aibn
Accident
Investigation Board
Norway

Issued September 2014

REPORT MARINE 2014/10

REPORT ON MARINE ACCIDENT – MV FAVORITA LAGM6/9298519 SHIPBOARD OCCUPATIONAL ACCIDENT IN THE EAST CHINA SEA ON 24 AUGUST 2013

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This report has been translated into English and published by the Accident Investigation Board Norway (AIBN) to facilitate access by international readers. As accurate as the translation might be, the original Norwegian text takes precedence as the report of reference.

Photo of ferry on the Norwegian west coast: Bente Amandussen

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NOTIFICATION OF THE ACCIDENT

The Accident Investigation Board (AIBN) was notified of an occupational accident on board the *MT Favorita* by the Norwegian Maritime Authority on Saturday 24 August 2013. The accident had occurred on the same day. A seaman from the Philippines had suffered a fall in the cargo hold in connection with a cleaning job. The seaman was evacuated by helicopter and flown to Taiwan, but he was declared dead on arrival at the hospital in Taipei. On the same day, the AIBN decided to initiate a safety investigation into the accident. On 2 September 2013, two representatives of the AIBN travelled to Grimstad to speak with the shipping company. After loading cargo in Japan, *Favorita* sailed to Australia, where the AIBN boarded the vessel on 16 September 2013 to interview the crew and conduct technical examinations.

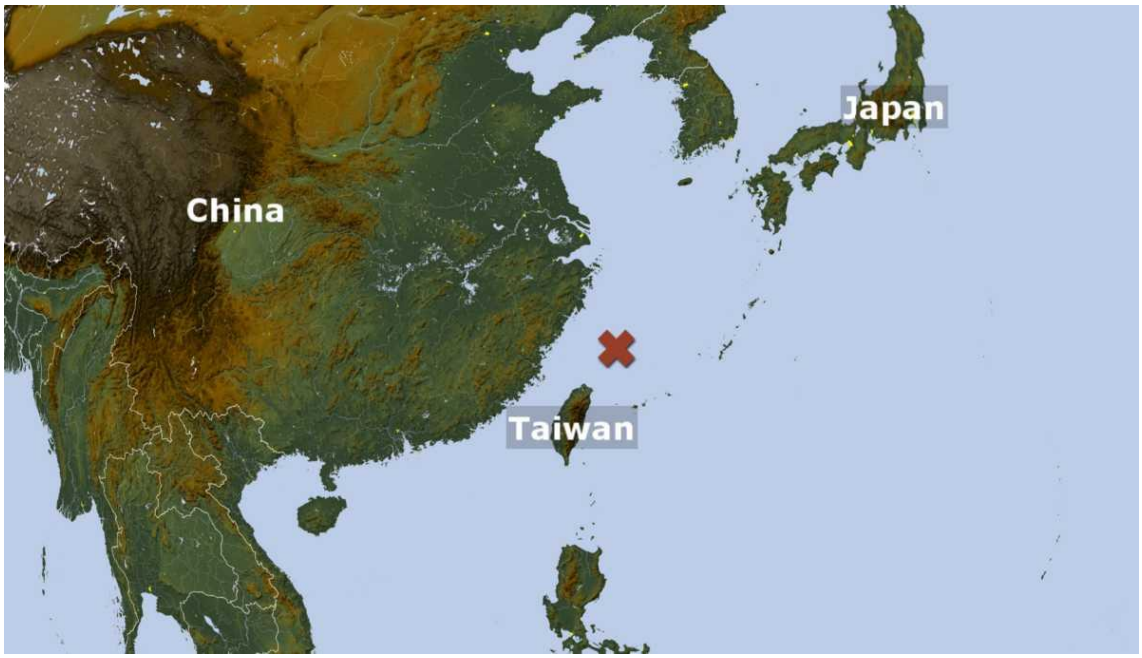

Figure 1: The accident occurred on board 'MV Favorita' NNE of Taiwan. Source: AIBN

SUMMARY

On 24 August, *MV Favorita* was en route to Tsukumi in Japan to load cement clinker after unloading salt in China. While the cargo hold was being cleaned to prepare for the new cargo, a motorman fell down from a ladder and hit his head on the tank top. His helmet was not secured with a chin strap and the helmet fell off before he landed at the tank top. The motorman fell from a height of about one metre and was knocked unconscious. First aid was administered, and the injured person was transferred to the vessel's hospital where first aid treatment was continued. The injured person was later brought to a hospital in Taipei by a helicopter from Taiwan. The motorman was declared dead on arrival at the hospital.

The investigation shows that the motorman removed the safety line just before he fell and that he fell from a relatively low height while descending the ladder to move it to the next area to be cleaned. Based on theories on planned behaviour the AIBN believes that the motorman disconnected the safety line because he might have felt he was in control of the situation and that there was little risk of an accident so close to the bottom of the ladder. Removal of the safety line also allowed for a more unhampered descent.

