



Bundesstelle für Seeunfalluntersuchung
Federal Bureau of Maritime Casualty Investigation
Federal Higher Authority subordinated to the Federal Ministry
of Transport and Digital Infrastructure

Investigation Report 452/19

Very Serious Marine Casualty

**Accident with subsequent Loss of Life
on board SAJIR
in the Roadstead off Ningbo (China)
on 19 December 2019**

15. September 2021

This investigation was conducted in conformity with the Law to improve the safety of shipping by investigating marine casualties and other incidents (Maritime Safety Investigation Law – SUG). According to said Law, the sole objective of this investigation is to prevent future accidents. This investigation does not serve to ascertain fault, liability or claims (Article 9(2) SUG).

This report should not be used in court proceedings or proceedings of the Maritime Board. Reference is made to Article 34(4) SUG.

The German text shall prevail in the interpretation of this investigation report.

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1 SUMMARY

On 19 December 2019, the German-flagged container ship SAJIR was at anchor in ballast in the roadstead about 10 nm off the pilot transfer position at Ningbo (China).

A bosun and two deck ratings inspected the empty cargo holds and removed any objects that could have caused an obstruction when loading containers. At about 1700¹, the bosun was in cargo hold 9 and fell some 8 m from the enclosure of part of the engine room onto the floor of the cargo hold, suffering life-threatening injuries due to the impact.

It was not possible to establish why – despite his professional experience – the bosun entered this cargo hold without a torch. The fatal occupational accident is made all the more tragic by the fact that physically inspecting the cargo hold would not have been absolutely necessary.

The fall from a height was caused by an unsecured access point to an unilluminated cargo hold, even though – as on comparable ships – a risk of falling from a height does exist there for reasons of ship design.

Despite the proximity to an international port, the crew had to conduct the ensuing emergency management largely without external support. They immediately administered first aid at the scene of the accident, provided transport from the scene of the accident to the ship's hospital under difficult conditions and took charge of emergency care with the support of the telemedical maritime assistance service in Cuxhaven (TMAS Germany)². Despite the medical care on board, the bosun succumbed to his serious injuries at around 2040.

The immediately requested emergency doctor arrived on board some 4.5 hours (at 2140) after the master first called for one but all that was left for him to do was record the crew member's time of death.

It was not possible to establish why the emergency doctor arrived on board so late. Responsibility for medical care therefore remained with the master and attending crew members until the death of the bosun.

The crew benefited from the well-equipped ship's hospital, the master and deck officers' medical training, as well as the medical advice provided by TMAS Germany. In particular, the defibrillator facilitated the emergency medical care administered in the ship's hospital by the officers.

The ship's operator analysed the accident. Following that, all areas on board SAJIR and other ships in the fleet where a similar risk of falling from a height existed that did not already have markings or barriers were secured accordingly.

¹ All times shown in this report are UTC + 8 hours and correspond to local time in Ningbo.

² In addition to its designation, TMAS, the telemedical maritime assistance service in Cuxhaven is also referred to internationally as 'Medico Cuxhaven'.

A comparable fatal accident has already occurred within the BSU's area of responsibility once before in 2014. The BSU had already concluded at that time that such accidents could not be ruled out completely.³

The safety recommendations drawn up in response to this accident seek to

- reduce comparable hazards on all ships if possible;
- simplify emergency reports for ship's commands on board ships flying the German flag;
- disseminate the experience made with the medical equipment, in particular with regard to the rescue stretcher⁴, the defibrillator and the Maritime Medical Handbook;
- ensure regular information for ship operators and crews of ships flying the German flag about assistance following traumatic experiences;
- ensure further development of the standards of competence of seafarers in medical care and a culture of communication between crew member hierarchies, and
- ensure adherence to applicable international minimum standards of training and manning.

Further aspects and details can be found in the investigation report.

³ See Investigation Report 272/14 on the fatal accident on board the MV MAERSK SURABAYA on 1 September 2014 off Shanghai (published 28 August 2015).

⁴ The term 'rescue stretcher' is the official designation (see Subsections 3.4.9.3 ff.).

2 FACTUAL INFORMATION

2.1 Photograph



Figure 1: Container Ship SAJIR⁵

2.2 Ship Particulars

Name of ship:	SAJIR
Type of ship:	Container ship
Flag:	Federal Republic of Germany
Port of registry:	Hamburg
IMO number:	9708784
Call sign:	DIGO2
Owner:	NF Shipping Maritime 3 Ltd.
Shipping company/operator:	Hapag-Lloyd AG
Year built:	2014
Shipyard:	Hyundai Heavy Industries Co., Ltd (South Korea)
Classification society:	DNV GL
Length overall:	368.52 m
Breadth overall:	51.06 m
Draught (max.):	15.50 m
Gross tonnage:	153,148
Deadweight:	149,360 t
TEU:	14,500
Engine rating:	54,900 kW

⁵ Source: Hasenpusch Photo-Productions.

Main engine:	1 Hyundai MAN B&W 9S90ME-C10 nine-cylinder two-stroke diesel engine
(Service) Speed:	21 kts
Hull material:	Steel
Hull design:	Double hull
Minimum safe manning:	17
Miscellaneous:	10 sister ships

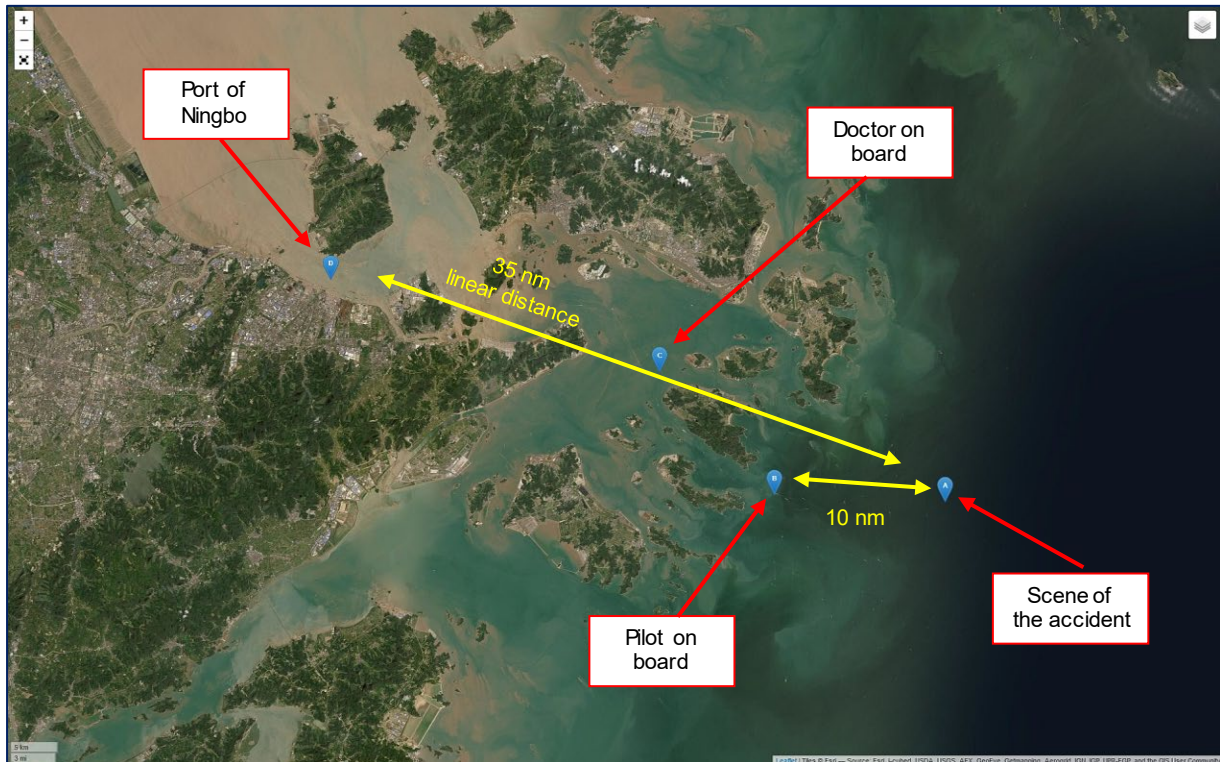
2.3 Voyage Particulars

Port of departure:	Ningbo (China)
Port of call:	Ningbo (China) ⁶
Type of voyage:	Merchant shipping, international
Cargo information:	Unladen
Manning:	27
Draught at time of accident:	D _f = 4.90 m, D _a = 7.70 m
Pilot on board:	No
Number of passengers:	None

2.4 Marine Casualty Information

Type of marine casualty:	Very serious marine casualty – crew member falls from a height into cargo hold with subsequent loss of life
Date, time:	19/12/2019, 1700
Location:	Xiashimen (roadstead off Ningbo)
Latitude/Longitude:	φ 29°44.4'N λ 122°31.5'E
Ship operation and voyage segment:	At anchor in the roadstead
Place on board:	Cargo Hold No. 9
Human factor:	Yes
Consequences:	Death of a crew member

⁶ The SAJIR was laid up in the meantime.

Figure 2: Scene of the Accident and Distances⁷

2.5 Shore Authority Involvement and Emergency Response

Agencies involved:

TMAS Germany,
MRCC⁸ Bremen, MRCC Beijing (China),
Vessel Traffic Service (VTS) Ningbo,
shipping agent in Ningbo,
Seamen's mission;

Resources used:

Employers' Liability Insurance Association
(BG Verkehr⁹), Prevention Division

Equipment to illuminate the scene of the accident;
lines and spineboard¹⁰ for transporting the injured
crew member from the cargo hold to the ship's
hospital; in the ship's hospital (inter alia): oxygen
mask, oxygen, morphine, defibrillator; satellite
phone and VHF¹¹ maritime radio (working
channels) in particular for requesting the
emergency doctor and telemedical assistance; ship
for transferring the emergency doctor.

⁷ Source: www.geoplaner.de (specifically: worldimagery).

⁸ MRCC: Maritime Rescue Coordination Centre.

⁹ BG Verkehr: German Social Accident Insurance Institution for Commercial Transport, Postal Logistics and Telecommunication.

¹⁰ The spineboard (also referred to as a *Miller Board* or *backboard*, depending on manufacturer) is an aid for transporting people who have had an accident with possible spinal injury.

¹¹ VHF: Very high frequency.

Actions taken:

The crew took charge of first aid at the scene of the accident, transport to the ship's hospital and emergency care until death with the support of TMAS Germany. They alerted a doctor and sailed the ship to the position of rendezvous with the doctor. A doctor formally confirmed the death.

Some crew members took up the offer of support from the Prevention Division of the BG Verkehr to help them deal with a potentially traumatic incident.

3 COURSE OF THE ACCIDENT AND INVESTIGATION

3.1 Inspection and Interviews on board SAJIR

On 27 January 2020, nearly six weeks after the fatal accident, the BSU carried out an inspection and interviewed crew members on board the vessel SAJIR in Hamburg.

In particular, the delay was a consequence of the time needed to obtain an entry permit for China. The delay was deemed acceptable due to the nature of the accident being investigated, as in the BSU's view possible changes at the scene of the accident would not have had an adverse effect on the investigation. The BSU did not believe this had a significant effect on the interviews with the crew members directly involved in the accident, either. Firstly, travelling to the vessel in China would have meant several days would pass before the interviews took place. Secondly, all the crew members were still on board in Hamburg because it was only there that the planned replacement of some of the people involved was to take place.

At the request of the master, the BSU did not engage in planned discussions with three crew members directly involved in the accident (one able seafarer and two ratings) because it had subjected them to severe psychological stress. The ship's operator replaced all crew members displaying symptoms of psychological stress in Hamburg unscheduled.

3.2 Course of the Accident

The following account of the course of the accident is based on information submitted in writing by the ship's operator¹², a photographic report from the crew, AIS data from MarineTraffic¹³, the BSU's face-to-face interviews with the master and the ship's officers directly involved in the accident, as well as the BSU's inspection of the ship.

On 19 December 2019, the container ship SAJIR was at anchor in ballast in the Xiashimen roadstead about 10 nm off the pilot transfer position at Ningbo (China). The vessel was scheduled to enter the port of Ningbo on the following day and load cargo.

The chief mate ordered the bosun, one able seafarer and two ratings from the deck department to inspect all cargo holds. They were to remove any lashing equipment and other items left in position that might have jeopardised the safe stowage of containers. During these works, SAJIR was at anchor and displaying relatively little movement at a wind force of about 5 Bft from NNW and a wave height of 1-1.5 m.

At about 1655, the four seafarers were situated on different levels of the non-watertight transverse bulkhead¹⁴ of cargo hold no. 9.

¹² The accident report, the ship's internal accident investigation and the written statements of all crew members directly involved in the accident were referred to.

¹³ AIS: Automatic identification system. This radio system is used to exchange navigation and other ship data. MarineTraffic is a commercial provider through which AIS data can be retrieved.

¹⁴ These transverse bulkheads have several levels/floors. These floors provide access to the various container tiers and design-related platforms in the cargo hold.



Figure 3: Entrance Area of Cargo Hold No. 9 level with the Manhole¹⁵

The able seafarer saw the bosun climb from one of the transverse corridors through an unsecured manhole into the aft section of cargo hold no. 9, meaning he was no longer visible.



Figure 4: Manhole¹⁶

This part of the cargo hold was dark because of the closed hatches and lack of illumination. Very little light came from the illuminated entrance area of the transverse bulkhead through the manhole into the cargo hold.

¹⁵ Source: Crew of SAJIR.

¹⁶ Source: Photographic report from the crew of SAJIR.



Figure 5: Light available with closed Hatch Covers and reduced Daylight¹⁷

The manhole led the bosun to the upper side of the engine room's box-shaped enclosure, which was nearly 8 m in height and did not offer any protection against falling at its edges.



Figure 6: View of the Enclosure from the Starboard Side with open Hatch Cover¹⁸

The able seafarer waited in front of the manhole for the bosun to return. Since the bosun did not return as expected after a short period of time, he went to the manhole and used the light beam from his torch to search for the bosun on the upper side of the enclosure. Since he was unable to see the bosun, he also climbed through the manhole

¹⁷ Source: Photographic report from the crew of SAJIR.

¹⁸ Source: Photographic report from the crew of SAJIR.

onto the enclosure and carefully went to the edge of it. He saw the bosun on the port side lying on his back on the floor of the cargo hold, which was nearly eight metres lower.



Figure 7: Reconstructed Scene showing Position of the Bosun as he was found¹⁹

The able seafarer called the two ratings and asked them for assistance. Both of them immediately came to the scene of the accident and also saw the bosun lying on the lower floor of the cargo hold. One of the ratings went to the chief mate's office as quickly as possible to inform him of the accident.

¹⁹ Source: Photographic report from the crew of SAJIR.



Figure 8: Height of Fall, Lack of Lighting, Access to the Cargo Hold Deck²⁰

3.3 Emergency Response Management

In addition to the sources mentioned in Section 3.1, the recordings in the voyage data recorder (VDR) of the conversations on the bridge and the ship's dynamic data were also analysed for the events described below.

