MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

ACCIDENT REPORT

VERY SERIOUS MARINE CASUALTY | REPORT NO 29/2011 | DECEMBER 2011

MV *FREMANTLE EXPRESS*

Fatality during mooring operation

Veracruz (Mexico)

15 July 2011

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SUMMARY

On 15 July 2011, *Fremantle Express*, a UK-registered container vessel, was berthing in the port of Veracruz when a headline parted under tension. The broken mooring line recoiled and struck an ordinary seaman (OS) who was standing on the forecastle. The seaman died of his injuries. The vessel was moving astern along her berth at the time of the accident, assisted by two tugs.

The MAIB investigation found that: the combined effect of the vessel's movement astern and her bow paying off the berth had resulted in a snatch loading on the mooring rope; the rope had previously suffered abrasion damage that had lowered its residual strength to less than 66% of its original strength; the OS had stepped into the snap-back zone of the rope; and no warning had been given to him by other members of the mooring party.

A recommendation has been issued to the vessel's managers designed to ensure that the effectiveness of control measures put in place following this accident is kept under review and that, during mooring operations, a sufficient number of experienced crew is available at each mooring station.

FACTUAL INFORMATION

Narrative

At 0642 (UTC -5) on 15 July 2011, *Fremantle Express* arrived off the port of Veracruz (Mexico) with 433 containers on board. The vessel was operating a container feeder service in the Gulf of Mexico and the Caribbean Sea, calling at nine ports in a 21-day period.

At 0906, the pilot boarded the vessel and the crew were instructed to proceed to their respective mooring stations. The weather conditions were suitable for the vessel to berth, with good visibility and light airs. The bridge was manned by the master, third officer, helmsman and pilot. The forward mooring station was manned by the chief officer, bosun, a trainee seaman, a cadet and OS Shiva Nand. The aft mooring station was manned by the second officer and two able-bodied seamen (AB). The helmsman, who was also an AB, was expected to join the aft mooring party on completion of his bridge duties, once the vessel had been placed alongside its berth. Communications between the bridge and mooring stations were conducted by VHF radio.

At 0926, *Fremantle Express* passed the breakwater and was met by two tugs. At 0930, the aft tug was made fast on the port quarter and the second tug was directed to stand by forward to assist as and when required.

At 0942, the vessel approached her intended berth assisted by the two tugs, and the aft backspring was sent ashore. At 0944, the master instructed the chief officer to send the forward lines ashore. The cadet was tasked with throwing a heaving line to the mooring gang ashore while the trainee seaman and Shiva tended the lines. The bosun, facing aft, operated the winch controllers and took instructions from the chief officer who was standing on the starboard observation platform **(Figure 1)**.

At 0945, the master instructed the second officer not to heave in the slack in the aft lines that had been sent ashore as the vessel was required to move 10 metres astern. At 0946, the trainee seaman and Shiva passed a forward backspring ashore from the starboard winch drum **(Figure 2)** and then passed a headline from the centre mooring winch through the centreline fairlead. At 0947, the master instructed the second officer to check the aft backspring as the vessel had now