The shipping company's safety management system and procedures appear to have been well implemented, and the AIBN felt that the way the system was managed from the shipping company's office concurred with how it was implemented in practice on board. However, in the AIBN's opinion, safety on board during cleaning of the cargo holds would be improved if the use of ladders for work at height were avoided.

Figure 2: 'MV Favorita'. Photo: Ugland Marine Services AS

1. FACTUAL INFORMATION

1.1 Details of the vessel and the accident

The vessel	
Name	*MV Favorita'*
Flag state	Norway
Class society	DNV
IMO number / call signal	9298519/ LAGM6
Type	Bulk
Build year	2005
Owner	Ugland Shipping AS
Operator/ Responsible for ISM	Ugland Marine Services AS
Construction material	Steel
Length	189.99 m
Gross tonnage	30 078
Minimum safe manning	16
Actual Manning	23
The voyage	
Port of departure	Dongguan, China
Port of arrival	Tsukumi, Japan
Type of voyage	International voyage
Cargo	In ballast condition
Information about the accident	
Date and time	24 August 2013, 09:20 local time

Type of accident	Occupational accident
Place/position where the accident occurred	East China Sea, position N 26° 45’ E 123° 03’
Place on board where the accident occurred	Cargo hold 5
Injuries/deaths	One crew member died
Damage to vessels/the environment	None
Vessel operation	Cleaning of cargo hold
At what point of the vessel's voyage	En route
External environmental factors	Wind SSE 3, wave height 0.5 m, daylight
Involved onshore authorities, implemented response actions	
Who was involved	Keelung Costal Radio Station, NRCC Taiwan, the shipping company
Resources involved	Helicopter
Action response time	1 h 40 min from first contact until arrival
Implemented actions	Evacuation by helicopter
Results achieved	Crew member evacuated to hospital and declared dead on arrival

1.2 Chain of events

Favorita had discharged salt in China and, on 24 August, she was en route to Japan to load cement clinker.

Before the work was started that morning, a safety meeting was held in which a safe job analysis (SJA) was conducted related to cleaning of the cargo holds. The meeting was attended by the members of both the deck and the engine crew who were to participate in the cleaning of the cargo holds. The job was reviewed, and the methods to be used were discussed along with the potential risks involved in the work. A check was also carried out of the safety equipment.

It was established practice in the company that the engine crew were responsible for cargo hold 5. The crew entered the hold via a protected, fixed ladder at the forward end of the cargo hold and started rigging to prepare for the work. There were three men down in the cargo hold, while one man stood at the hatch coaming to assist with lowering equipment, adjusting the water flow for high-pressure jetting etc. They communicated by hand-held radios. When they had completed rigging, they started to perform the scheduled work. The motorman stood on a ladder (mobile aluminium ladder) while jetting at high pressure, while a colleague supported the ladder and controlled the safety line; see Figure 3. Just after nine o'clock, another member of the engine crew went down into the cargo hold to help out. He started rigging a scaffolding to be used during cleaning of the forward and aft bulkheads.

When he had finished cleaning one area, the motorman started descending the ladder to move it to the next position. The engineer who supported the ladder moved aside so that the motorman would be able to come all the way down. Approximately one metre before the bottom, the motorman reached up and disconnected the safety line. The engineer called out to remind him that he still had a way to go and should wait. But the motorman suddenly fell backwards and lost his helmet just before he landed on the back of his head on the tank top. This occurred at approximately 09:20 local time.