The master was alone on the bridge when the accident happened at about 1700. At that time, the chief mate was on his way from the bridge to the cargo office when the rating approached him and reported the fall from a height in the cargo hold. The bosun was lying on the floor of the cargo hold and still moving. The chief mate immediately went back to the bridge and informed the master at 1704.

The master sent the chief mate to the scene of the accident to obtain further information, e.g. on the height of the fall and injuries, as quickly as possible. Shortly after, he ordered the rescue team assigned for such events, which actually also included the injured bosun, and crew members from the engine department to proceed to cargo hold no. 9.

The chief mate put on his personal protective equipment (PPE), collected the emergency case from the ship's hospital and arranged for the spineboard to be collected from the hospital and taken to the scene of the accident as he was on his way there.

²⁰ Source: Photographic report from the crew of SAJIR.

The chief mate arrived at the scene of the accident at about 1710, where he immediately began to administer first aid and checked the vital functions. The bosun was responsive, he recognised the chief mate and complained in English (the on-board language) of severe pain in his lower back. Otherwise, the chief mate was unable to detect any further external injuries at that point.

Meanwhile, most of the crew had arrived at the scene of the accident. The chief mate made arrangements for the bosun to be transported from the cargo hold to the ship's hospital in order to make use of the options for further examinations and medical treatment there.

The chief mate kept the master informed of the situation in the cargo hold. Internal communication was conducted via handheld VHF transceivers. The master found the internal radio traffic difficult to follow at times because many crew members were using this means of communication and the voice quality was poor due to technical challenges with the radio devices.

At 1723, the master called the ship's agent²¹ in Ningbo by satellite phone. The latter should arrange for medical assistance on board as quickly as possible.

A number of preparations were necessary to ensure transport would be as safe as possible for both the rescuers and the injured bosun. For example, the electro-technical rating installed emergency lighting with the support of other crew members because very little light entered the cargo hold through a gap in the hatch covers. For the vertical transport of the bosun on the 8 m high enclosure, a block with tackle were attached. They intended to carry the bosun from the enclosure's upper cover through the manhole to the transverse corridor of the cargo hold. After that, they planned to pull him upward two decks higher via ladders (about 10 m) to the height of the cargo hatches and then carry him via the cargo hatches to the forward deckhouse about 140 m away. He was then to be transported to the ship's hospital on the A-deck via a stairway that was more than 4 m high.

²¹ The ship's agent – also referred to as a ship broker – acts on behalf of the ship operator in port and should, inter alia, assist the master with all tasks arising in the port, such as

- clearance;
- ordering tugs, pilots, linesmen;
- ordering supplies for the ship (provisions, spare parts);
- mail transport, and
- medical care for crew members.

(See also Raven/Bahnsen, *Kommentar zum Seehandelsrecht* [commentary on maritime trading legislation] 5th edition 2018).

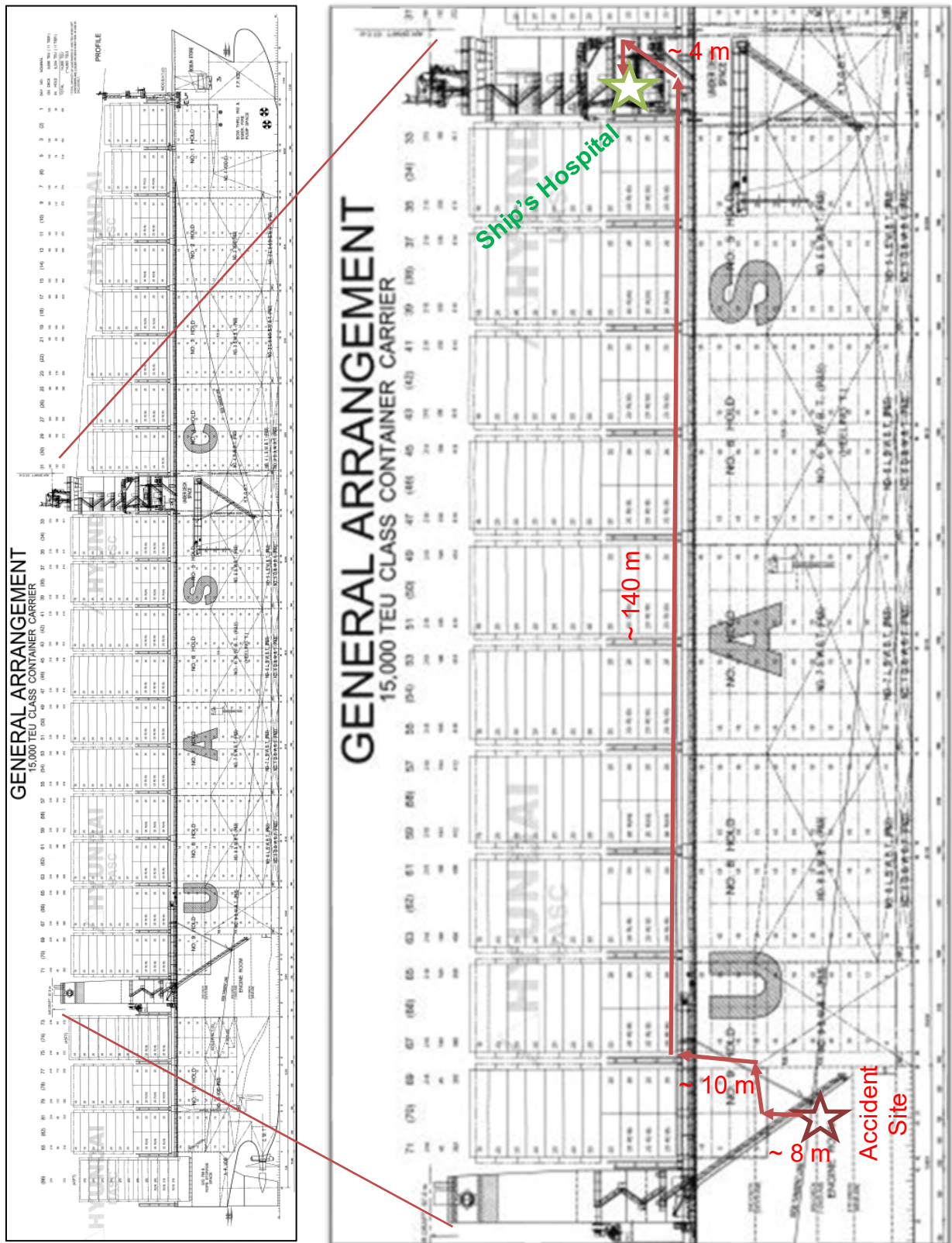


Figure 9: Route from the Scene of the Accident to the Ship's Hospital²²

²² Source: Extract from the general arrangement plan.

At 1731, the master contacted TMAS Germany in Cuxhaven by satellite telephone to obtain telemedical assistance.

At that time, the injured bosun was still responsive but could no longer communicate verbally. The emergency responders noticed that he was rolling his eyes.

Based on the information provided by phone, TMAS Germany recommended that the casualty be supplied with oxygen and analgesics and told the master it would arrange medical care locally if desired. The master gratefully accepted the offer and relayed the treatment recommendations internally. The conversation lasted until 1744.

During the phone conversation with TMAS Germany, the bosun was laid on the spineboard in the cargo hold. While this was happening, the chief mate noticed a laceration on the back of his head that was bleeding somewhat. As some of the crew members tried to secure the bosun on the board, he verbally expressed his displeasure with these measures. After he was secured, he was pulled onto the enclosure with the aid of the tackle construction and from there upward via the ladders to the hatch cover, as planned. Vertical transport was difficult because the bosun slipped on the board and screamed in pain. While covering the some 140 m across the hatch covers to the forward bridge structure, four to six crew members continuously replaced one another while carrying the spineboard. The final few metres via the ascent from the upper deck to the sick bay on the A-deck were also extremely arduous. The vital functions were continuously checked during transport.

At 1751, the master was notified that the casualty was level with the hatch covers. At 1752, the ship's agent called the ship. The master advised the agent about the current situation and repeated his request for medical assistance as soon as possible. The agent did not have any information as to whether, when or how a local doctor would board the vessel.

Immediately after, at 1753, the master reported the accident to VTS Ningbo via the heavily used VHF working channel 08 with a routine call and requested medical assistance as soon as possible for the treatment of a seriously injured person. VTS Ningbo then asked for the phone number of the ship's agent. At 1759, VTS Ningbo made contact and told SAJIR to stand by for further instructions.

After the difficult route to the deck of the ship's hospital was overcome, the bosun was unsecured and moved from the spineboard to the hospital bed. He received medical care in particular from the chief mate, a watchkeeping officer and other crew members.

The officers consulted the book "Instructions for Medical Care on Merchant Ships - Guidelines for Captains and Ship Officers" for guidance. In accordance with the recommendations in this handbook, the attending crew members tried to keep the bosun still. This involved some of the crew members having to restrain the bosun at times. At the same time, the transport stretcher was made ready with a vacuum mattress for helicopter transport. Assistance from TMAS Germany was regularly available. The second officer took charge of communication. The bosun was breathing unassisted. He opened his eyes when addressed but no longer recognised the people around him. He spoke a few words in his first language, Tagalog. However, crew

members in the sick bay who spoke Tagalog were not able to understand him. His pulse was racing at about 140 beats per minute and the blood pressure was extremely low at 80/60. He was given oxygen to help him to breathe. The officers unsuccessfully tried three to four times to insert an intravenous line so as to administer a saline solution intravenously. As recommended by TMAS Germany, the bosun was given 1 ml of morphine intramuscularly for pain relief at about 2000.

In the meantime, VTS Ningbo had made contact at 1821. SAJIR was advised to weigh anchor, sail for Ningbo and take a doctor on board while on her way there.

The master arranged everything immediately so that SAJIR could set sail. The five shackles of anchor chain were on board after about 20 minutes and the voyage could gradually begin. Since SAJIR was in ballast, her maximum speed was about 14 kts.

The SAJIR reached the pilot transfer position at 2000. Contrary to the wishes of the master and crew, only the pilot came on board; a doctor was not present. They continued the approach to Ningbo under pilotage.

In the ship's hospital, the bosun became more active at about 2000, presumably as a result of the morphine and reduction in pain. He tried to move his arms, legs and head.

At about 2025, the injured bosun began to convulse. He stopped breathing at about 2030 and the attending officers were unable to detect a pulse.

The attending crew members then put the semi-automated defibrillator in position and began cardiopulmonary resuscitation. A breathing bag and oxygen mask were used and the defibrillator's instructions were followed. The bosun's condition did not change, however. Although blood oxygenation levels could be measured, there was no heartbeat without the defibrillator. At 2050, TMAS Germany reportedly advised that the resuscitative measures could be discontinued. Despite the clearly negative indications of the defibrillator and the recommendation of TMAS Germany, the deck officers and several crew members continued the cardiopulmonary resuscitation. They did not want to give up shortly before the expected arrival of a doctor in front of the numerous crew members present and assisting in the ship's hospital.

At 2128, SAJIR dropped anchor at a quarantine anchorage to take the doctor and the ship's agent on board. Both of them had approached SAJIR from the opposite direction on a tug in the meantime and boarded via the pilot ladder at 2133. Since the doctor, in particular, had little practise with boarding via a pilot ladder, the transfer was further delayed until the pilot ladder was lowered to an appropriate height for the doctor.

When the Chinese doctor arrived at the ship's hospital at about 2140 with the Chinese agent as an interpreter, the chief mate instructed all other crew members present to leave the room. The doctor pronounced the bosun dead at 2145 and resuscitative measures were discontinued.

The agent and doctor disembarked at 2206. SAJIR hoisted anchor again and continued in the direction of the port of Ningbo. The master remained on watch on the

bridge. The crew dressed the deceased bosun as well as they possibly could, placed him in the body bag kept on board and then put him in the cold storage room.

3.4 Investigation

The accident under investigation is an occupational accident in which a crew member fell from a height of 8 m and succumbed to his life-threatening injuries on board.

To begin with, it was established whether similar accidents had occurred in previous years and if so, how many. The aim was to better classify the potential hazard, as well as to establish whether any safety recommendations published had already been taken into account and – in the light of the current accident – whether they would be sufficient going forward.

Based on the preliminary accident investigation, several factors were identified that might have had a significant impact on the accident and its consequences. They were therefore investigated in greater detail and include

- the ship's basic structural conditions (cargo holds with a risk of falling from a height);
- the ship's crew;
- the competence of crew members involved in the accident;
- occupational health and safety, and
- emergency management.

Everyone involved in the investigation – the operator and crew of the SAJIR, in particular – provided constructive support.

3.4.1 Similar Accidents

A similar fatal accident occurred within the BSU's area of responsibility on the container ship MAERSK SURABAYA in 2014.²³ In this particular case, the ship was in ballast and laid up in a roadstead off Shanghai. An experienced electro-technical rating was requested to repair defective lighting in the transverse corridors of cargo hold no. 9 at the same time as cleaning works were scheduled. To that end, he also went on the enclosure of part of the engine room, fell and succumbed to his injuries on board about 60 minutes later. It was not possible to clarify why the electro-technical rating went on the enclosure or what caused him to fall.

The accident was most likely due to inattentiveness on the part of the electro-technical rating. To make the crew members more aware of the risk of falling in this particular area, the ship operator had yellow and black safety markings applied at the edges of the enclosure and warning signs pointing out the risk of falling at appropriate positions in response to the accident. Where necessary, the ship operator's other ships also took these measures. The BSU therefore dispensed with the publication of a corresponding safety recommendation.

²³ See Investigation Report 272/14 on the fatal accident on board MV MAERSK SURABAYA on 1 September 2014 off Shanghai. Published 28 August 2015.

Since the accident was most likely due to the inattentiveness of a crew member, the BSU assumed that such accidents would not be entirely avoidable in the future, despite appropriate markings.

The BSU has not found any other marine casualties that concern a fall from an enclosure in a cargo hold in the European Marine Casualty Information Platform²⁴ (EMCIP) database, which has been maintained since 2011. However, it cannot be ruled out that other comparable accidents have occurred within the European sphere of competence, as every detail is not always recorded in EMCIP in a statistically evaluable manner.

3.4.2 Shipbuilding – Fall Hazards in a Cargo Hold

Due to her size and cargo capacity of just under 15,000 TEU²⁵, SAJIR is classified as an Ultra Large Container Ship (ULCS) – also referred to as an Ultra Large Container Vessel (ULCV). Depending on the source of information, container ships of more than 10,500, 12,000 or 14,000 TEU are classified as a ULCS.

The deckhouse on most ULCSs is separate from the engine room and positioned further forward to allow containers to be stacked higher on deck (taking into account the required line of sight in the direction ahead²⁶). The machinery is positioned as near to the stern as possible to save the cost of a long propeller shaft and reduce the space needed for the shaft tunnel, for example, in turn creating space for additional container slots. This is sometimes referred to as a twin-island design.

Due to this arrangement of the machinery, engine room enclosures regularly protrude into one of the aft cargo holds on these classes of vessel. Since crew members or other people generally do not have to step on such enclosures and the space available can be used for storing cargo as far as possible, no fall protection is installed there.