Figure 1

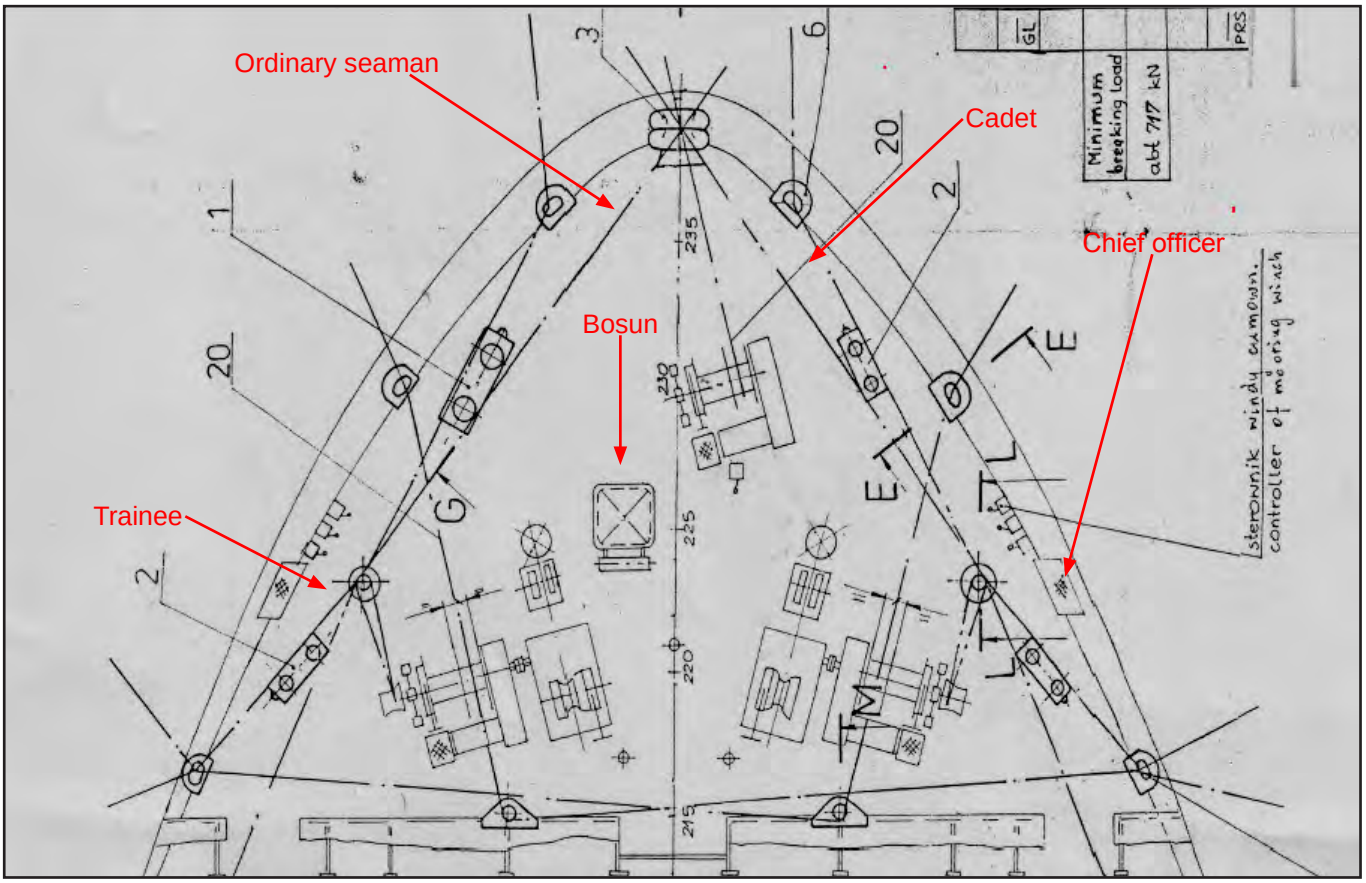
Operating position of mooring winch

only 5 metres to go astern; this was overheard and noted by the chief officer. The master then temporarily applied ahead propulsion to stop the vessel's astern movement.

At 0948, the master instructed the second officer to slacken the aft backspring as *Fremantle Express* was now required to move a further 10 metres astern. This was also relayed to the chief officer with instructions to heave on the forward backspring. The chief officer signalled the bosun to heave on the forward backspring and to slacken the headline. At 0952, the master advised the chief and second officers that the vessel still had 6 metres to move astern. He also told the chief officer to stop heaving so that when the aft mooring party had passed its sternlines ashore, both mooring parties could heave together to bring the vessel into position.

