer A/S has:

- Issued an interim safety flash to inform its global fleet of this accident and to take immediate preventative actions.
- Conducted a review of manoverboard recovery equipment across its global fleet, and crews' familiarity with the equipment including their conduct of manoverboard drills within its European region.
- Completed a review of vessel access within its European region.

The **Maritime and Coastguard Agency** has:

- Added the following to Merchant Shipping Instructions to Surveyors (MSIS) 23:
  - *Where a Record of Equipment (MSF1102) is issued to a vessel, any conditions, limitations for exemptions or equivalences on that vessel should be stated in the comments section of the MSF1102. Where applicable verification surveys should include verification of the conditions of the exemption/limitation, examination of fitness for purpose, and familiarity of crew to use the related equipment. This may include a drill in addition to functional tests.*
- Decided to conduct MOB recovery drills on all tugs irrespective of tug manning levels.

Essar Oil UK Limited has:

- Temporarily prohibited tugs from making fast at Tranmere oil stages until a new mooring system is implemented.

- Conducted a joint risk assessment with Svitzer UK and other tug companies who use the Tranmere oil stages.

SECTION 5 - RECOMMENDATIONS

Svitzer A/S is recommended to:

2019/121 Review and amend its procedures, as necessary, to ensure that observations and non-conformities identified during internal audits are not closed out before corrective actions have been completed and safety lessons disseminated throughout the fleet.

2019/122 Adopt measures to ensure that all crew are trained in the manoverboard recovery equipment on board their vessels and that regular drills are completed by all crews irrespective of the rotas they work.

2019/123 Ensure that a thorough assessment of site-specific risks, leading to an agreed procedure, is completed for all the locations where Svitzer tugs provide their service. Where shared risks are identified, work jointly with the asset owners and operators to achieve this.

Essar Oil UK Limited is recommended to:

2019/124 Ensure that a thorough assessment of site-specific risks, leading to an agreed procedure, is completed for all locations where tugs provide their services. Where shared risks are identified, work jointly with the tug owners and operators to achieve this.

Safety recommendations shall in no case create a presumption of blame or liability

Marine Accident Report