Cargo holds with accessible enclosures exist on SAJIR's ten sister ships and on many other ULCSs. According to an article in THE MARITIME EXECUTIVE of 3 November 2020, there were 451 ULCSs in service worldwide on 1 January 2018, and the number is increasing.

The fatal accident on board MAERSK SURABAYA (see Section 3.4.1) demonstrates that cargo holds with accessible enclosures also exist on smaller container ships. MAERSK SURABAYA was built in 2006, is designed for the transport of 8,400 TEUs and is thus neither a ULCS nor of twin-island design.

²⁴ EMCIP has been operated by EMSA (European Maritime Safety Agency), the European Commission and EU/EEA Member States since June 2011. In principle, all marine casualties falling within the competence of EU/EEA Member States are recorded in EMCIP.

²⁵ TEU: Twenty-foot Equivalent Unit is an internationally standardised unit. However, the length of a 20-foot container is only 19 feet and 10½ inches (6.058 m) because two such containers in a row cannot be longer than a 40-foot container and a 3-inch (7.62 cm) gap is required.

²⁶ According to RESOLUTION A.708(17) adopted on 6 November 1991, the view of the sea surface from the conning position should not be obscured by more than two ship lengths, or 500 m, whichever is less, forward of the bow to 10° on either side irrespective of the ship's draught, trim and deck cargo.

Further cargo holds on board the SAJIR and other container vessels also pose a risk of falling from a height, as accessible platforms with a fall risk exist due to the shape of the hull or necessary tanks, for example.

3.4.3 Manning


In the following it was investigated whether the SAJIR was safely manned on the day of the accident in accordance with international and flag State regulations and whether insufficient competence of the crew members, in particular the fatally injured bosun, can be ruled out.

To this end and to begin with, an examination as to whether the flag State complied with legal requirements when issuing the minimum safe manning document was carried out. This was followed by an examination as to whether the ship operator complied with its obligations.

3.4.3.1 Minimum Safe Manning Document

As the competent authority of the German flag State, the Ship Safety Division (BG Verkehr) issued a minimum safe manning document on 2 December 2019 in accordance with Regulation V/14(2) SOLAS²⁷, as amended (see Figure 10 or Annex 9.1).

²⁷ SOLAS: International Convention for the Safety of Life at Sea, 1974/88.




Bundesrepublik Deutschland
 BG Verkehr - Dienststelle Schiffssicherheit

Federal Republic of Germany
BG Verkehr - Ship Safety Division

Schiffsbesatzungszeugnis
Minimum Safe Manning Document

Ausgestellt im Namen der Bundesrepublik Deutschland von der Berufsgenossenschaft Verkehrswirtschaft Post-Logistik Telekommunikation nach Maßgabe der Bestimmungen von Regel VI/14(2) des Internationalen Übereinkommens von 1974/88 zum Schutz des menschlichen Lebens auf See, in der jeweils geltenden Fassung.
 Issued under the provisions of Regulation VI/14(2) of the International Convention for the Safety of Life at Sea, 1974/88, as amended, under the authority of the Government of the Federal Republic of Germany by the Berufsgenossenschaft Verkehrswirtschaft Post-Logistik Telekommunikation.



Name des Schiffes: SAJIR	Schiffsart: Frachtschiff	
<small>Ship's Name</small>	<small>Type of Ship cargo ship</small>	
Heimathafen: Hamburg	IMO-Nr.: 9708784	Unterscheidungssignal: DIGO2
<small>Port of Registry</small>	<small>IMO Number</small>	<small>Distinctive number or letters</small>
Bruttoanzahl: 15318 BRZ	Haupttriebsleistung: 37620 kW	Zeitweise unbesetzter Maschinenraum: AUT
<small>Gross Tonnage</small>	<small>Main Propulsion Power</small>	<small>Temporarily Unattended Machinery Space</small>
Kunstsatzgebiet: Weltweite Fahrt		
<small>Trading Area</small>	<small>Unlimited Voyages</small>	

Betreibendes Unternehmen: See Safety Management Certificate
Operating Company

Auf Seereisen gilt das in diesem Dokument genannte Schiff als ausreichend besetzt, wenn auf ihm mindestens die in der nachstehenden Tabelle vermerkte Schiffsbesatzung vorliegt.
 The ship named in this document is considered to be safely manned if, when it proceeds to sea, it carries not less than the number and grades / capacities of personnel specified in the table below.

<small>Kapitän Master</small>	<small>1</small>	<small>II/2, IV/2, VI/2(1), VI/3</small>	<small>Leiter der Maschinenanlage Chief Engineer Officer</small>	<small>1</small>	<small>III/2, VI/2(1), VI/3</small>
<small>Erster Offizier Chief Mate</small>	<small>1</small>	<small>II/2, IV/2, VI/2(1), VI/3</small>	<small>Zweiter techn. Offizier Second Engineer Officer</small>	<small>1</small>	<small>III/2, VI/2(1), VI/3</small>
<small>Nautische Wachoffiziere Navigational Watchkeeping Officers</small>	<small>2</small>	<small>II/1, IV/2, VI/2(1), VI/3</small>	<small>Techn. Wachoffiziere Engineering Watchkeeping Officers</small>	<small>1</small>	<small>III/1, VI/2(1), VI/3</small>
<small>Schiffschmied General Purpose Rating</small>	<small>---</small>	<small>---</small>	<small>Schiffselektrotechniker/-elektriker Electrical Technicians / Electricians</small>	<small>---</small>	<small>---</small>
<small>Schiffsman Deck (wachbefähigt) Rating Deck (watchkeeper)</small>	<small>5</small>	<small>II/4, VI/1 or VI/5, VI/1</small>	<small>Schiffsman Maschine (wachbefähigt) Rating Engine (watchkeeper)</small>	<small>3</small>	<small>III/4, VI/1 or III/5, VI/1</small>
<small>Schiffsman Deck Rating Deck</small>	<small>1</small>	<small>VI/1</small>	<small>Schiffsman Maschine Rating Engine</small>	<small>---</small>	<small>---</small>
<small>Koch Cook</small>	<small>1</small>	<small>VI/1</small>	<small>---</small>	<small>---</small>	<small>---</small>
<small>Gesamtzahl: Total Number:</small>			<small>17</small>		

Etwas besondere Anforderungen oder Bedingungen:
 Special requirements or condition, if any:

Ausgestellt in Hamburg am: 02.12.2019
 Issued at Hamburg on: 02.12.2019


Gültig bis: 05.12.2024
 Valid until: 05.12.2024

Berufsgenossenschaft Verkehrswirtschaft
 Post-Logistik Telekommunikation
 - Dienststelle Schiffssicherheit -

2) Davon insgesamt mindestens 1 EU/EWR-Staatsangehöriger
 thereof total minimum 1 EU/EWR-Citizen(s)

Nationales Recht (national law)
 1) EU/EWR-Staatsangehöriger
 EC/EEA-Citizen
 3) Oder Auszubildender zum Schiffschmied im zweiten oder dritten Ausbildungsjahr
 Or general purpose trainee in the 2nd or 3rd training year
 SBZ 11/2017

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Figure 10: SAJIR's Minimum Safe Manning Document²⁸; see also Annex 9.1.

This Regulation states that the flag State shall issue an appropriate certificate based on a transparent procedure to determine safe manning of the ship, taking into account the recommendations of Resolution A.1047(27) (Principles of Minimum Safe Manning) of the Maritime Safety Committee (MSC).

Germany has transposed SOLAS and the recommendation into binding national law through Annexes A and C to the *Schiffssicherheitsgesetz (SchSG)* [Ship Safety Act]. The official translation and promulgation of MSC Resolution A.1047(27) was published in the Gazette of the Federal Ministry of Transport, Building and Urban Affairs (4/2013 No 48 on p. 201) (see Annex 9.2).

²⁸ Source: BG Verkehr. Highlighting by BSU.

The Resolution has the following four Annexes:

1. Guidelines for the application of principles of minimum safe manning.
2. Guidelines for determination of minimum safe manning.
3. Responsibilities in the application of principles of minimum safe manning.
4. Guidance on contents and model form of minimum safe manning document.

This Resolution provides guidance to operators responsible for the safe manning of ships and to the Administration responsible for certification. This will not be looked at in greater detail for lack of necessity in the current accident under investigation. Instead, reference is made to the Resolution appended to this report (Annex 9.3).

The competent Ministry, BMVI²⁹, has summarised and put into legal form the material elements of the Resolution through the *Schiffsbesetzungsverordnung (SchBesV)*³⁰ [German Ordinance on Safe Manning], in particular Sections 2 and 8.

Section 2(1) SchBesV states that shipowners “[...] shall man the ship with due regard to the number, competence and qualification of the crew members so as to ensure

1. the safety of the ship,
2. the safe watchkeeping,
3. the observance of the provisions of health and safety at work, including the restrictions on working hours, of on-board protection of health and medical care as well as of marine environmental protection,
4. the maintenance of public safety and order on board and
5. the language communication among the crew members.”

According to the second sentence of this section, for the manning of ships “[...] the operational requirements, especially the type of ship, the level of automation, the equipment, the intended use, the sequence of ports, the route and the type of cargo carried shall be taken into account.”

Pursuant to Section 8 SchBesV, BG Verkehr “[...] shall issue a safe manning document according to the model published in the Gazette of the BMVI if the requirements set out in Section 2(1) [*inter alia*] are complied with.”

²⁹ BMVI: Federal Ministry of Transport and Digital Infrastructure.

³⁰ SchBesV, 18 July 2013 (BGBl. [Federal Law Gazette] I p. 2575), as last amended by Article 12 of the Act of 17 July 2017 (BGBl. I p. 2581).

According to her minimum safe manning document, SAJIR had to be manned by at least 17 crew members for international voyages.

With regard to the manning of the deck department at the support level³¹ of relevance to this accident, at least six crew members qualified in accordance with Regulation VI/1 (basic safety training) of the Annex to the STCW Convention were required to be on board.

Deckhands holding a certificate of proficiency in accordance with Regulation VI/1 of the Annex to the STCW Convention shall have received approved basic training or instruction in accordance with the tables in A-VI/1 STCW Code in

- personal safety;
- fire prevention and firefighting;
- first aid, and
- social responsibility.

Crew members must demonstrate such competence on board before they may be assigned safety or pollution-prevention duties.

Five of the six crew members were additionally required to be (at least) competent in navigational watchkeeping in accordance with Regulation II/4 of the Annex to the STCW Convention.

Moreover, crew members holding a certificate of proficiency in accordance with Regulation II/4 of the Annex to the STCW Convention are competent in navigational watchkeeping at the support level and are basically capable of

- executing helm orders issued in English;
- steering ships in accordance with instructions;
- keeping a proper lookout by sight and hearing;
- liaising with an officer in charge of the navigational watch on the bridge on other associated tasks, and
- assisting with emergency procedures on the bridge.

Able seafarers deck qualified to a higher standard in accordance with Regulation II/5 of the Annex to the STCW Convention can also assist in all other duties in the deck department. These include, e.g. duties relating to

- all types of mooring arrangement;
- the cargo, and
- safe operation of the technical deck equipment.

Accordingly, able seafarers decks are also qualified to apply precautionary measures for occupational safety and accident prevention. According to Table A-II/5

³¹ The mandatory part of the STCW Code defines the term 'support level' as being the level of responsibility typically associated with performing assigned tasks, duties or responsibilities on board a seagoing ship under the direction of the master or a ship's officer. STCW Code: Annex to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978.

STCW Code, candidates for a corresponding certificate of proficiency must also demonstrate, in particular, knowledge, understanding and proficiency in those areas which were of direct relevance in the context of the bosun's fall, and include

- working aloft;
- working in enclosed spaces;
- permit to work systems;
- personal protective equipment.

Accordingly, the minimum safe manning document issued by the Ship Safety Division (BG Verkehr) was largely consistent with the ship operator's application, which did not provide for a rating deck (without navigational watch proficiency).

3.4.3.2 Crew on the Day of the Accident

According to the crew list, 27 crew members were on board when the accident happened. Seven of them were seafarers assigned to the deck department at the support level (ratings deck), who were employed in three different capacities. They included the fatally injured bosun, three able seafarers deck (AB)³² and three ordinary seafarers (OS)³³.

Regardless of their capacity on board, all seven ratings deck were holders of a Philippine certificate of proficiency in accordance with Regulation VI/1 (basic safety training) and Regulation II/5 (able seafarer deck) of the Annex to the STCW Convention.

Certification as an able seafarer deck means that the ratings had acquired the highest possible competency at support level under international law.

3.4.3.3 Certificates of Proficiency under the STCW Convention

By issuing certificates of proficiency, parties to the STCW Convention confirm that they have established that certificate holders have the qualifications certified based on the methods agreed in the STCW Convention.

Parties to the STCW Convention are required to submit a report on which provisions of the STCW Convention they apply and how they are implemented to the Secretary-General every five years. Based on these reports, independent persons acting on behalf of the IMO³⁴ ensure that the relevant provisions of the STCW Convention are fully complied with.

The IMO's MSC last published the most recent status of reporting obligations of Parties to the STCW Convention to the IMO's Secretary-General on 17 May 2021 in MSC.1/Circ.1164/Rev.23 (Annex 9.3).

³² n/a.

³³ n/a.

³⁴ International Maritime Organization.

The Philippines last reported on 3 February 2009 in accordance with the circular. Based on this report, the MSC confirmed its compliance with the provisions of the STCW Convention for the last time.

3.4.4 The Bosun's Competence – Duties – Working Hours

The fatally injured bosun was 41 years old at the time of the accident. He was employed by the Philippine private seafarers' agency Marlow Navigation Phils., Inc. and had been placed by it with the ship operator for service on board SAJIR.

He was fit for service at sea at the time of the accident and possessed all official certificates of proficiency, in so far as these are internationally provided for seafarers in the capacity of bosun on container ships. In particular, this included the certificate of proficiency as an able seafarer deck in accordance with Regulation II/5 of the Annex to the STCW Convention.

Prior to the accident, he had worked at the support level in the deck department of various merchant ships for a total of 12 years, including slightly more than four years as a bosun on several container ships. He had been employed on ULCSs on which – similar to the SAJIR – the deckhouse was positioned well forward separate from the machinery for almost half that period (23 months). It is highly likely that these ships also had comparable cargo holds with engine room enclosures.

The bosun had been on board SAJIR for seven months. He was respected and appreciated as an experienced bosun and popular among the crew.

According to the ship operator's³⁵ job description, the bosun reported to the chief mate (see Annex 9.4). He was responsible for all duties in the deck department and supervised three ABs and three OSs.

According to the documentation required under the ISM Code³⁶, the bosun had been informed of his duties and instructed in accordance with all internal corporate requirements.

The bosun performed his duties during the day and was exempt from watchkeeping. The bosun had complied with the maximum hours of work and minimum hours of rest.