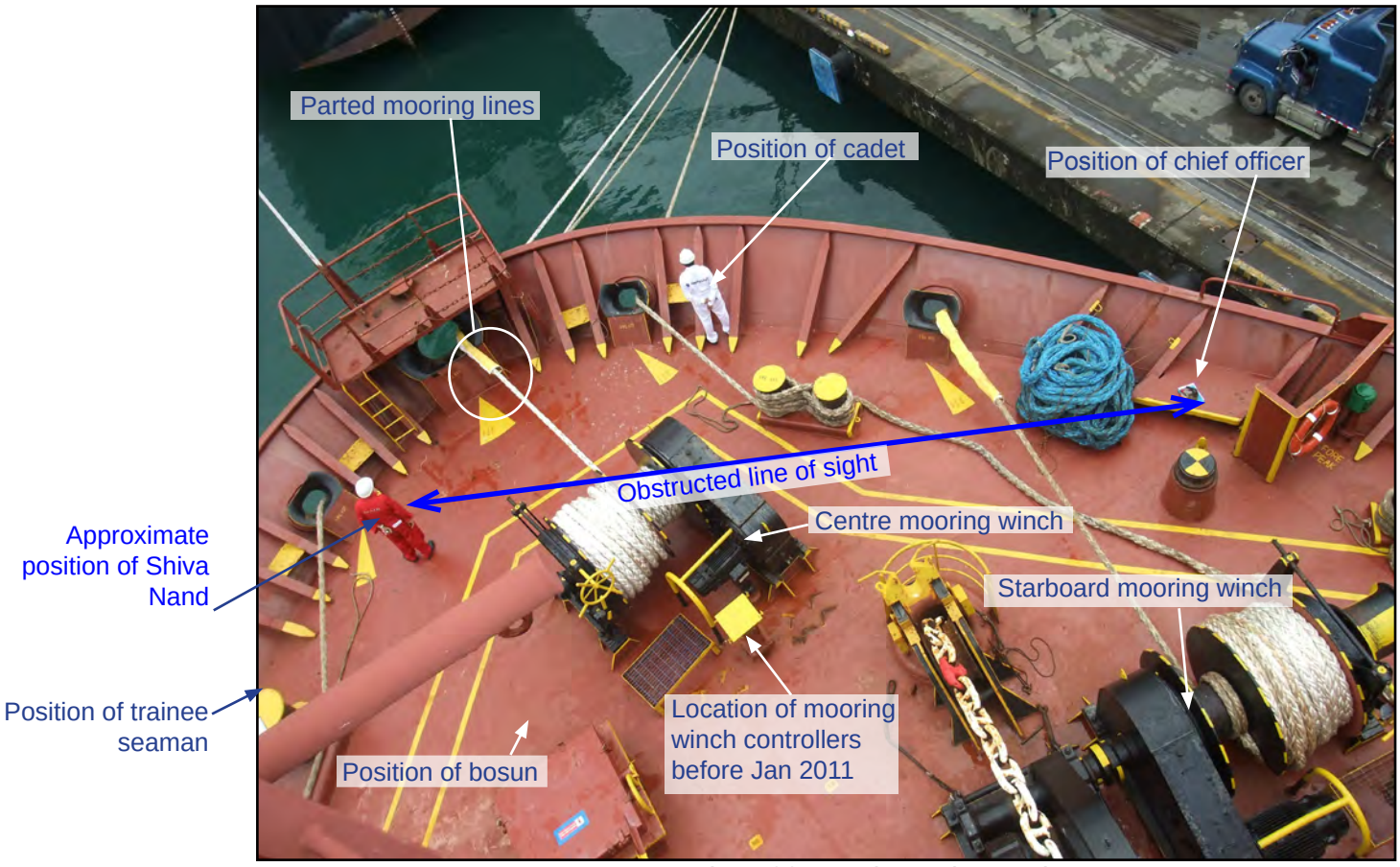
At 0954:26, the master asked the chief officer if any headlines were ashore. The chief officer told him that one headline was secured ashore on a bollard and that another two headlines would be ashore in a further 2 minutes. At this time, the trainee seaman and Shiva were in the process of passing the two headlines from the port side of the forecastle **(Figure 3)**.

Figure 2



General layout of the forward mooring station and mooring arrangements

Figure 3



Reconstruction of forward mooring station

At 0954:39, the master instructed the chief and second officers to start taking weight on their respective mooring lines as the vessel was about 2 metres from her intended final position. This was acknowledged by both men. The chief officer estimated that the headline from the centre mooring winch, which was now stopped, had appropriate slack to allow the vessel to move astern 2 metres while gradually taking the load.

The pilot then gave an instruction for the tugs to stop pushing. Soon afterwards, the chief officer noticed *Fremantle Express'*s bow paying off the berth. This happened as Shiva approached the centreline fairlead, through which he would have been able to visually estimate how much slack was required on the headline he was sending from the port fairlead for its eye to reach the bollard ashore. Without warning, the headline parted, snapped back and struck Shiva.