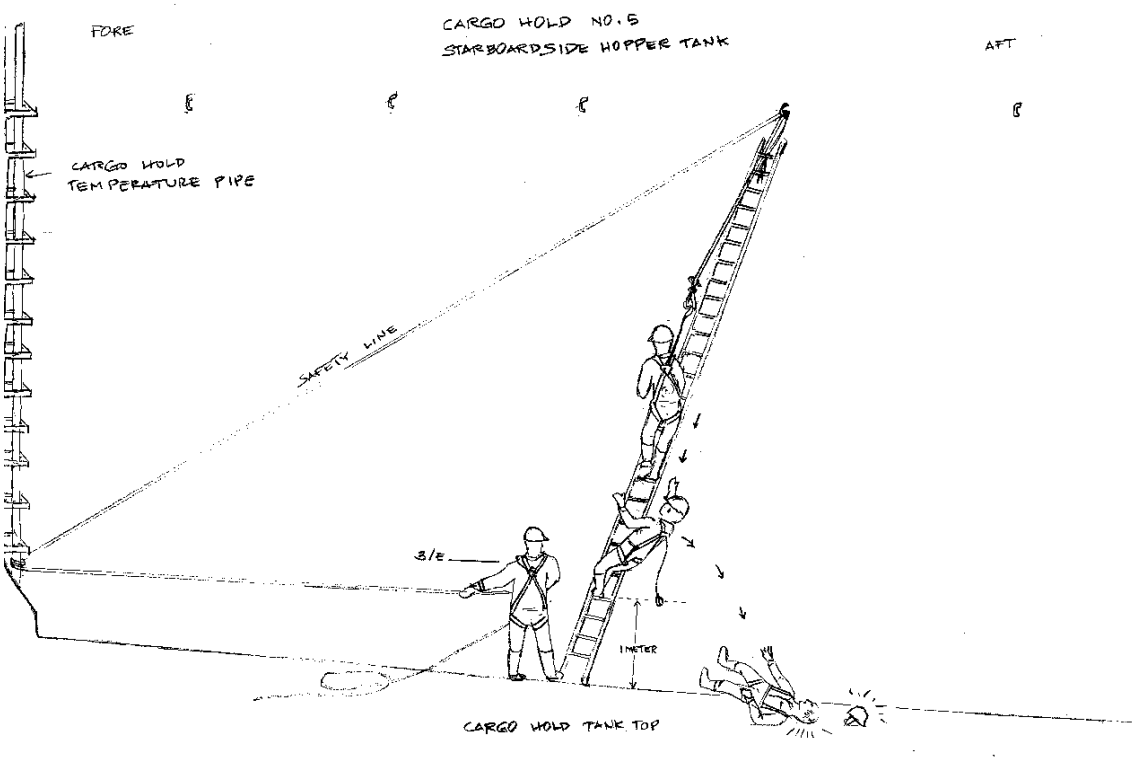

Figure 3: Schematic drawing of the accident. The ladder rested against the hopper tank plating, which had a slope of approximately 45 degrees. Source: 'MV Favorita'.

The engineer saw that the motorman appeared lifeless and was bleeding from the back of his head. He placed the motorman's head and shoulders in his lap for support and to try to stop the bleeding, at the same time as he called out to the others in the cargo hold to get their attention and call for help.

The captain was out on deck when he heard over the radio that one man had suffered a fall and lay injured in cargo hold 5. He immediately climbed into the cargo hold together with a member of the deck crew. Portable oxygen equipment was fetched from the hospital, and oxygen was administered. After a while, the whole crew had become aware of the situation and a stretcher with a head immobiliser was lowered into the cargo hold. The motorman was lifted onto the stretcher and hoisted out of the cargo hold by the deck crew using ropes and tackle.

After being hoisted out of the cargo hold, the motorman was carried to the vessel's hospital where oxygen was administered and the crew monitored his pulse and blood pressure.

1.3 Weather and sea conditions

The accident occurred in daylight. A force 3 wind was blowing from SSE, and the estimated wave height was 0.5 m. Due to some ocean swells, however, the captain decided not to use the vessel's crane to hoist the injured motorman out of the cargo hold.

1.4 Rescue/salvage operation

The captain contacted Keelung Coastal Radio Station and was immediately put in contact with NRCC Taiwan. NRCC Taiwan sent for a helicopter, which arrived at the vessel one hour and 40 minutes after initial contact. Just before 12:00, the injured motorman was hoisted on board the helicopter on the vessel's own stretcher. He was flown ashore and transferred to hospital. He was declared dead on arrival at the hospital at approximately 15:30.

1.5 Shipping company

1.5.1 General information

J.J. Ugland Holding AS is a family-owned company with its head office in Grimstad in Norway. The company's business is shipyards and offshore activities, as well as maritime activities including shuttle tankers, platform supply vessels (PSV), heavy lift vessels (HLV) and bulk carriers. The shipping activities are fully integrated, which means that all functions, including operation, technical services, manning, finances and business development are carried out internally. The bulk cargo fleet in Ugland Bulk Carriers AS is owned by Ugland Shipping AS and operated by Ugland Marine Services AS, in the following called the shipping company. The fleet comprises 11 handy-max bulk carriers. The shipping company is certified in accordance with the ISM Code, ISPS (ships), ISO 9001, ISO 14001, OHSAS 18001, Achilles and FPAL.

1.5.2 Safety Management

1.5.2.1 *Safety management system structure*

Ugland Marine Services' quality and safety management system consists of a number of different manuals that describe activities relating to the shipping activities and operation of the company's vessels:

- The 'Main Office Manual' presents the shipping company's safety and environmental protection policy, among other things, describes the system structure and provides an overview of the documentation that is relevant to the system, including the manuals that must be available on board.

- The 'Main Shipboard Manual' is a supporting document for the captain and crew that is designed, among other things, to ensure that the tasks assigned on board are carried out in a uniform manner in accordance with the shipping company's requirements and procedures. The manual includes governing procedures relating to the system for handling nonconformities, training, safety of personnel, vessel and environment, as well as procedures for maritime and technical operation, including for maintenance of the vessel and equipment.

- The 'Health & Safety Manual', including subordinate manuals, contains descriptions, procedures and checklists for handling nonconformities, shipboard training and safety drills, safe work practice and personal protective equipment.

1.5.2.2 *Procedures*

The shipping company had no separate procedures or checklists for cleaning cargo holds, but it expected this to be carried out in accordance with good seamanship and based on a prior risk assessment and safe job analysis (SJA).