3.4.5 Post-mortem Examination

The body of the fatally injured bosun was examined externally and toxicologically by the SHANGHAI MEDICAL COLLEGE FUDAN UNIVERSITY, CENTER OF FORENSIC SCIENCE. According to the report dated 12 March 2020³⁷, the death was

³⁵ In accordance with the ISM Code (International Safety Management Code), the duties are defined in the SMM (Safety Management Manual), Document QEM/SMM-06-01/3.4/08-00 dated 1 June 2018.

³⁶ International Safety Management (ISM Code): The "International Management Code for the Safe Operation of Ships and for Pollution Prevention" is an internationally binding convention in which the measures for the organization of a safe ship operation are bindingly regulated. The ISM Code is part of the International Convention for the Safety of Life at Sea (SOLAS Convention, Chapter IX).

³⁷ The examination could not be made until almost three months after the accident due to measures imposed in China to prevent the spread of COVID-19.

caused by head and chest injuries as a result of a fall. No toxicological substances or alcohol were detected in the blood.

3.4.6 Working Day of the Bosun

The accident happened on SAJIR's seventh day at the anchorage. The bosun's day started with a meeting on the bridge at about 0710. The master, chief mate and bosun discussed the work schedule for that day. From 0800 to about 1000, the bosun mainly checked the stock of lashing equipment needed. During that period, from about 0900 to 0930, he was on the forecastle when an anchor manoeuvre was carried out because SAJIR had to leave her previous position due to a military exercise that had been announced. Since SAJIR was scheduled to sail into Ningbo on the following day and take on cargo, the master had planned to move the vessel to the vicinity of the pilot transfer position in any case.

When asked by the bosun, the chief mate confirmed at 1000 that all cargo holds should be checked during the course of the day. The holds did not need to be swept or washed. Only larger objects were to be removed so as not to jeopardise the subsequent stowage of the containers.

The bosun had to interrupt the inspection of the cargo holds between 1530 and 1600 for the anchor manoeuvre near the pilot transfer position. One OS stated that up until this point, the bosun had inspected all the cargo holds except for no. 7, 8 and 9. About 30 minutes before work was due to end, at about 1700, the bosun and three other deckhands went into the entrance of cargo hold no. 9. Shortly after, the bosun climbed through a manhole into the unlit, dark part onto the enclosure in the cargo hold and fell.

3.4.7 Communication Culture

The SAJIR has been operated by Hapag-Lloyd AG under the German flag since 21 May 2019. Both the company and the ship had valid certificates for a functioning ship safety system in accordance with the ISM Code at the time of the accident.

The documents provided to the BSU were comprehensive.

In the context of the accident, the investigation focused on the description of the duties and responsibilities of the crew members in the ISM Main Manual. According to these rules, both the bosun and the deckhands are required to perform the tasks assigned to them in accordance with the instructions of their respective superiors (see Annex 9.4). Chapter 6.7 "Effective Communication" of the manual requires crewmembers to cooperate in a trustful manner at all times ("Under all circumstances crewmembers shall communicate and cooperate in a trustful manner"). However, this is in the context of the determination of the on-board language and the question as to when a communication in the native language is permissible.

Based on this finding, the basic conditions for a culture of communication between two crew members in a subordinate relationship were considered given that the fatally injured bosun had entered the unlit cargo hold without a torch and was observed doing so by a deckhand under his authority. The latter had not advised his superior of the

risk of entering the hold without a torch, although there was a recognisably dangerous situation here.

In retrospect, the BSU was unable to determine why the deckhand did not address the situation.

Whether a critical exchange of views can be expected and demanded from crew members at the support level at all is doubtful, taking into account the internationally binding minimum standards of competence according to the STCW Code.

It was only with the incorporation of the Manila Amendments in the STCW Convention on 1 January 2012 that mandatory minimum standards for the effective use of all resources were introduced for officers in charge of navigational and engineering watches for the implementation of safe watchkeeping on the bridge and in the engine room. The English version of the STCW Code refers to these standards as bridge resource management (BRM) and engine-room resource management (ERM)³⁸. The validation of a certificate of competency for service on ships with a gross tonnage of ≥ 500 or propulsion power of ≥ 750 kW involves all officers, including masters, demonstrating that they are capable of explicitly including subordinates, in particular, in the decision-making process. In the criteria for assessing the competence of officers in charge of a watch, it states: "Communication is clearly and unambiguously given and received." According to the STCW-Code³⁹, Navigating officers must be able to engage in an exchange of views that is appropriately critical of the matter in hand when doubt is raised by speech or action. Officers in charge of an engineering watch must be able to challenge and retort to questionable decisions or actions in an objective manner.

On the other hand, crew members at the support level are not necessarily required to be prepared for critical involvement in the safe operation of a ship according to the STCW Code. They are required to convey messages clearly and concisely. Depending on the interpretation of this requirement, this may of course also mean comments to superiors. However, the BSU's investigators are compelled to question why the wording is clear for officers.

3.4.8 Occupational Health and Safety

The bosun lost his life due to a typical occupational accident. He apparently entered a dark cargo hold through a freely accessible manhole without a torch or other means of illumination and then fell from a platform that was not equipped with an anti-fall device.

In accordance with the regulations of the international Maritime Labour Convention, risk assessments must be carried out on ships flying the German flag for the protection of crew members according to the *Arbeitsschutzgesetz (ArbSchG)* [German Occupational Health and Safety Act]. Moreover, any national occupational health and safety legislation must also be observed.

³⁸ See Tables A-II/1 and A-III/1 STCW Code, each containing the standards for the effective use of resources on the bridge and in the engine room. The relevant tables are published in the attachment of the Federal Law Gazette part II No. 18 dated 4 July 2013 in volume 3 (page 754 until page 1267).

³⁹ See footnote 39.

This gives rise to a number of obligations for employers and employees. The aspects rated as being of relevance to the accident (risk assessments, risk prevention and PPE) have been looked at in greater detail below.

3.4.8.1 Risk Assessments

In accordance with the ArbSchG and the 'Principles of prevention' (DGUV regulation 1) accident prevention regulations, the ship operator carried out an evaluation of all the risks regularly occurring in the operation of its fleet and prepared 86 risk assessments.

There was no risk assessment that could be directly applied to the task associated with the accident, i.e. a visual inspection of cargo holds and the disposal of waste. On the one hand, the operator had not classified this activity as potentially hazardous in its own right, and on the other hand, several risk assessments were available that could be relevant in the context of such an activity. These include, for example:

- use of walkways;
- work in confined and dangerous spaces;
- work aloft;
- use of doors;
- use of stairs;
- maintenance of lashing and equipment, and
- waste processing and disposal.

3.4.8.2 Risk Prevention

In the interests of health and safety at work, employers must take technical or organisational measures to prevent or sufficiently limit hazards to the health and safety of crew members.

If this is not possible, Subsection 1.3 of the Annex) *Arbeitsstättenverordnung (ArbStättV)*⁴⁰ [German Ordinance on Workplaces] states that safety and health signs shall be displayed in accordance with the specifications of Directive 92/58/EEC. A risk of falling prevailed in the present case. The Directive provides the following pictogram:

⁴⁰ ArbStättV, 12 August 2004 (BGBl. I p. 2179), as last amended by Article 4 of the Act of 22 December 2020 (BGBl. I p. 3334). The regulations under consideration here have remained unchanged in force since 2 December 2016.

Figure 11: Fall Hazard Pictogram⁴¹

According to the Directive, the pictograms used may vary slightly or be more detailed, provided that they convey the same meaning.

3.4.8.3 PPE and Torch

The air temperature was about 8 °C when the accident happened. In accordance with requirements, the bosun was wearing his PPE (work boots, work gloves, helmet), overalls with a hood, winter jacket and a T-shirt on his head to ward off the cold. His torch, which was not part of the PPE, was found in his locker after the accident.

The ship operator included detailed information on PPE in the ISM manual, which concerns both general principles and work-specific provisions. As a general rule, PPE must be adapted according to the prevailing risk. If the danger of a fall from a height of more than 2 m is identified in advance, then fall protection consisting of a safety harness with lifeline and anti-fall device must be worn.

The need to have a torch at hand in certain cases is explicitly mentioned only in the context of navigational watchkeeping.

As with every other crew member, the bosun's shipboard briefing included basic instruction in the arrangements on board for using PPE.

⁴¹ Source: Section 3.2. of Annex II to Council Directive 92/58/EEC of 24 June 1992 on the minimum requirements for the provision of safety and/or health signs at work (ninth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC) (OJ L 245, 26.8.1992, p. 23) CELEX: 31992L0058. As last amended by Article 1 of Regulation (EU) 2019/1243, 20.6.2019 (OJ L 198, p. 241).

3.4.9 Emergency Response Management

After the fall, the crew tended to the gravely injured bosun according to the options available on board. During the investigation, emergency response management – often referred to ashore as the rescue chain – was considered in greater detail with regard to the

- medical training of the crew members;
- medical equipment;
- first aid and transport to the ship's hospital;
- medical first aid in the ship's hospital, and
- alerting of the emergency doctor.

3.4.9.1 Medical Training of Crew Members

In accordance with minimum international standards, every crew member engaged in ship safety and security on board SAJIR had acquired at least a certificate of proficiency in elementary first aid as defined by Table A-VI/1-3 STCW Code in various countries, in particular Germany and the Philippines. These crew members had all demonstrated that they could take immediate action after an accident – or another medical emergency – by:

- not endangering themselves;
- minimising further harm to the casualty;
- raising the alarm, and
- performing essential life-sustaining emergency measures where necessary.

The officers were all qualified in advanced medical first aid (Table A-VI/4-1 in conjunction with Table A-II/1 STCW Code) in accordance with the minimum international standards set out in the STCW Convention. In the event of an accident or illness on board, such crew members are expected to have knowledge of and be skilled in emergency medicine to a degree that far exceeds first care. This includes pharmacological knowledge, sterilisation and use of medical instruments, knowledge of emergency care for cardiac arrest, respiratory arrest and respiratory distress, as well as knowing how to seek telemedical assistance.

Moreover, the officers directly responsible for the bosun's medical care and the master had all acquired qualifications in Germany for the medical care of people on board in accordance with Section A-VI/4 paragraphs 4 to 6 of the STCW Code.

Masters and officers qualified in medical care are also expected to

- provide medical care to the sick and injured until they can be transferred to the care of professional medical services, and
- coordinate all external (medical) support measures. This includes helicopter evacuation, for example.

If it was more than five years since holders of a German certificate completed their initial training according to Tables A-VI/4, then these crew members had refreshed

their qualifications by attending a course approved by the Ship Safety Division (BG Verkehr).

This refresher is only required under European law and transposed by the fourth sentence of Section 109(1) SeeArbG for vessels flying the German flag (but only for the master and the officer in charge of medical care).⁴²

Under international law, only one crew member would have had to be qualified according to paragraphs 4 to 6 of A-VI/4 STCW, namely the crew member responsible for medical care on board.

The STCW Convention does not require refresher training in first aid or medical qualifications of a higher standard.

The non-binding Guideline B 4.1.1 (Provision of Medical Care) for the mandatory Regulation 4.1 (Medical care [for seafarers] on board ship and ashore) in the Maritime Labour Convention, 2006⁴³ recommends that Parties ensure that all seafarers responsible for medical first aid undergo a refresher course approximately every five years “[...] to enable them to maintain and increase their knowledge and skills and to keep up-to-date with new developments.”

3.4.9.2 Medical Equipment

According to the international Maritime Labour Convention, SAJIR’s crew members had a legal right to be provided with comparable standards of medical care on board as that provided for workers ashore in Germany wherever possible.

Since medical care has to be provided by a master or deck officer in the absence of a doctor, the equipment on board is designed to enable laypersons with appropriate basic training to provide medical care to sick or injured people on board.

The third sentence of Section 107(2) SeeArbG states: “The medical equipment must be suitable [...] to guarantee the protection of the health of the persons on board and their prompt suitable medical treatment and care on board.” The principle here is that the equipment is considered to be suitable if it satisfies the state of medical requirements in maritime shipping (state of medical knowledge) most recently notified by the BMVI in the Gazette of the BMVI or in the Federal Gazette, in each case.

The fifth Notice on the state of medical knowledge was effective on the day of the accident. This has since been repealed by the sixth Notice.⁴⁴ The investigation did not

⁴² See Article 5 of Council Directive 92/29/EEC of 31 March 1992 on the minimum safety and health requirements for improved medical treatment on board vessels (OJ L 113, 30.4.1992, p. 19).

⁴³ Maritime Labour Convention, 2006 of 23 February 2006 (BGBl. 2013 II p. 763), as last amended by the Amendments of 2016 to the Code of the Maritime Labour Convention, 2006, approved by the Conference at its one hundred and fifth Session, Geneva, 9 June 2016 (BGBl. 2018 II p. 495).

⁴⁴ Sixth Notice on the state of medical requirements in maritime shipping (state of medical knowledge) of 18 February 2020. Promulgation in the Federal Gazette. Published Tuesday 2 June 2020. BAnz [Federal Gazette] AT 02/06/2020 B8. The fifth Notice was applicable on the day of the accident. None of the amendments concerned the rescue stretcher.

uncover any evidence to suggest that the equipment did not comply with the stipulated state of medical equipment on board.

The investigators found several items of equipment that were on board due to the national standard and facilitated medical care considerably. In particular, they include

- the ship's standardised pharmacy;
- the defibrillator, and
- the book 'Instructions for Medical Care on Merchant Ships - Guidelines for Captains and Ship Officers'.

Being a German-flagged ship, SAJIR's apothecary cabinet had a fixed stowage plan. All medicines were numbered and the stowage positions clearly assigned. Since TMAS Germany was well acquainted with the pharmacy on this German ship, communication with the attending officer was unambiguous.

The ship's semi-automatic defibrillator with ECG display and ECG transmission to TMAS Germany assisted the attending officers and assisting crew members in the life-sustaining emergency measures. The defibrillator also made it possible for them to determine that resuscitative measures were clearly unsuccessful and would not necessarily have had to be continued based on this information in conjunction with TMAS Germany's recommendations. However, this grave decision did not have to be taken by a medical layperson in this particular case because the arrival of a doctor was in sight.

In addition to the telemedical assistance, the attending officers consulted the Instructions for Medical Care on Merchant Ships - Guidelines for Captains and Ship Officers issued by the Maritime Medical Service (BG Verkehr) in 2007 as a reference book and were able to satisfy themselves that their actions were correct and proportionate. Unlike the International Medical Guide for Ships published by the WHO⁴⁵ in 2007, the German handbook is adapted to German medical equipment.

Shortly before the accident, in November 2019, the Maritime Medical Service (BG Verkehr), which is responsible for maritime medical matters in Germany, published a revised version in German. The English version followed in 2020. The revised version illustrates treatment measures in practise (taking into account the medical equipment, the spaces on board and the medical training of deck officers) with colour photos and videos available for downloading. The handbook is also an outfitting requirement and must be on board every German-flagged merchant ship by her next internal annual inspection at the latest.

⁴⁵ WHO: World Health Organization.