At 0955:21, the chief officer reported to the master that the headline had parted. The master enquired if anybody was injured. The chief officer's line of sight was obscured by the mooring winch **(Figure 3)** and he could not see Shiva. However, the bosun informed him that Shiva had been struck by the parted rope and had collapsed on deck. The chief officer promptly conveyed this to the master.

The master activated the vessel's medical response team and also asked the pilot to arrange for the shore emergency services to attend. Although he was wearing a safety helmet at the time of the accident, and despite receiving prompt medical assistance, the injuries Shiva sustained to his head were fatal.

The parted mooring rope

The headline parted in the vicinity of the centreline fairlead. It was an 8-strand polypropylene rope, 72 mm in diameter and when new had a minimum tensile strength of 101.6 tonnes. The rope had been brought into service on 12 July 2010. It was subjected to a monthly visual examination and was last inspected on 18 June 2011. Its condition at that time was recorded as "satisfactory".

Following the accident, a representative sample **(Figure 4)** of the rope and the outboard section of the failure zone **(Figure 5)** were analysed by Tension Technology International Limited (TTI) to confirm the condition of the rope and establish the mode of failure. TTI concluded that:

1. The representative sample had lost a significant amount of strength, with an optimistic calculation giving a residual strength of 66% of its original strength.

2. The main cause of this strength loss was external abrasion damage.

3. The abrasion damage existed before the failure incident.

4. Internal abrasion damage contributed to the failure, but to a lesser degree.

5. The pre-existing external abrasion damage on the failure zone was worse than the representative sample.

6. It is possible that thermal degradation had occurred.

Instructions and guidance

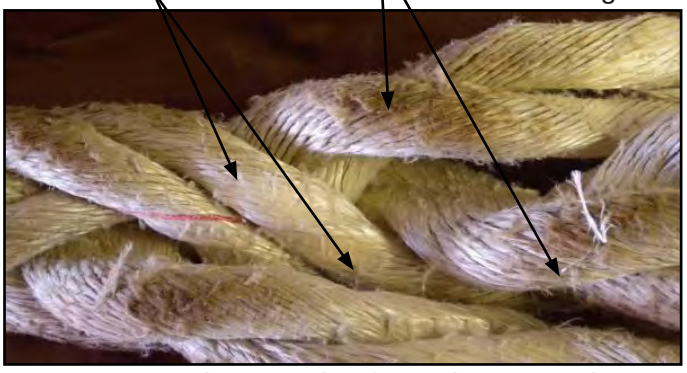
Anglo Eastern Ship Management Limited (the company responsible for the vessel's technical management) provided *Fremantle Express* with procedural instructions and guidance in accordance with its safety management system. Instructions relevant to this accident were:

1. Safe Mooring Procedures, which provided instructions on the planning and execution of mooring and anchoring operations.

External abrasion damage

Internal abrasion damage

Figure 4



Representative sample of mooring rope taken 4 metres from the eye

Figure 5

Section of the failure zone showing extreme abrasion damage

2. Maintenance and Technical Instruction Manual, which provided instructions and guidance on mooring rope inspection, care and handling, and retirement criteria.

Additionally, the company had launched a fleet-wide concentrated quality, health, safety and environment campaign on 30 June 2011 that focused on mooring and anchoring operations.

The Maritime and Coastguard Agency's Marine Guidance Note 308 (M+F), the Code of Safe Working Practices for Merchant Seamen and OCIMF[1] publications 'Effective Mooring' and 'Mooring Equipment Guidelines' contain similar advice to that provided by the company.

ANALYSIS

The accident scenario

The combined effect of *Fremantle Express*'s movement astern and her bow paying off the berth resulted in a snatch loading on the headline, which caused it to part.

Having estimated there was sufficient slack on the headline for the vessel to reach her final position, and without knowledge of the pilot's instruction to the tugs to stop pushing, the chief officer temporarily focused his attention aft. When he turned to observe the headline again, it was already under tension and there was insufficient time for him to give a warning or instruct the bosun to slacken the rope before it parted.

From his aft-facing position at the winch controllers, the bosun was unaware that load was coming onto the headline and was unable to see Shiva, who was standing in the rope's snap-back zone behind him. Although the trainee seaman and cadet saw the bow paying off the berth, they did not recognise the risk to Shiva in sufficient time to warn him before the rope parted.