The procedure for risk assessments and SJAs required potential risks associated with critical or dangerous activities to be identified and adequate precautions to be taken in order to prevent harm to personnel, vessel and equipment. As a minimum, everybody who was assigned responsibility or tasks in connection with a job was required to participate in the meeting at which the risk assessment was carried out. An SJA was required to be carried out prior to critical or hazardous operations and to be documented in a checklist for risk assessment and SJA. This was done in a safety meeting on the same morning as the accident occurred.

1.6 The vessel

MV Favorita is a handy-max bulk carrier of 52,220 DWT, built at Tsuneishi Heavy Industries in Cebu in the Philippines in 2005. The vessel is 189.99 metres long overall, with five cargo holds and four cranes. The minimum safe manning of the vessel is 16 crew, however the actual manning at the time of the accident was 23. *Favorita* was chartered by RIO TINTO SHIPPING (ASIA) PTE LTD in Singapore at the time of the accident. The vessel is mainly engaged in the tramp trade in Asia and Australia.

Figure 4: 'MV Favorita' is a handy-max bulk carrier with five cargo holds and four cargo handling cranes. Photo: AIBN

1.7 The crew

Virtually all crew members on board *Favorita* were highly experienced. Most of the crew had sailed on board the company's bulk carriers for more than ten years, while several of them, including the captain and chief engineer, had done so for almost 25 years.

The motorman who died was 61 years old and had sailed for the shipping company for 22 years. He had retired a year earlier, but had been asked to re-join the crew for this one trip as he was regarded as a skilful and experienced motorman and was physically fit. He still held the papers required for the position, and he underwent the required medical examination before he signed on again.

All crew members on *Favorita*, as in the rest of the company's bulk cargo fleet, were from the Philippines. The shipping company recruits to the crew for all its own vessels, and has employed a former captain as a manning agent in Manila. The company has focus on accommodating the crew so that they choose to remain with the company for a long time.

1.8 Operational conditions

It has become established practice in Ugland that it is the engine crew who are responsible for cleaning cargo hold 5. The other cargo holds are cleaned by the deck crew, assisted by members of the mess crew. A supplement was paid for cleaning the holds, and the deck crew often needed extra assistance to complete the cleaning on time. Restrictions applied to apprentices, ordinary seamen/ engine boys/ greasers and mess crew regarding work at height, but they participated in work that could be carried out down on the tank top.

Cargo hold 5 is different from cargo holds 2, 3 and 4 in that the hopper tanks extend further up the sides towards the aft end of the tank because the cargo hold narrows as a consequence of the hull design. Cargo hold 1 has much the same shape as cargo hold 5, except that it narrows at the forward end rather than the aft end.

Figure 5: Shape of cargo hold 3 with a cargo of cement clinker. Photo: AIBN

The method used to clean the cargo holds was chosen according to the type of cargo that had been discharged, and the type of cargo that would be taken aboard in the next port. On the voyage in question, *Favorita* had carried salt, and a lime coating had therefore been applied to the lower part of the cargo hold to prevent the salt from corroding the hull. The vessel had carried several cargoes of salt in a row, so there were three layers of lime coating that needed to be removed before the vessel could load cement clinker in Japan on its next voyage. An attempt was made to remove the coating using chemicals, which was the normal way of cleaning, but the coating was too thick, so the cargo holds had to be jetted down at high pressure.

Figure 6: Reconstruction of scenario in cargo hold 5. Photo: 'MV Favorita'.

The ladders used during the cleaning of the tanks were ordinary aluminium ladders that leaned against the hopper tank plating, which had a slope of approximately 45 degrees. In cargo hold 5, it was necessary to join two ladders to reach the upper part of the hopper tank plating, while one ladder was enough in the other holds. Extendable ladders were used to some extent, which were secured by winding rope around the ladders; in other places, two single ladders were used, which were held together by ropes. The AIBN has received conflicting information about which ladders were used at the time of the accident, and it can also not say whether it had any impact on the outcome of the accident. Scaffoldings were used when cleaning the fore and aft ends of the cargo holds, as the bulkheads were vertical.

The cleaning of the cargo holds was physically demanding and could go on for days. The crew of *Favorita* had previously discussed the need for a lift on board without this having been raised with the shipping company's office. The crew members themselves had concluded that the stowing and storage of such equipment when it was not in use would pose a challenge. The investigation has shown that, on board at least one sister vessel, slanting scaffoldings were used during the cleaning of the cargo holds.

Figure 7: Ladders and scaffoldings were stored at the forward end of cargo hold 2. Photo: AIBN

Figure 8: Ladders that were extended were always secured using extra ropes. Photo: AIBN

Cargo hold 5 had welded eye bolts along the upper part of the hopper tank plating. Ropes were threaded through these eye bolts in order to secure the ladder at the top, at the same time as the safety line for securing the crew member who stood on the ladder was threaded through one of the eyes. The safety line was then passed to a pipe to the fore (or aft) of the cargo hold, wound three times around the pipe and passed on to the crew member who was in charge of controlling the safety line; see Figure 3.