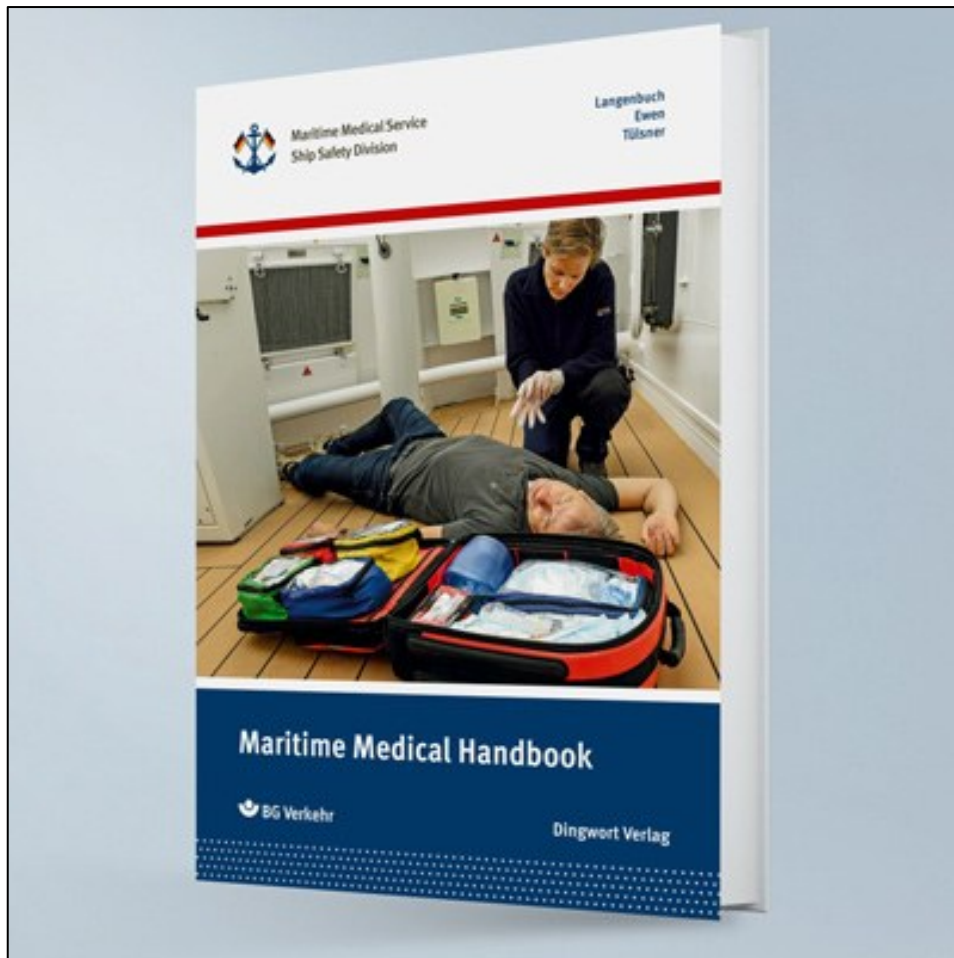


Figure 12: Maritime Medical Handbook, 2020 Version⁴⁶

3.4.9.3 First Aid and Transport to the Ship's Hospital

The rescue chain for accidents ashore usually involves the following stages:

- the scene of the accident is secured with due regard to self-protection;
- emergency calls are made;
- first responders administer first aid (life-sustaining emergency measures/treatment of wounds);
- professional responders (emergency medical technicians, paramedics, emergency doctors, etc.) arrive at the scene of the accident and continue first aid with all available life-saving equipment;
- professional responders stabilise the patient and ensure safe transport to a hospital;

⁴⁶ Source: www.deutsche-flagge.de. The German Flag State Administration's central internet portal, which is operated jointly by the BMVI, the Ship Safety Division (BG Verkehr) and the Federal Maritime and Hydrographic Agency (BSH).

- a number of specialists and doctors with expertise in various fields administer professional treatment in the hospital.

The rescue chain of SAJIR's crew basically corresponded to this process but professional support was confined to telemedical assistance.

SAJIR's crew members responded promptly and according to their training and the underlying conditions. After securing the scene of the accident (in particular by installing auxiliary lighting) and monitoring the vital functions, preparations were made to transport the gravely injured bosun to the ship's hospital in order to use the resources available there to treat him and prepare him for helicopter evacuation.

Two rescue stretchers were available to the crew – a Ship Safety Division approved stretcher⁴⁷ with integrated vacuum mattress and a spineboard.

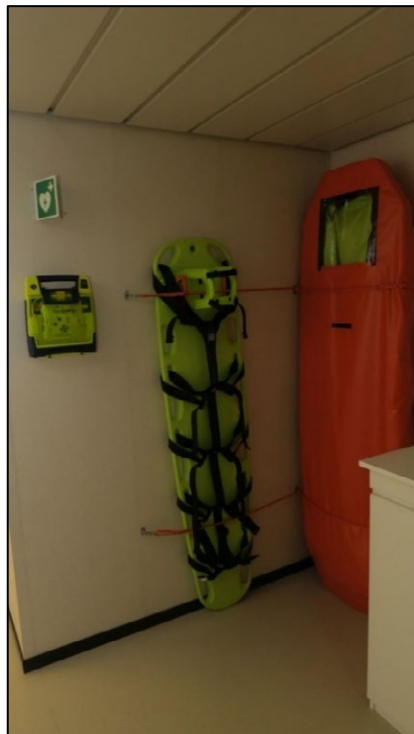


Figure 13: Stretchers in SAJIR's Hospital⁴⁸

Due to the spatial conditions at the accident site and the transport route, the crew decided to use the more handy size spineboard.

⁴⁷ 'Rescue stretcher' is the official designation provided in the notice of the state of medical requirements in maritime shipping (state of medical knowledge), see Footnote 43.

⁴⁸ Source: BSU.

Figure 14: Rescue Stretcher – Width⁴⁹Figure 15: Spineboard – Width⁵⁰

While speaking with the BSU, the chief mate reported that the bosun, who was secured on the spineboard, slipped downward a little due to lack of support during the vertical transport from the cargo hold floor to the enclosure and complained of pain. In the light of the negative experience of crew members, the advantages and disadvantages of the two means of transport are examined in greater detail in this investigation with a view to identifying recommendations for improvement where appropriate.

3.4.9.3.1 Approved Rescue Stretcher

According to No. 25.01 of Annex 2 to the state of medical knowledge, a rescue stretcher must be approved by BG Verkehr. Basic requirements for approval are:

- manoeuvrability by crane;
- integrated vacuum mattress (including vacuum pump);
- belt system;
- weather protection, and
- instructions for use.

3.4.9.3.2 Comparison between a Rescue Stretcher and Spineboard

On request by the BSU, the ship's command of SAJIR documented the transport route with a rescue stretcher approved by BG Verkehr and worked out the advantages and disadvantages from the point of view of the crew between the two carrying systems on board.

The narrowest points of the hatch entrances to the cargo holds had an inside diameter of 62 cm. The route was limited at the ladders by fall protection.

⁴⁹ Source: Crew of SAJIR.

⁵⁰ Source: Crew of SAJIR.

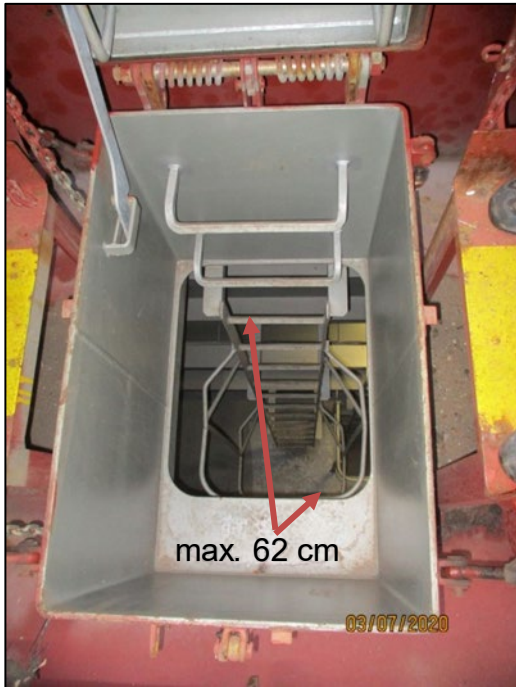


Figure 16: Hatch Entrance⁵¹

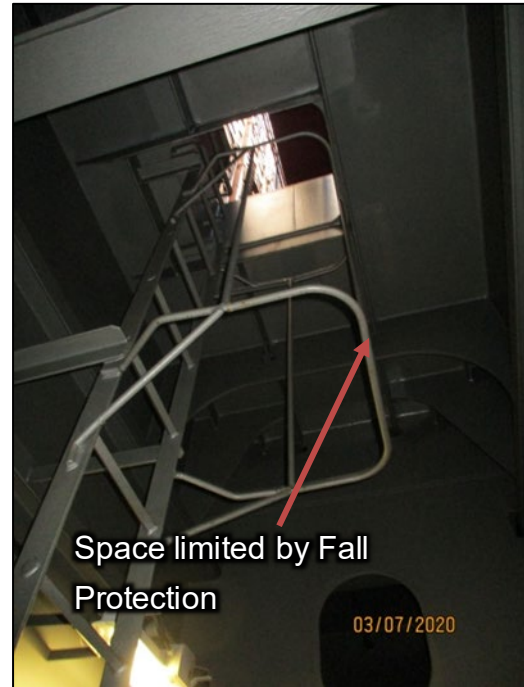


Figure 17: Hatch Ladder⁵²

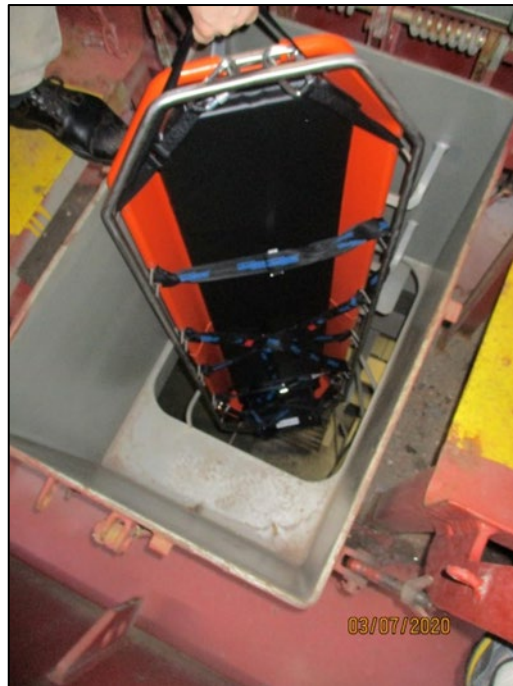


Figure 18: Rescue Stretcher in Hatch Entrance⁵³

The width of the access to cargo hold no. 9 in the upper platform area was 55 cm.

⁵¹ Source: Crew of SAJIR.

⁵² Source: Crew of SAJIR.

⁵³ Source: Crew of SAJIR.



Figure 19: Access to Cargo Hold No. 9⁵⁴

Freedom of movement would have been restricted on deck, too, if a rescue stretcher had been used.

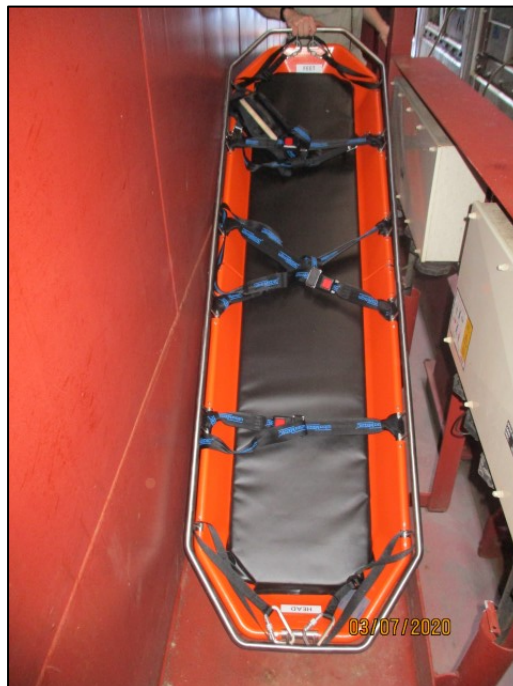


Figure 20: Rescue Stretcher in the Side Passage⁵⁵

⁵⁴ Source: Crew of SAJIR.

⁵⁵ Source: Crew of SAJIR.

Unlike the spineboard, the approved rescue stretcher has a vacuum mattress and an integrated footrest, allowing people to be transported in a stable position.



Figure 21: Footrest on the Rescue Stretcher⁵⁶

On the spineboard the body can only be secured by the belt system. The manufacturer's instructions for using the belts do not correspond to the recommendations of such organisations as the International Trauma Life Support (ITLS)⁵⁷, which state that the chest strap should be passed under the armpits through the highest accessible handle and secured with Velcro fasteners.

⁵⁶ Source: Crew of the SAJIR.

⁵⁷ ITLS was established in the United States at the beginning of the 1980s with the aim of reducing mortality and disability rates after an injury. Training courses for emergency services are currently offered in 70 countries.



Figure 22:
Manufacturer's
Instructions⁵⁸



Figure 23: ITLS Recommendation⁵⁹

3.4.9.4 Medical First Aid in the Ship's Hospital

Medical first aid was administered in accordance with the medical training. The officers used all the resources available to them. In particular, these include the telemedical assistance in their first language (German), the Instructions for Medical Care on Merchant Ships, the respirator, the defibrillator and the anaesthetic kept on board.

Despite the proximity to a world port, the crew members did not receive professional medical support on board.