Ergonomics

The forward mooring deck of *Fremantle Express* was spacious, with a designated walkway and snap-back zones clearly marked with yellow paint **(Figure 3)**. The winch controllers had been positioned on deck, aft of the centre mooring winch. This provided the winch operator with a good view of the mooring deck and allowed the load on most of the forward mooring lines and the movements of members of the mooring party to be monitored from the control position. However, in January 2011, a decision was taken to move the winch controllers to a more protected location within the forepeak hatch coaming. The new position meant that the winch operator was therefore required to face aft during mooring operations, thus removing any opportunity for additional oversight.

At the time of the accident, the chief officer was unable to monitor Shiva continuously as his line of sight to the OS was obscured by the central mooring winch **(Figure 3)**. Had the bosun been operating the winch controls from the original, forward facing position, it is likely that he would have recognised that Shiva was entering a snap-back zone at a time when the headline was coming under tension and been able to provide a suitable warning to the OS and the chief officer.

Mooring rope inspection

The forward mooring deck arrangement on *Fremantle Express* was such that the mooring ropes had to be led through Panama fairleads. The high frequency of port calls and the absence of roller fairleads meant that ropes were routinely subject to significant external abrasion damage. In one of her regular ports, the effect of swell on Fremantle Express while she was alongside required protective sleeves to be fitted to the ropes in way of the fairleads in an attempt to reduce the rate of wear.

Company instructions required all mooring ropes to be inspected every month and each time the rope was in use. The company also provided comprehensive retirement criteria for mooring ropes.

Records held on board Fremantle Express indicate that the ropes were inspected as required, and that some had been cropped when considered necessary. The mooring rope that parted had previously been cropped twice since being brought into service. Although its condition on 18 June 2011 was recorded as "satisfactory", the assessment made by TTI following the accident suggests that a lower standard of acceptability was being applied on board than that required in the company's instructions.

[1] Oil Companies International Marine Forum, a voluntary association of oil companies having an interest in the shipment and terminalling of crude oil and oil products.

The accident could have been prevented had the company's retirement criteria been followed on board Fremantle Express and the damaged and degraded mooring rope been withdrawn from service.

Crew interaction

Fremantle Express's crew conducted mooring operations on an almost daily basis. They were familiar with their tasks, and required minimal supervision.

The company's instructions and guidance on mooring operations included the dangers of ropes parting and the observance of snap-back zones. These were reinforced in a concentrated safety campaign on mooring and anchoring operations in June 2011. The campaign highlighted the need to conduct a tool-box meeting before every mooring operation. However, no tool-box meeting was held prior to Fremantle Express berthing in Veracruz.

The onboard risk assessment relied on countering inexperience or human error by the crew with training and communication. Although Shiva and other members of the crew should have been sufficiently aware, through training, of the need to keep clear of snap-back zones if there was a risk of a mooring rope parting, they still needed to recognise when the risk was present. This relied on their own perception and understanding of the situation, or on being warned of the situation by someone else.

The snatch loading and parting of the mooring rope occurred without the audible warning that will often occur when a synthetic rope comes under significant tension. Shiva was therefore unaware of the imminent danger. The chief officer was unaware of the risk of the mooring rope parting until it was too late to give a warning, and the bosun was unaware that Shiva was standing in the snap-back zone behind him. This left the relatively inexperienced trainee seaman and cadet as the only other members of the forward mooring party who could have given a warning. They were both aware of the bow paying off the berth but did not recognise the potential risk to Shiva before the rope parted.

Despite the frequency and routine nature of mooring operations on board *Fremantle Express*, a tool-box meeting conducted before each operation would have reminded all mooring party members of the intended plan and the safety considerations to take into account, and may have encouraged further communications and interaction during the operation.

The vessel's three experienced ABs were deployed to the aft mooring station. Had one of them been deployed forward, he might have more readily recognised the danger and provided a sufficiently early warning to prevent the accident.

Pilot and tug action

While the movement of *Fremantle Express* astern along the berth was a planned manoeuvre, the bow paying off the berth as the forward tug stopped pushing was not anticipated. The pilot did not communicate to the master that he had given an instruction for the tugs to stop pushing. Had he done so, the master could have alerted the chief officer to the fact, and to the possible consequences.