The high-pressure hose was lowered into the hold and secured from above, and the person operating the high-pressure hose was also able to take some load off the hose by using a short piece of rope attached near the nozzle to secure it.

The lower part of the cargo hold was cleaned before a ladder had to be introduced to start on the upper part of the hopper tank plating. On having cleaned one section, the crew member who performed the cleaning had to climb down from the ladder to move it before he could proceed to clean the adjacent area. Since the work was strenuous, they took it in turns to stand on the ladder. According to the information obtained by the AIBN, it was less comfortable to climb down the ladder with the safety line attached, as it was attached at the back and would sometimes get in the way; it was, however, normal practice not to disconnect the safety line before stepping onto the tank top.

Since the ladder was connected to a rope that was strung between the welded eye bolts, it was not necessary to attach the ladder to a new eye bolt every time it was moved, while it was still possible to position the ladder between the eye bolts and secure it from above. The safety line, on the other hand, was always repositioned and threaded through a new eye bolt.

The motorman fell while climbing down to move the ladder.

1.9 Relevant rules and regulations

1.9.1 Regulations of 14 March 2008 No 306 relating to safety management systems on Norwegian ships and mobile facilities (Regulations on Safety Management Systems)

The Regulations on Safety Management Systems are based on the International Safety Management (ISM) Code. Among other things, the purpose of the ISM Code is to ensure safety at sea and to prevent personal injuries or loss of life. The responsibilities of the shipping company include to ensure safe practice in the operation of ships and a safe working environment. Protection shall be provided against all identified risks. The shipping company shall prepare instructions and procedures to ensure the safe operation of ships.

1.9.2 Regulations of 1 January 2005 No 8 relating to the working environment, safety and health of employees on board ships (the OH&S Regulations)

Section 2-1 of the Regulations state that the following general guidelines shall form the basis for the implementation of the provisions set out in the Regulations:

a) risk factors are to be eliminated;

b) any risk which cannot be eliminated shall be individually assessed;

c) any risk shall be counteracted at the source;

d) technical progress shall be taken into account;

e) common protective measures of a technical nature, or measures, methods or procedures related to the organization of the work shall, if possible, have priority before individual protective measures.

Section 2-2 of the Regulations concerns risk assessments. Hazards on board shall be identified, and when a hazard has been identified, the risk it represents shall be assessed. Section 2-3 includes a provision that the measures and working methods applied shall ensure the best possible level of protection and continuous improvement of the safety of workers. The work shall be adapted to the individual worker, particularly as regards the design of the workplace. The planning and assessment of the working environment and implementation of the necessary preventive measures shall take place in cooperation with those who work on board.

Pursuant to Section 4-3, the choice of work equipment shall take account of working conditions and the nature of the work with a view to minimising any hazards to those who work on board.

The Regulations include an annex setting out provisions on the use of work equipment for temporary work at height, corresponding to Annex 2 to the Regulations on Safety Measures, see below.

1.9.3 Regulations of 15 June 1987 No 507 concerning safety measures etc. on passenger ships, cargo ships and lighters (the Regulations on Safety Measures)

Annex 2 to the Regulations, 'Provisions on the use of work equipment for temporary work at height', includes the provision in Section 1.1 that if temporary work at a height cannot be carried out safely and under appropriate ergonomic conditions from a suitable surface, the selected work equipment most be the most suitable to ensuring and maintaining safe working conditions. Collective protection measures shall be given priority over personal protection measures. The dimensions of the work equipment shall be appropriate to the nature of the work to be performed and to the foreseeable stresses, and shall allow passage without danger.

Section 1.2 includes the provision that ladders may only be used as work stations for work at a height under circumstances in which the use of other, safer work equipment is not justified because of the low level of risk and either the short duration of use of the ladder or existing features on site that the employer cannot alter.

Section 1.6 states that temporary work at a height may be carried out only when the weather conditions do not jeopardize the safety and health of workers.

Section 2 of the Annex contains special provisions on the use of ladders, including how ladders are to be positioned and secured. Section 2.3 states that ladders shall be used in such a way that workers have a secure handhold and firm foothold at all times. In particular, if a load has to be carried by hand on a ladder, it must not preclude the maintenance of a secure handhold.

1.10 Injury statistics

1.10.1 Statistics from the Norwegian Maritime Authority

Since 2003, a total of 100 accidents have been registered on Norwegian ships related to falls at the same level or to a lower level in cargo holds. Seventy-three of these accidents resulted in more than 72 hours' absence, while five were fatal accidents. The AIBN has investigated/ initiated investigations into three of the fatal accidents that have occurred after 1 July 2008, without finding any relevant similarities between them.

1.10.2 Statistics from the shipping company

The shipping company has informed us that, for many years, there has been a falling trend with regard to the number of accident involving personal injuries. The trend has flattened out, however, in recent years. The shipping company has not previously registered any injuries that are immediately comparable with the death on board *Favorita*.