3.4.10 Alerting of Emergency Doctor

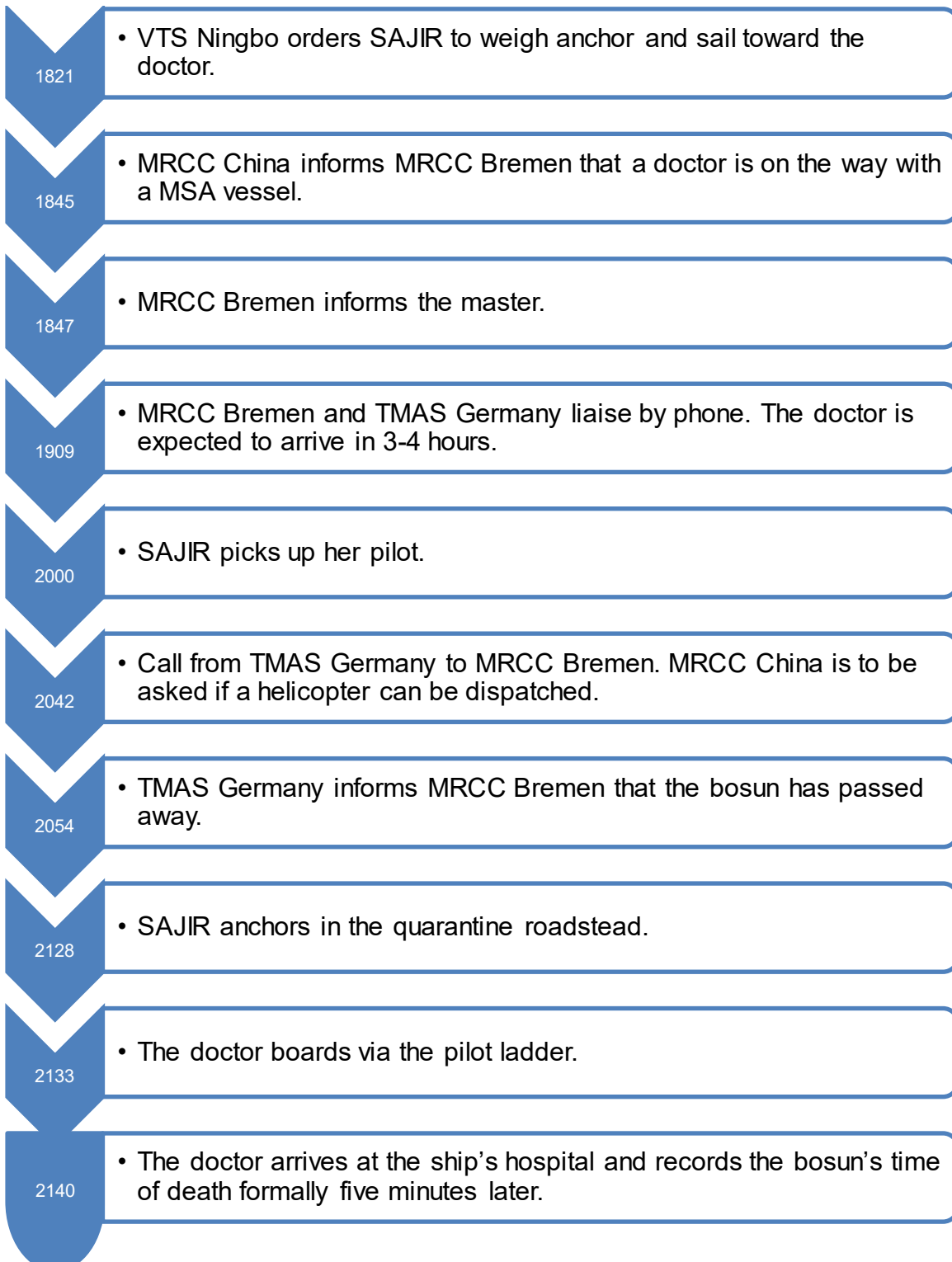
Since SAJIR was laid up in a roadstead only about 35 nm (linear distance) from the port of Ningbo and it took about 4.5 hours for a doctor to arrive on board, the relevant events are presented below chronologically on the basis of the information given by SAJIR (see Section 3.3 on emergency response management) and the mission log of MRCC Bremen.

Despite the involvement of the China Maritime Safety Administration (MSA), no information was received from MRCC Beijing (China).

⁵⁸ Source: Crew of SAJIR.

⁵⁹ Source: ITLS Germany. Securing method for spineboards (version 08/07).

- 1704 • Report to the master on the bridge about who fell and where it happened.
- 1710 • First responders arrive at the scene of the accident.
- 1723 • Master requests a doctor by satellite phone via the ship's agent.
- 1731 • Master calls TMAS Germany by satellite phone.
- 1744 • Call to TMAS Germany ends. TMAS Germany agrees to assist.
- 1752 • The ship's agent calls the master by satellite phone. The master repeats his request for medical assistance as soon as possible.
- 1753 • The master requests medical assistance as soon as possible on the VHF working channel. VTS Ningbo requests the phone number of the ship's agent.
- 1753 • TMAS Germany reports the emergency to MRCC Bremen by phone.
- 1759 • VTS Ningbo orders SAJIR to stand by for further instructions.
- 1812 • MRCC Bremen notifies MRCC China about the emergency by email, requesting urgent medical evacuation, in particular.
- 1820 • In addition to the email, MRCC Bremen also notifies MRCC China about the emergency by phone.



3.4.11 Alerting of Emergency Doctor via the GMDSS

Due to the long period of time between the request for and arrival of a doctor on board, the busy radio traffic on the operating channel of VTS Ningbo and the military exercise that made it necessary for SAJIR to leave her original anchor position in the morning

and shift toward Ningbo, the investigators considered whether an alert via the GMDSS⁶⁰ might have been a more promising option for obtaining a doctor and thus professional support to relieve the crew members on board.

Alerting via the GMDSS makes it possible to

- alert MRCCs immediately;
- give reporting parties maximum priority in call handling;
- reach all suitably equipped parties within reception range;
- reach maritime stations that may have a doctor on board (military units and passenger vessels), and
- reach maritime stations that may be able to provide helicopter assistance (military units).

Since only one party can transmit on each radio channel at a time, reports in the maritime radio service are divided into four levels in accordance with Article 53 of the Radio Regulations (RR⁶¹):

- a) distress calls, distress messages, and distress traffic;
- b) urgency communications;
- c) safety communications;
- d) other (routine) communications.

Greater importance is attributed to higher priority messages. 'Other communications' have the lowest priority.

Article 32.9 RR states that a master may only transmit a distress call if a ship or person is threatened by grave and imminent danger and requires immediate assistance.

The master decides when grave and imminent danger prevails and immediate assistance is required. The master also decides on the frequency on which the distress call is transmitted. Making it possible to reach all maritime and coastal radio stations within a range of about 30 nm, VHF is usually used in coastal areas and busy maritime traffic.

The distress call button on VHF units makes it possible to transmit a DSC⁶² distress alert on DSC channel 70. This alert informs recipients of the ship's MMSI⁶³, position

⁶⁰ GMDSS: Global Maritime Distress and Safety System.

⁶¹ n/a

⁶² DSC: Digital selective call.

⁶³ MMSI: Maritime Mobile Service Identity. The MMSI is a unique identifier for each maritime or coastal radio station within the GMDSS. Using this MMSI makes it possible to establish a connection for a maritime radio call with a specific maritime or coastal radio station by means of DSC.

and – after prior selection – the type of distress. The options available are limited, so serious injury reports would be categorised as ‘undesigned distress’.

DSC distress alerts are (ideally) transmitted until acknowledged by a coastal radio station.

After a DSC distress alert, the reporting party makes the distress call with the distress message on VHF channel 16. Other radio stations on the channel that are not involved in the distress call are required to maintain radio silence.

Similar procedures exist for Medium Frequency (MF) and Inmarsat C⁶⁴, which SAJIR could have used because suitable maritime radio equipment was on board for that purpose.

According to Chapter IV Regulation 5-1 No 2 SOLAS, information on the shore-based GMDSS installations shall be published in the GMDSS Master Plan. The GMDSS Master Plan is available in the GMDSS Manual and in the IMO’s Global Integrated Shipping Information System (GISIS)⁶⁵.

According to the Master Plan, Ningbo Radio was the nearest coastal radio station to the SAJIR that could have received a VHF DSC distress alert. This coastal radio station’s reception range is specified at 25 nm and was therefore outside the maximum VHF range of the SAJIR, which was anchored about 35 nm away from it.⁶⁶

According to the chart published in the Master Plan, the SAJIR was in an area with A2 sea area GMDSS installations at the time of the accident.

⁶⁴ Inmarsat is a British company that operates a mobile radio service via geostationary satellites. GMDSS functionalities can be used with Inmarsat C.

⁶⁵ GISIS: <https://gisis.imo.org/Public/GMDSS/Default.aspx>.

⁶⁶ Information according to IMO, GISIS of 1 April 2020: GMDSS Master Plan. A2 sea area.

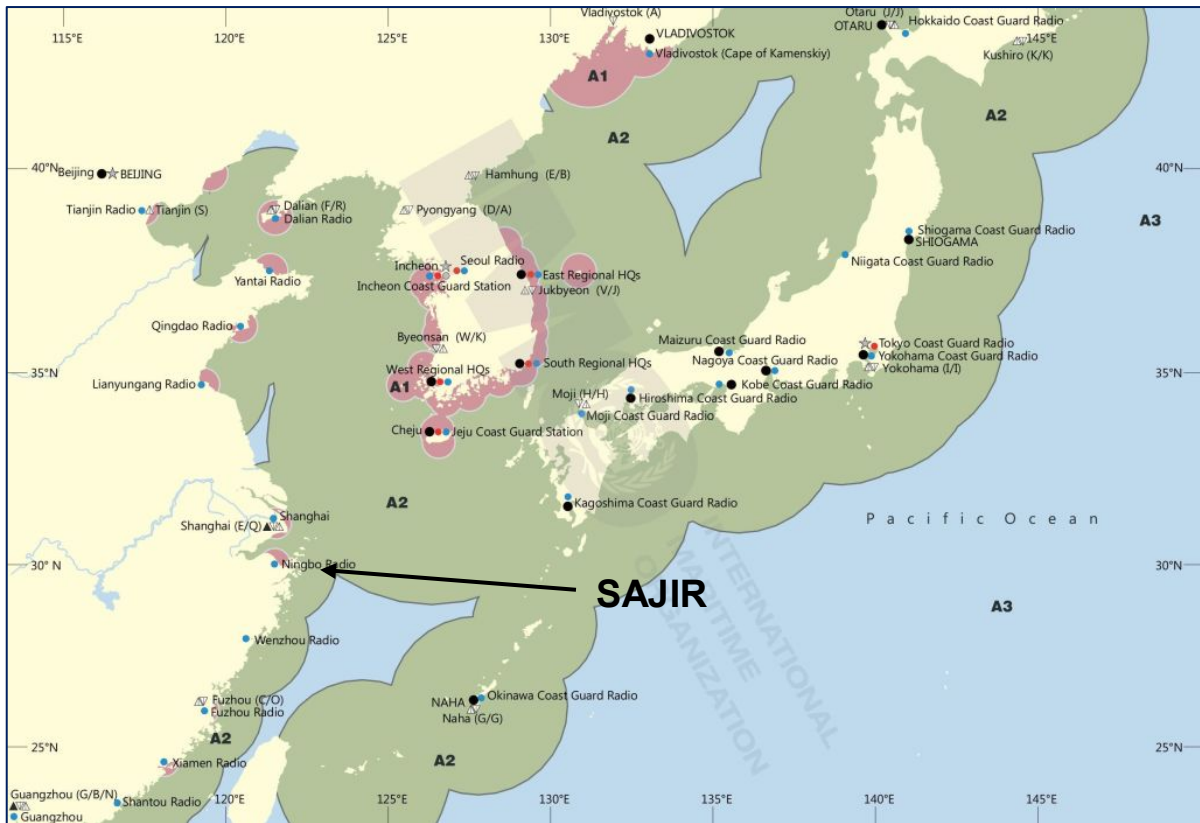


Figure 24: Shore-based GMDSS Installations⁶⁷

A2 sea areas are situated outside A1 sea areas. At least one MF coastal radio station for DSC alerts on 2187.5 kHz is continuously within radiotelephony range in these areas. During the day, the maximum range is about 180 nm from the coastline and at night up to 400 nm can be covered.

3.4.12 Support for Seafarers after traumatic Events

This fatal accident was an exceptional, extreme event for SAJIR’s crew members. Although they did not witness the fall of their colleague directly, they could not – despite every measure taken – prevent his death and experienced it directly. It is possible that for some crew members the bosun was not only a colleague, but also a good friend.

According to the BG Verkehr’s Instruction Chart A10⁶⁸, extreme events can trigger trauma. The people affected are in a state of shock because they are unexpectedly confronted with something terrible. Such exceptional situations cannot always be coped with through habitual processing patterns. In the medium and long term, a trauma-related condition such as post-traumatic stress disorder can develop.

⁶⁷ Source: GMDSS MANUAL 2019 EDITION, Annex 5 GMDSS Master Plan Figure 11.

⁶⁸ BG Verkehr helps managers to implement the requirements of occupational health and safety legislation, e.g. by providing instructional aids (<https://www.bg-verkehr.de/medien/medienkatalog/unterweisungsmedien>) [in German].

To avoid this and to stabilise the psyche, initial care immediately after an extreme event is important. Ideally, crew members or contact persons ashore are trained as psychological first responders and can provide effective support.⁶⁹

For organisational reasons, the BSU was not able to conduct personal interviews with certain crew members until six weeks after the fatal fall from a height. The interviewers had no means of preventing interviewees reliving the events, which affected them in various forms emotionally.

Representatives of the Prevention Division (BG Verkehr) attended the personal interviews with the agreement of all parties involved and advised interviewees that BG Verkehr has a professional support service available for people affected by traumatic events.

Below, the BSU looks at the support offered to seafarers following extreme events on German-flagged ships, as such or similar exceptional events can trigger physical and psychological stress in all individuals. This can lead to sleep disorders, difficulty concentrating and many other more serious symptoms.⁷⁰ The BSU believes that such consequences can have a negative impact on ship operations and result in marine casualties if they remain undetected.

3.4.12.1 Prevention Division (BG Verkehr)

SAJIR's crew members had statutory insurance cover for the consequences of occupational accidents and diseases (see Section 2(1)(1) SGB VII⁷¹). BG Verkehr is the insurer responsible for maritime entrepreneurs.

Insured parties receive all benefits, such as medical treatment and rehabilitation, from a single provider. If employees are confronted with extreme events during their work, those directly affected and their superiors are able to seek counselling from trauma experts. These arrange professional support for member companies and those affected as quickly as possible.

Trauma experts are specially trained personnel from BG Verkehr's accident divisions and can provide information about treatment options and refer to suitable therapists, who should be located as close as possible to the crew member's home. Larger companies can even have their own staff trained as trauma experts.

From the perspective of the statutory insurer, member companies should respond as quickly as possible when crew members have a traumatic experience. The BG Verkehr's website states [in German] that one reason for this is that victims suffer from insomnia, flash backs or also impaired concentration. Moreover, early treatment also prevents possible chronification. As with any other accident-related illness, the most

⁶⁹ See Instruction Chart A10.

⁷⁰ See BG Verkehr's emergency folder on traumatic events [in German]. Information for affected parties and managers 2018/Mat-No. 670-300-034.

⁷¹ The Seventh Book of the [German] Social Code – Statutory Employment Accident Insurance (Article 1 of the Act of 7 August 1996, BGBl. I p. 1254), as last amended by Article 13 of the Act of 28 March 2021 (BGBl. I p. 591).

important thing is that the people affected recover as quickly as possible and can resume work.⁷²

The Ship Safety Division supports its member companies through publications, e.g. in the internet, in the magazine "SicherheitsProfi", by advising member companies through the responsible supervisors and with the publication of an emergency folder (attachment 9.5). The emergency folder is aimed directly at those affected and superior. The dissemination within the company is the responsibility of the member company.

3.4.12.2 German Seamen's Mission

The telemedical service informed the German Seamen's Mission (DSM) in Hamburg about the accident on 19 December 2020. The latter then contacted the DSM in Hong Kong. The DSM in Hong Kong liaised with the ship operator, reportedly offering to have an employee flown to the ship. However, this was dispensed with because SAJIR was laid up in the roadstead and at that point it was not possible to establish how the employee would be able to board the vessel.