Although the unexpected lateral movement of the bow contributed to the accident, the potential for mooring ropes to unexpectedly come under load during berthing and unberthing operations is not uncommon, and mooring parties should be continually alert to the possibility.

CONCLUSIONS

1. The re-positioning of *Fremantle Express*'s forward mooring deck winch controllers in January 2011 was ill-considered, and no forethought had been given to the potential consequences of moving them.

2. The requirement for the bosun to face aft while operating the winch controllers removed his ability to monitor the deck, and so prevented him from supporting the chief officer with his experience.

3. The chief officer was unaware of the risk of the mooring rope parting until it was too late to give a warning, and the bosun was unaware that Shiva was standing in the snap-back zone behind him.

4. Had the bosun been operating the mooring winch in a central position facing forward, it is

likely that he would have recognised the risk of the rope parting and would have warned the chief officer and Shiva accordingly.

5. Analysis of samples of the parted mooring rope following the accident, suggests that a lower standard of acceptability was being applied on board than that required in the company's instructions.

6. The accident could have been prevented had the company's rope retirement criteria been followed on board and had the damaged and degraded mooring rope been withdrawn from service.

7. The trainee seaman and cadet were both aware of the bow paying off the berth but did not recognise the risk of the rope parting in sufficient time.

8. Had one of the three ABs on board been deployed to the forward mooring station, he might have more readily recognised the danger and provided a sufficiently early warning to prevent the accident.

9. A tool-box meeting conducted before each operation would have reminded all mooring party members of the intended plan and the safety considerations to take into account, and would have encouraged further communications and interaction during the operation.

10. Although the unexpected lateral movement of the bow contributed to the accident, the potential of mooring ropes to unexpectedly come under load is an everyday occupational hazard, and mooring parties should be continually alert to the possibility.

ACTIONS TAKEN

Anglo Eastern Ship Management Limited has circulated a fleet-wide bulletin, requiring the following:

- A thorough risk assessment of mooring operations and a review of the mooring procedures being followed on board.
- An inspection of all mooring ropes to identify and replace damaged ropes in line with company procedures and ensure a detailed record of inspections and condition is maintained.
- Training for all crew on identifying and understanding the dangers associated with snap-back zones.
- That no modifications are made to the mooring equipment and its layout without completing a risk assessment and obtaining the requisite approvals.

The mooring winch controllers on the foredeck of *Fremantle Express* have been relocated to a position which affords the operator forward visibility.

The concentrated safety campaign on mooring and anchoring operations was extended to 30 September 2011 with emphasis placed on the lessons learnt from this accident. The company now requires crews of vessels to discuss and implement the above requirements, and to record these actions in the minutes of their next safety meeting.

RECOMMENDATION

Anglo Eastern Ship Management Limited is recommended to:

2011/157 Develop in-house controls to verify:

- Measures it has introduced to improve the safety of mooring operations on board its vessels have been implemented.
- A sufficient number of experienced crew are routinely allocated to each mooring station during berthing/ unberthing operations.

SHIP PARTICULARS

Vessel's name	*Fremantle Express*
Flag	UK
Classification society	American Bureau of Shipping
IMO number	9062996
Type	Container vessel
Registered owner	Hapag-Lloyd Ships Limited
Manager(s)	Anglo Eastern Ship Management Limited
Construction	Steel
Length overall	188.0m
Registered length (LBP)	176.68m
Beam	30.0m
Gross tonnage	23540
Minimum safe manning	15
Authorised cargo	Containers

VOYAGE PARTICULARS

Port of departure	Altamira – Mexico
Port of arrival	Veracruz – Mexico
Type of voyage	International
Cargo information	Containers
Manning	27

MARINE CASUALTY INFORMATION

Date and time	15 July 2011 at 0955 (UTC -5)
Type of marine casualty or incident	Very Serious Marine Casualty
Location of incident	Veracruz - Mexico
Place on board	Forward mooring deck
Injuries/fatalities	One fatality
Damage/environmental impact	None
Ship operation	Berthing
Voyage segment	Arrival
External & internal environment	Wind: Light airs Visibility: Good
Persons on board	27