1.10.3 Statistics from the Norwegian Labour Inspection Authority

According to the Norwegian Labour Inspection Authority's webpage with facts about head protection, approximately 74,000 occupational head/neck injuries were registered in Norway during the period 1998–2007, one-eighth of which were caused by fall accidents. Information is not available, however, as to whether a failure to use head protection, or faults and defects in the equipment, have been contributory causes. It is nonetheless assumed that the correct use of protective equipment would have resulted in much fewer or less serious head injuries. The Norwegian Labour Inspection Authority urges the use of chin straps on helmets when so warranted by the situation, to prevent the helmet from falling off in connection with sudden movements, awkward work positions etc.

1.11 The shipping company's safety work

According to the shipping company, it focuses on good safety work on board its vessels, and it organises regular conferences for officers and crew. The AIBN observed that the shipping company's thoughts and attitudes relating to safety concurred with those of the shipboard crew. The crew were well informed about the different parts of the safety management system. Regular meetings were held on board in which everybody was involved, and the crew felt that it was not a problem to raise objections or discuss work execution and safety issues, regardless of their position and experience on board. The general attitude was that one must look after oneself and one's colleagues, and not compromise on safety. Nonconformities were reported without any fear of negative consequences on the part of the crew.

1.12 Human factors

It may be difficult to understand why someone acted as they did, unless this was clearly stated by the person in advance of the action, when no questions can be put to him or her afterwards. In order to substantiate the probable cause of an action under such circumstances, one can consult the literature on psychological theory and research.

1.12.1 Theories about behaviour

Many models of understanding can be used in this type of probability substantiation. One psychological theory that may be relevant to this investigation is 'The Theory of Planned Behaviour' (Ajzen, I (1991)). This model has given rise to much research, and empirical support for the theory is now available from many fields of research (The theory of planned behaviour. Organizational Behaviour and Human Decision Processes, 50: 179–211.)

The essence of the theory can be illustrated as follows:

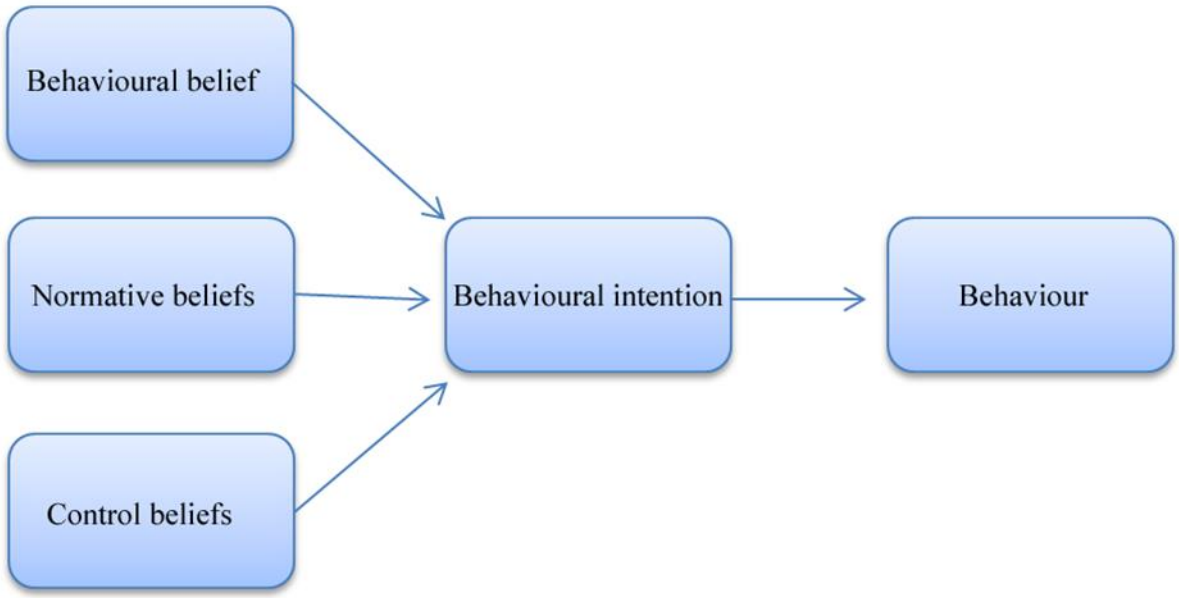

Figure 9: The theory of planned behaviour. Source: 'The Theory of Planned Behaviour' (Ajzen, I (1991)).

Behavioural beliefs are largely based on a perception of the potential consequences of behaving in a particular manner in a given situation. Will the person benefit or lose by such behaviour? Will he or she encounter much resistance? If the behaviour is in breach of laws and regulations, or norms, how great is the chance of being discovered? How great are the potential positive and negative consequences of such behaviour?