According to information published on the internet⁷³, the DSM promotes the welfare of seafarers in cooperation with state institutions, maritime organisations, trade unions and employers. In particular, it provides pastoral care. In this context, the DSM takes the holistic view that pastoral care is care for body and soul. It is open to all seafarers in need of assistance, regardless of their social, national, cultural or religious background.

In Hamburg the DSM has set up a centre for psychosocial emergency care for seafarers. Psychosocial emergency care is intended to provide an early and appropriate response to critical life events and associated stresses. The DSM has 30 professionals who are trained in certified courses and can supervise seafarers in the PSNV. If necessary, the centre refers seafarers to competent psychological or psychiatric services. The centre sees itself as an interface between seafarers, staff of the Seamen's Mission, ship operators and BG Verkehr.⁷⁴

The DSM employs 700 people on a full-time and on a voluntary basis in 35 port cities around the world. It cooperates closely with the seamen's missions of other countries and is a member of the International Christian Maritime Association.

⁷² See <https://www.bg-verkehr.de/versicherung-leistungen/unsere-leistungen/trauma-lotsen> [in German]. Last retrieved on 16 April 2021.

⁷³ See <https://www.seemannsmmission.org/index.php>; last visited on 20 April 2021.

⁷⁴ See the German Flag's 'Latest News' dated 26 April 2021 [in German], <https://www.deutsche-flagge.de/de/aktuelles/aktuelle-nachrichten>; last visited on 4 June 2021.

4 ANALYSIS

The fall from a height was caused by an unsecured access in an unilluminated cargo hold, even though – as on comparable ships – a risk of falling from a height does exist there for reasons of ship design.

It was not possible to establish why – despite his professional experience – the bosun entered this cargo hold without a torch. The fatal occupational accident is made all the more tragic by the fact that a physical inspection would not have been required for the cargo hold check.

Similarly, it was not possible to clarify why a rescue helicopter with a doctor on board was not dispatched to the vessel. Responsibility for medical care therefore remained with the crew until the bosun passed away. The crew members were thus exposed to a traumatic event. Traumatic events can have a negative impact on the health of crew members and on ship safety.

The ship operator analysed the accident, clearly identifying and securing this and similar fall hazards on board SAJIR and other ships under their fleet management in the process.

The aspects of the investigation are evaluated in greater detail below.

4.1 Shipbuilding – Fall Hazards in a Cargo Hold

Cargo holds with engine room enclosures or tanks protruding into them, which can be walked on and yet cannot be secured against falls from a height, are regularly found on container ships.

Since such platforms do not have to be walked on every day and this hazard can be addressed with barriers, notices and PPE, changes in ship design would be disproportionate. However, it must be ensured that all ship operators and crews are aware of potential hazards so that appropriate measures in accordance with the ISM Code and occupational safety can be taken if necessary.

4.2 Manning

4.2.1 Minimum Safe Manning Document

The minimum safe manning document issued by Germany is consistent with the internationally agreed model.

The certificate indicates that according to the Ship Safety Division (BG Verkehr), six deckhands were sufficient for safe manning SAJIR in the deck department at support level. They should be qualified at least in accordance with Regulation VI/1 (basic safety training) and – with the exception of one – all in accordance with II/4 (forming part of the navigational watch) of the Annex to the STCW Convention.

Neither the ship operator nor the flag State considered it necessary to require an able seafarer deck (AB) qualified in accordance with Regulation II/5 of the Annex to the STCW Convention for minimum safe manning.

4.2.2 Crew on the Day of the Accident

SAJIR was manned by 27 crew members on the day of the accident, i.e. ten more seafarers than required for minimum safe manning according to the minimum safe manning document.

In the deck department of relevance to the accident and by way of derogation from the minimum requirements set out in the minimum safe manning document, both the fatally injured bosun and all the other six ratings deck on board held a certificate of proficiency as an AB. Accordingly, the bosun and all other ratings were qualified for the duties to be carried out in the cargo hold in principle

4.2.3 Certificates of Proficiency under the STCW Convention

All ratings deck on the SAJIR held Philippine certificates of proficiency according to Regulation II/5 of the Annex to the STCW Convention. This Regulation entered into force on 1 January 2012 as part of the Manila Amendments to the STCW Convention. However, since the Philippines has yet to comply with the mandatory reporting obligations to the IMO's Secretary-General (the last report being made on 3 February 2009), there is no information on the verification of implementation of and compliance with the standards.

Administrations, ship operators, masters and other stakeholders cannot, therefore, have confidence within the meaning of the regulations that holders of Philippine certificates of proficiency are actually competent to the standards stated on the certificates.

4.3 Bosun

The BSU assumes that the bosun was basically aware of the risk of falling in cargo hold no. 9 given his professional experience and the previous seven months spent working on SAJIR.

There was no evidence to suggest that alcohol, medication or drugs affected physical or mental capacity.

4.4 Occupational Health and Safety

There is neither an access barrier nor identification of the risk of falling in the cargo hold. According to the ship operator, this was not consistent with the standard on the ships in its fleet. Since SAJIR only became part of the fleet under its management on 1 May 2019.

The bosun was not wearing any special PPE. No party involved, including his direct superior, assumed that the assigned task posed a particular risk.

The bosun would not have had to enter the cargo hold for the task assigned. The BSU believes that illumination of the platform would have been sufficient for the determination of the cargoworthiness⁷⁵. Since it is highly unlikely that the bosun was carrying a torch, he could have asked one of his deckhands to do this.

⁷⁵ Cargoworthiness: According to Section 485 (Sea- and Cargoworthiness) of the Commercial Code, "the carrier [...] shall ensure [...] that the holds [...] of the ship in or on which goods are loaded are in the

4.5 Communication Culture

One of the deckhands saw his superior enter the cargo hold without a torch. It was not possible to establish whether the deckhand was aware of the risk, whether he would have had the opportunity to speak to his superior, and whether he would have spoken to him if he had.

However, the investigation revealed that the formal framework itself did not allow for the implementation of a culture of critical communication on board.

On the one hand, crew members are not necessarily trained for this in accordance with the STCW Convention, and on the other hand, the ISM manual indicates that such a mechanism is not required on board.

4.6 Emergency Response Management

4.6.1 Medical Training of Crew Members

SAJIR's crew members satisfied the international as well as higher European minimum standards of medical competence that must be demonstrated. Moreover, in addition to the master, the two officers who provided medical care to the bosun first acquired or refreshed their qualifications in medical care within the previous five years.

The attending officers were familiar with the medical equipment and medical first aid options available to them. They benefited from the fact that they had completed both their initial and refresher training in Germany and that this training is adapted to the conditions found on board ships flying the German flag.

4.6.2 Medical Equipment

During its visit to the ship, the BSU gained the impression that the medical equipment corresponded to the state of medical knowledge which is mandatory at national level. The BSU believes that this equipment also met the minimum international requirements of the Maritime Labour Convention.

The ship's standardised pharmacy cabinet made it possible for the officers to communicate clearly with TMAS Germany.

The defibrillator enabled crew members to perform the best possible resuscitative measures. If necessary, this device will provide a sound basis for the decision of medical laypersons as to when life-sustaining measures are no longer meaningful and can be discontinued.

The Instructions for Medical Care on Merchant Ships provided medical laypersons with a reference book tailored to their equipment. The new version published as Maritime Medical Handbook Sea in 2019 is even more applicable in practise due to many practical illustrations.

condition necessary for loading cargo, carriage and preservation of the goods (cargoworthiness)." Law of 10.05.1897 (RGBl. I p. 219) last amended by law of 16.07.2021 (BGBl. I p. 3079).

The analysis of the investigation results with respect to the spineboard are summarised in the next chapter.

4.6.3 Transport and medical First Aid in the Ship's Hospital

The crew members took advantage of all the resources available to them on board as well as their individual skills to help the gravely injured bosun.

They were helped by the fact that in addition to coordination of the equipment and training of the medical first responders, the telemedical assistance could be carried out in the first language of the officers and TMAS Germany was familiar with the conditions on board.

Of the two rescue stretchers available in the hospital, the crew opted for the spineboard, a stretcher not approved by the Ship Safety Division. Due to its width of 43 cm, it offered a spatial advantage over the rescue stretcher, which has a width of 60 cm. The board had considerable disadvantages when it came to vertical transport, however. It lacked a footrest that would have provided additional support for the person being transported. Similarly, the body could only be secured by means of a belt system. Care had to be taken to ensure that the belts were fastened properly, especially under the arms. The situation was aggravated by the fact that the manufacturer's instructions were incorrect in this regard.

The accident has demonstrated that the transport of casualties to the ship's hospital or to the evacuation site by helicopter, for example, should be planned for in advance. Crew members have to take into account the ship's structural conditions, but also different loading and weather conditions in order to be able to actually negotiate the narrow passageways and reduce tilting or turning the stretcher to an absolute minimum.

Despite the greater width of 60 cm, transport using the approved rescue stretcher would have been possible. From the perspective of the BSU, the means of transport chosen had no influence on the failure of the treatment.

4.7 Alerting of Emergency Doctor

The master first requested a doctor by satellite phone via the ship's agent. He gratefully accepted the offer of the telemedical maritime assistance service to also arrange medical support (from Germany). Notwithstanding the above, the master also requested a doctor from VTS Ningbo via the operating channel at a later stage. The VTS merely requested the phone number of the ship's agent and therefore presumably simply forwarded the request to the agent, whom the master had already contacted 30 minutes earlier.

If one reflects on the period between the master's first information about the bosun's fall at 1704 and the arrival of the doctor at the ship's hospital, four hours and 36 minutes had passed. If one reflects on the period between the first request by phone via the ship's agent, four hours and 17 minutes had passed.

MRCC China was notified of the emergency via MRCC Bremen at the latest at 1820. It can be regarded as certain that it was only after MRCC China became aware of the

emergency that a doctor was immediately sent by ship to the oncoming SAJIR. As a result, three hours and 20 minutes passed before the arrival of the doctor.

Due to lack of feedback from MRCC China, the BSU has no knowledge of

- whether MRCC China was first informed of the emergency by MRCC Bremen;
- why a helicopter was not deployed, and
- how long a helicopter transfer would have taken.

Following a request from the BSU, ARCC Glücksburg⁷⁶ advised that in Germany helicopters are only used if the operational command is aware of the urgency. However, such helicopter operations cannot always be carried out at short notice. Flight standby times can be up to one hour, for example. Absent doctors or technical problems can cause further delays. The maximum range is based on a rescue helicopter's average flight time of about 3.5 hours at flight speeds of about 80 to 150 kts. Detours, e.g. to pick up doctors from a certain hospital, as well as the time needed for winching up and down the doctor and patient must always be taken into account.

4.8 Alerting of Emergency Doctor via the GMDSS

Alerting the emergency doctor via GMDSS with a DSC distress alert would only have been directly received by the coastal radio station and thus by MRCC China via MF. Alternatively, the competent MRCC could have been reached by sending a message over the Inmarsat C system.

If the master had sent a DSC distress alert via VHF, which in the opinion of the BSU would have been the usual alert near the coast, this could not have been received by a coastal radio station. However, all maritime radio stations within a range of about 30 nm would have received this alert and – in addition to all the other challenges – the master might have had to communicate extensively via maritime radio.

4.9 Support for Seafarers after traumatic Events

Each crew member will have perceived and mentally processed the accident differently. In the opinion of the BSU, all ship operators, ship's commands and crew members should be familiar with the programmes of the Prevention Division (BG Verkehr) and of the Seamen's Mission for helping people cope with extreme emotional events.

These programmes should be made use of if necessary and possible. As with all other negative influences on personal performance, negative psychological consequences should be avoided. In particular, due to the fact that crew sizes are regularly reduced to a minimum on many ships, undetected and untreated psychological impairments can have a considerably negative impact on ship safety.

⁷⁶ The Aeronautical Rescue Coordination Centre in Glücksburg (ARCC Glücksburg) is responsible for such tasks as air rescue in the SAR area "Sea" and cooperates with MRCC Bremen.

The BSU is not in a position to assess whether the accident caused mental harm to individual crew members. Nor is the BSU in a position to assess the extent to which a visit by the DSM on board SAJIR would have had a positive effect on crew members. However, the BSU is of the opinion that the support work of the DSM cannot be valued highly enough, especially after traumatic events.

The investigators gained the impression that SAJIR's crew members only became aware of the support offered by BG Verkehr six weeks after the accident during interviews with the BSU and BG Verkehr in Hamburg.

The programme is basically directed at all crew members. However, if necessary, only therapists practising in Germany could have been referred to. While measures necessary for crew members domiciled abroad are being financed, those affected must seek a therapist close to their home independently – if anything comparable actually exists there. Furthermore, written information from BG Verkehr was only available in German.

5 Actions Taken

5.1 Ship Operator / Shipping Company

5.1.1 FLEET CIRCULAR

The ship operator investigated the fatal occupational accident internally and initiated a number of measures to prevent similar accidents with a fleet circular on 22 January 2020 (see Annex 9.6).

Cargo holds with enclosures around part of the engine room and with the deckhouse located far forward separate from the machinery, as on SAJIR, can also be found on other ULCSs belonging to the fleet. They include ten Hamburg Express class ships and five Valparaiso Express class ships. On these ships, any access point that has an area with a fall hazard behind it had to be secured and areas with a fall hazard had to be identified immediately.

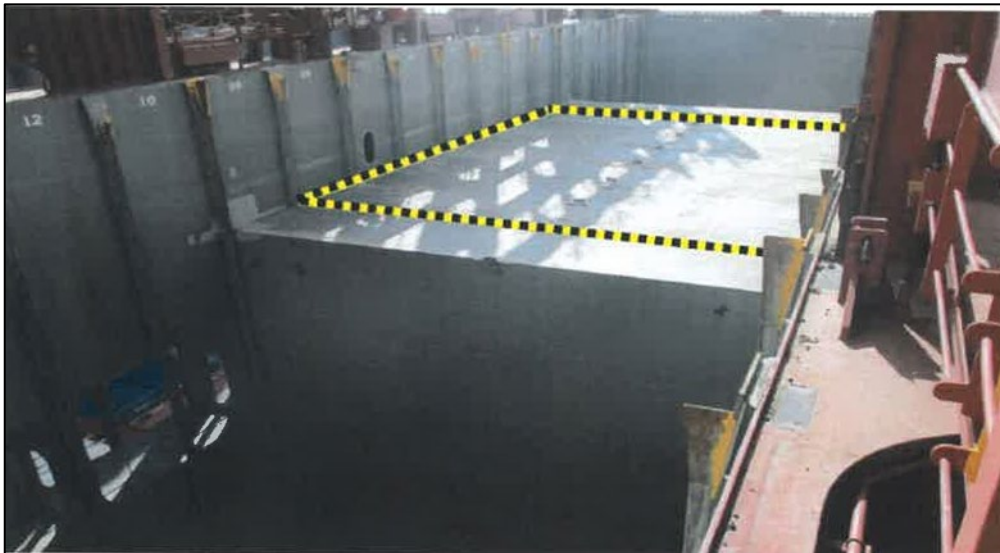


Figure 25: Fleet Circular showing Markings to warn of a Fall Hazard⁷⁷

Notwithstanding the hazards actually found on board, the following orders were issued for all ships:

- all crew members must be informed about any specific cargo hold structures and the resulting hazards in a separate briefing;
- all crew members must be repeatedly informed about the above hazards during the monthly briefing on entering the cargo hold ('Permission for Tank Inspection and Entry into Confined & Dangerous Spaces');
- the proper operation of cargo hold lighting (BSU note: if present) must become one of the periodic routine inspections and documented accordingly in the logbook or maintenance book, and

⁷⁷ Source: Photograph taken from the fleet circular.