Normative beliefs have to do with what a person thinks others expect of him or her in a given situation. They include what a person thinks or knows that others believe concerning the relevant behaviour (good/bad, smart/less smart etc.) and what behaviour he or she thinks or knows that others expect from a person in the given situation. In order to understand a person's normative beliefs, it is important to know the reference group, for example the work team of which the person is a member.

Control beliefs concern a person's subjective perception of how easy or difficult it would be for him or her to perform the relevant behaviour. Examples of factors that typically have an impact on the perception of behavioural control is the person's assessment of his/her own skills and knowledge necessary to perform such behaviour. Other factors include a person's self-confidence in general, and the perceived degree of autonomy in the given situation, i.e. to what extent the person feels that he or she can behave in a certain way at his/her own will or that something/someone stands in the way of an action.

A person's beliefs in the three abovementioned areas are largely decisive for his or her behavioural intentions, which, in turn, are decisive in relation to whether, when and how a particular action is executed.

1.12.2 The theory of optimistic bias (also known as 'unrealistic optimism')

Some findings from research in the field of subjective risk assessment are also worth noting here. People consistently tend to believe that negative events and accidents are less likely to happen to them than to others (the 'it won't happen to me' mentality). This applies in particular to accidents that happen frequently and have potentially serious

consequences, for example traffic accidents. In the following, this is described as 'optimistic bias'.

One study also shows that, the stronger the feeling of perceived control, the greater the optimistic bias (Klein, C T F & Helweg-Larsen, M (2002)). Perceived Control and the Optimistic Bias: A Meta-Analytic Review. Psychology & Health, Volume 17, Issue 4).

1.13 Medical circumstances, fall from low height

No post-mortem examination was carried out on the deceased, but it was concluded in the death certificate that the cause of death was neurogenic shock as a result of head trauma sustained in connection with a fall from a higher level. The witness who observed the fall estimated the height of the fall to be one metre.

The Norwegian Centre for Maritime Medicine (NCMM) at Haukeland University Hospital in Bergen has confirmed that falls from a low level or from the same level can cause serious head injuries in some cases, sometimes with a fatal outcome. It is not possible to say how high the risk is, but it is pointed out that the severity of the injury mechanism (inciting event) is not always proportionate to the severity of the injuries. The risk of death will sometimes increase if the injured person's injuries are not treated immediately and surgery in hospital is not possible.

1.14 Implemented actions

After the accident, the shipping company conducted a survey in order to map the event and take corrective action, including the following:

Alternative methods for rationalising the work and reducing the risk of injuries to personnel in connection with the cleaning of cargo holds will be evaluated and given consideration. A familiarisation course for seafaring personnel that focuses on the cleaning of cargo holds is being prepared and will be implemented.

The system for handling risks will be evaluated and simplified in order to get a better understanding of how an SJA can be a practical contribution to handling and reducing the risks associated with different work operations. The use of SJAs and general handling of risks will be one of the focus areas at officers' conferences.

2. ANALYSIS

2.1 Introduction

The AIBN's analysis is based on the factual information that was obtained in connection with the investigation. The information consists mostly of documentation from the shipping company, from interviews held at the shipping company's office and with the shipboard crew, and from technical shipboard examinations. In addition, the AIBN has made use of psychological theory and research.

First and foremost, the analysis focuses on understanding how such an accident could happen.

The accident occurred when the motorman fell down from a low height. The work at height had been completed, and he was on his way down the ladder. The AIBN has discussed human factors that may have contributed to the accident.

Even though the accident occurred when the motorman was on his way down the ladder, the AIBN has chosen to also discuss the use of ladders as work platforms, in addition to their use as a work tool for access to and from work at height.

2.2 Assessment of the chain of events

In its assessment of the chain of events, the AIBN has chosen to focus on the immediate causes that contributed to the accident, and on why the consequences were fatal even though the fall was from a relatively low height.

2.2.1 Why was the safety line disconnected?

The motorman was climbing down the ladder when he disconnected the safety line. The AIBN cannot determine why he did so despite not having come all the way down to the tank top. One possibility is that he believed that he had already reached the tank top. The AIBN does not consider this very likely, however, and has chosen not to investigate this possibility further.

Another possibility was that he felt that the safety line restricted his freedom of movement as he descended the ladder. None of his colleagues were able to confirm that he had complained about this on any previous occasion, however. Even so, it cannot be precluded that this was experienced as a problem on this occasion. The motorman disconnected the safety line at the same time as his colleague moved aside to make room for the motorman at the bottom of the ladder. This may have led to the safety line being payed out too slowly for the motorman to continue his descent unhindered. The AIBN assumes that he knew where he was, but that he disconnected the line because he felt secure and had a perception of being sufficiently in control since he had almost reached the deck. This will be discussed further in section 2.4.

2.2.2 Why did he fall from the ladder?

After disconnecting the safety line, the motorman immediately fell backwards and down onto the tank top. None of the witnesses to the accident observed what was the immediate cause of his fall. The AIBN has considered several possible causes, but has not been able to conclude with any certainty why he lost his balance and fell. He did not undergo a post

mortem examination, but the death certificate states shock caused by head trauma as the cause of death.