- all ship's managements must check whether there are any other comparable fall hazards on board their ships.

The ship operator points out in the fleet circular that there are individual container slots where a risk of falling must also be expected in the fore section of all ships. Due to the open design, in particular, these spaces cannot normally be entered accidentally. Consequently, the ship operator believes that yellow and black safety markings do not necessarily have to identify these hazardous areas. Warning signs and access protection should be applicable there, however.

The BSU's investigators found that the following measures had been implemented when they carried out the inspection on 27 January 2020:



Figure 26: Secured Access to Cargo Hold with a Risk of Falling⁷⁸

⁷⁸ Source: Crew of SAJIR.



Figure 27: Warning in front of Access⁷⁹



Figure 28: Photograph showing the actual Risk of Falling⁸⁰

⁷⁹ Source: Crew of SAJIR.

⁸⁰ Source: BSU.



Figure 29: Another Part of SAJIR with Fall Protection⁸¹



Figure 30: Area that has yet to have Fall Protection applied⁸²

⁸¹ Source: BSU.

⁸² Source: BSU.

5.1.2 Post-Emergency Procedure

Based on the Ship Safety Division's emergency folder, the ship operator integrated an instruction for a procedure after emergencies (Post-Emergency Procedure) within the scope of the ISM-Code.

During the development of this process, the Ship Safety Division (prevention) informed the operator that the trauma-pilots generally only speak German. Thus, the operator incorporated further contact details such as the seafarers mission, the telephone counselling of various countries, ISWAN (International Seafarers Welfare and Assistance Network) and Mind Call.

5.2 Ship Safety Division (prevention)

The Ship Safety Division (prevention) published an article in its magazine "SicherheitsProfi" (edition 3/2020) and introduced several safety measures as an example.

- Securing access to hazardous areas with hinged barriers or hangers,
- Placing signs against fall hazards,
- Ground markings at sufficient distance from the edge of the fall,
- Lighting equipment for crewmembers.

5.3 Support of seafarers after traumatic incidents

The Prevention Division (BG Verkehr) was able to make an offer of support to any crew member who requested help dealing with the traumatic event.

The DSM now offers counselling via the internet as an alternative to personal visits on board.

5.4 Certificates of competency in accordance with the STCW-Convention

There are several Parties to the STCW Convention that do not regularly report to the IMO on the implementation of the Convention, thereby making it credible that certificates of proficiency will only be issued if all standards are met.

The IMO Sub-Committee HTW⁸³ has already focused on the topic "Reporting obligations according to the requirements of the STCW Convention" under the agenda item "Implementation of the STCW Convention". At the HTW 7 meeting (15 - 19.02.2021), a working group as well as a correspondence group following the meeting, with the participation of Germany, were established to review the requirements for reporting obligations under the STCW Convention, to identify problems and challenges faced by participants in connection with the reporting

⁸³ HTW Human Element: Training and Watchkeeping

obligations and the related assessment process, and to develop a recommendation to assist stakeholders in the preparation, submission as well as review of the reports.⁸⁴

For this reason, the BSU refrains from issuing a corresponding safety recommendation.

⁸⁴ See report HTW 7/18 dated 12/3/2021 of the IMO Subcommittee about its 7th session to the Maritime safety committee

6 CONCLUSIONS

6.1 Occupational Safety (Shipbuilding – Fall Hazards in Cargo Holds)

Barriers and markings might have alerted the bosun to the risk of falling and then he may only have illuminated the cargo hold with a torch if necessary or instructed one of the ratings to illuminate it.

The ship operator immediately investigated the accident and secured the specific and other hazardous areas on SAJIR and other ships in the fleet (see Section 5.1).

The measures adopted by the ship operator at least correspond to those taken on MAERSK SURABAYA (see Section 3.4.1). In the view of the BSU, the measures already taken are suitable for reducing the risk of similar accidents.

The BSU notes that markings to indicate a risk of falling are only effective in conjunction with permanently installed lighting or the use of torches.

Areas where a risk of falling exists should therefore be equipped with permanently installed lighting.

The BSU proposes that the warning signs shown in the EU Directive that indicate a risk of falling should be affixed at all workstations where there is a potential risk of falling as a matter of principle (see Figure 11: Fall Hazard Pictogram).

These warning signs are self-explanatory and should be easily recognisable for all seafarers. The BSU believes that the warning sign provided by the ship operator with the photograph of the enclosure in cargo hold no. 9 on board SAJIR may be helpful if the photograph depicts the specific risk of falling in that area and is affixed additionally.

Since many other container ships have similar hazardous areas, as many ship operators and crews as possible should be informed about this risk and the possible measures to mitigate it.

Accordingly, as the body responsible for implementing and monitoring the ISM Code, the Ship Safety Division (BG Verkehr) should publish a safety warning about this hazardous situation. However, only those ships operated under the German flag will be reached with this measure.

It is against this background that the BSU will publish a corresponding safety notice in the form of a lesson learned⁸⁵ so as to reach as many ship operators and seafarers as possible who could be exposed to a corresponding hazard.

⁸⁵ The publication of lessons learned by investigating authorities is based on a 2018 decision by the IMO. After completing an investigation, the BSU examines whether items of general safety information can be derived from the findings made. These are published in the form of lessons learned. Unlike safety recommendations, they are directed at a wider group of addressees or the general public with the aim of drawing attention to gaps in safety or existing risks.

6.2 Manning

6.2.1 Minimum Safe Manning Document

No ABs qualified in accordance with Regulation II/5 of the Annex to the STCW Convention were mandatory according to the minimum safe manning document.

The BSU is of the opinion that ships like SAJIR cannot be operated safely without an AB. In addition to the cargo hold inspections carried out on the day of the accident, other tasks occur daily that cannot be carried out without able seafarers.

Compliance with the requirements under Section 2(1) SchBesV (ship safety, in particular) and occupational health and safety regulations is on ships like SAJIR only possible in conjunction with crew members who are appropriately competent at the support level.

In keeping with this logic, the ship operator had manned SAJIR accordingly on a voluntary basis.

With that in mind, the Ship Safety Division (BG Verkehr) should only issue minimum safe manning documents in accordance with MSC Resolution A.1047(27), taking into account the actual requirements and in compliance with the STCW Convention, as amended in each case.

6.2.2 Certificates of Proficiency under the STCW Convention

Parties to the STCW Convention should comply with their related reporting obligations in a timely manner so that maritime administrations, ship operators, masters and other stakeholders can have confidence that holders of certificates of proficiency issued on behalf of those Parties actually have the competence shown in the standards indicated on the certificates. This situation could and should be highlighted at international meetings of the IMO and its sub-committees, irrespective of the already ongoing discussion in the sub-committee HTW.

6.3 Communication Culture

In the context of the intended revision of the STCW Convention⁸⁶, the BMVI should work toward further developing the minimum standards for seafarers at support level with regard to the communication culture, taking into account the regulations for officers at operational level (BRM and ERM) already implemented.

The BSU believes that it would be beneficial to encourage all crew members – regardless of capacity – to objectively scrutinise questionable decisions or actions and to address them in both hierarchical directions.

The ISM manual should therefore be revised accordingly.

⁸⁶ There is a proposal, supported by Germany, to revise the STCW Convention. The decision on the proposal will be made at the 104th session of the Maritime Safety Committee in October 2021 (see: MSC 104/15/5).

Instruction and practical application in the ship's daily routine should encourage crew members, in particular those of the support level, to use this option as far as possible.

6.4 Emergency Response Management

6.4.1 Medical Training of Crew Members

The crew members used all the options open to them on board swiftly and purposefully. This is all the more noteworthy because unlike professional rescue workers ashore, seafarers usually have no experience in dealing with such life-threatening events. It is for this reason in particular that it makes sense to attend refresher courses every five years, as is already laid down in European law for masters and officers. In a protected setting, knowledge can be refreshed, new knowledge adapted to the state of medical development can be acquired and practical exercises can be carried out.

This is the only way for crew members – such as those on SAJIR – to make an effective contribution to life-sustaining measures.

6.4.2 Medical Equipment

In the BSU's view, the benefits of the medical equipment on board German-flagged ships in respect of a standardised first-aid kit, the defibrillator and an up-to-date 'Maritime Medical Handbook' adapted to the equipment should as far as possible be communicated internationally and wherever possible implemented on ships of every flag.

The coloured photographs, graphics and the downloadable videos in the Maritime Medical Handbook are more informative than the black and white graphics in the WHO Guide. The German handbook should therefore be provided as a basis for revising the WHO Guide.

The crew of the SAJIR had two rescue stretchers at their disposal. The spineboard used was not approved, but had advantages and disadvantages during transport compared to the approved rescue stretcher. As far as additional medical equipment is subject to approval, the Ship Safety Division should have the opportunity to examine the equipment in order to decide whether it should be approved. Therefore, the Ship Safety Division should inform the ships operator in an adequate manner about the requirement for the examination.

6.4.3 First Aid – Transport – Medical Care in the Ship's Hospital

In the view of the BSU, medical first aid was carried out – despite all difficulties - in the best possible way in accordance with all the options available on board and with very great commitment of all crewmembers.

6.4.4 Alerting of Emergency Doctor via the GMDSS

In calling the ship's agent by satellite phone, the master used a method of obtaining professional assistance that is not always appropriate.

Given the findings of this investigation, the BSU believes it is advisable for ship's commands in similar cases to first transmit DSC distress alerts on frequencies through

which coastal radio stations can be reached directly or use GMDSS satellite radio systems.

Only in exceptional cases should a ship's command call the nearest competent MRCC by satellite phone. If the ship's command of a German-flagged ship has doubts with regard to reaching coastal radio stations, then it should additionally call MRCC Bremen by satellite phone and inform it about the emergency. As in the present case, MRCC Bremen will then notify the competent MRCC.

In the opinion of the BSU, the reporting channel used had no influence on the unsuccessful medical treatment.

6.4.5 Support for Seafarers after traumatic Events

In the view of the BSU, preferably all ship operators and crew members of ships flying the German flag should in principle know about existing programmes of the Prevention Division (BG Verkehr).

Accordingly, in addition to the publications on the internet and in the emergency folder, the BSU believes that this information should be disseminated. In this regard, the BSU considers the following options, for example:

- Ship operators should check whether the risk assessments available on board also take into account risks posed by traumatic extreme events and update them if not.
- The contact details of the operational contact persons, e.g., psychological first aiders, should be provided to the crewmembers in an appropriate manner.
- The contact details of trauma experts should be made known to crew members, e.g. by posting them on a noticeboard.
- The emergency folder should also be made available in English.
- If necessary, the procedural instructions in the ISM Code should be supplemented by a reference to the emergency folder at a suitable position.

7 SAFETY RECOMMENDATIONS

The following safety recommendations do not constitute a presumption of blame or liability in respect of type, number or sequence.

7.1 Federal Ministry of Transport and Digital Infrastructure (BMVI)

1. The BSU recommends that the BMVI call for the further development of the STCW Convention, promoting the following points in the process:
 - In the context of BRM and ERM, all crew members – those at support level, in particular – should be enabled and encouraged to objectively scrutinise questionable decisions or actions and to address them in both hierarchical directions.
 - Competence in basic first aid according to Table A-VI/1-3 STCW Code should be refreshed every five years in accordance with the refresher training already required in ship safety and security.
 - All masters and officers serving on a ship without a ship's doctor that is not on a near-coastal voyage should acquire a medical qualification in accordance with Regulation VI/4 of the Annex to the STCW Convention and be required to refresh it every five years.
2. The BSU recommends that the BMVI and the Federal Ministry of Health liaise and work toward further developing the WHO Medical Guide, using the Maritime Medical Handbook published by the Ship Safety Division (BG Verkehr) as a basis for this.

7.2 Ship Safety Division (BG Verkehr)

1. The BSU recommends that the Ship Safety Division (BG Verkehr) issue minimum safe manning documents for ships like SAJIR in such a way as to ensure that they must always be manned by a sufficient number of able seafarers deck (Regulation II/5 of the Annex to the STCW Convention).
2. BG Verkehr should inform the ship operators in an appropriate manner about the required testing of medical equipment with which existing equipment on ships requiring approval is to be supplemented. In these cases, the ship operators should then give BG Verkehr the opportunity to inspect the equipment in order to decide on approval.

7.3 Prevention Division (BG Verkehr)

1. The BSU recommends that the Prevention Division (BG Verkehr) disseminate information about existing support programmes for seafarers after traumatic events in German and English so that preferably all insured seafarers know about them.
2. The Prevention Division (BG Verkehr) should work toward ensuring that its member companies consider the issue of hazards posed by extreme events in the context of occupational safety and update risk assessments accordingly if necessary.

7.4 Ship Operator of SAJIR

1. The BSU recommends that the ship operator adequately illuminate working areas where there is a risk of falling and identify them with warning signs in accordance with the EU Directive.
2. The BSU recommends that the ship operator encourage all crew members – regardless of capacity – to objectively scrutinise questionable decisions or actions and to address them in both hierarchical directions. In particular, the ISM manual should be further developed and practical instruction given on board.

7.5 MRCC Bremen

The BSU recommends that MRCC Bremen advise⁸⁷ ship's commands of German-flagged ships that they should make more use of MF radio equipment in emergencies in an A2 sea area. If alerting a competent MRCC via GMDSS or possibly satellite phone does not appear to be possible or appropriate on the part of the ship's command, then the ship's command should notify MRCC Bremen of the emergency, e.g. by satellite phone. MRCC Bremen will then take further action.

⁸⁷ Such information can be disseminated e.g. with the support of the Ship Safety Division (BG Verkehr) by means of an ISM Circular.

With the support of the BSH, this information can be published in the notices to mariners (NtM) and given directly to masters and deck officers when maritime radio certificates are issued in accordance with the STCW Convention. The BSH can also forward this information to education centres approved for maritime radio training.

8 SOURCES

- Written explanations/submissions
 - from the ship's command
 - from the ship operator
 - from the bodies involved
- Witness testimony
- Post-mortem examination report
- Ship's certification
- Seafarer certificates
- Analysis of the VDR
- Legal framework

9 ANNEXES

- 9.1 The SAJIR's minimum safe manning document**
- 9.2 Promulgation of MSC Resolution A.1047(27) 'Principles of Minimum Safe Manning'**
- 9.3 MSC.1/Circ.1164/Rev.23**
- 9.4 Hapag-Lloyd AG: Responsibilities and competences of the bosun according to the ISM**
- 9.5 BG Verkehr: Emergency folder on traumatic events [in German]. Information for affected parties and managers**
- 9.6 Hapag-Lloyd AG: Fleet Circular – Additional safety measures for cargo holds**