Some form of distraction may have caused the motorman to momentarily shift focus from what he was doing. A momentary distraction may have been sufficient for him to lose his balance and fall.

He may also have slipped on a step on the ladder. He was wearing rubber boots with a robust sole and signs of normal wear. It was wet as a result of the cleaning, however, and the steps on the ladder were shallow as the ladder was leaning right up against the hopper tank plating.

The ladder was secured by ropes at the top and a person holding the ladder at the bottom. If the ladder had slipped away from the wall, he could possibly have caught his foot between the ladder and the hopper tank plating. There is nothing to indicate that the ladder was unstable in relation to the underlying surface, however.

The motorman may also have lost his balance because his foothold and grip were not firm. Just before he fell, he had reached up while standing on the ladder and disconnected the safety line. He used both hands to disconnect the line, which meant that he was not holding on to anything just before he fell. There was some ocean swell at the time of the accident, but the swell was not great enough for work in the cargo holds to be deemed unsafe. A ship en route is always subject to movement, however, and even minor movements can represent challenges when working under sub-optimal conditions.

The use of ladders as work platforms and access routes is discussed in more detail in section 2.5.

2.2.3 Failure to fasten the helmet's chin strap

The deceased was wearing a helmet while working in the cargo hold, but it fell off as he fell from the ladder and before he hit the tank top. The AIBN is unable to determine whether the chin strap was attached while he was working, but a witness observed that the helmet fell off before the motorman reached the tank top, and the helmet was found next to him with loose chin straps. Accordingly, the AIBN believes that the chin straps were not fastened when he fell. The helmet's chin straps were also intact when it was found.

Information provided by the crew suggests that helmets were always worn during work on deck and in the engine room. Whether the chin strap was fastened tended to be left to each of them to decide according to the work being carried out. This is in accordance with the AIBN's observations on board. The motorman's colleagues were unable to say with any certainty whether he was in the habit of fastening the chin strap; see also section 2.4.4.

2.2.4 The survival aspects

The fall from the ladder was about one metre. Even though the height was relatively small, the motorman died, probably as a result of the injuries sustained in the fall. In the AIBN's opinion, it is important to focus on the use of helmets and chin straps in connection with all work involving a risk of falling from the same or a higher level. Use of the chin strap could not have prevented the accident being considered here, but it

might have reduced the consequences of the fall. The motorman fell from a relatively low height, and the AIBN believes that, had the chin strap been fastened so that the helmet stayed in place when he hit the tank top, he would have had a greater chance of survival.

2.3 Assessment of the shipping company's safety management and procedures

The AIBN has reviewed the shipping company's safety management system and procedures. They seem to be well implemented in the shipping company, which was confirmed in the AIBN's interviews with the shipping company's management and *Favorita's* crew. The procedures seem to have been followed, and risk assessments were carried out in connection with this type of work. Rest period provisions were checked and followed by the shipping company's office, also in the context of extra work, which included tank cleaning. These factors will not be subject to further evaluation in the AIBN's analysis.

On the other hand, the AIBN takes a more critical view of choosing to use of ladders for work at height. This is discussed in section 2.5.

2.4 Assessment of human factors

Even though the shipping company stresses safety work through information, instructions, safe job analyses and general safety motivation, each individual crew member will still have their own understanding of the specific work situation in which they find themselves. Important individual differences regarding experience and competence, age, culture, personality etc. contribute to different people having a different understanding of the situation.

On a general basis, it can be said that these individual differences will result in different assessments of what constitutes safe job execution, what constitutes safe movement of equipment and people, how the job can be completed most efficiently etc. In turn, this means that, in certain situations, some people will act in a manner that is not fully in accordance with applicable procedures.

When assessing why the motorman disconnected the safety line before he reached the bottom of the ladder, we have assumed that he made some assessments on the basis of which he clearly intended to disconnect the line where he did, before doing so. What assessments he may have made is considered in the following on the basis of, among other things, the theory referred to in section 1.12. The AIBN stresses that the factors mentioned below are no more than hypotheses about the assessments that the motorman may have made, and not a description of the facts.

2.4.1 Behavioural beliefs

The motorman may have chosen to disconnect the line early because he considered it more desirable to achieve an advantageous work execution than to secure himself given that he was almost at the bottom of the ladder and felt that there was little risk of an accident. The AIBN assumes that he felt that the safety line was uncomfortable and a hindrance to his descent. Potential time savings and/or preparations for the next work operation may also have been contributory causes. He may have perceived that there would be little resistance from his colleagues given the low height / low risk. It was highly likely that the breach of safety procedures would be spotted by his colleagues, but

the motorman may have considered that it was relatively unlikely that it would be reported and have negative consequences.

2.4.2 Normative beliefs

The work team in question was carrying out a specific job in return for a specific remuneration. The incentive in the situation was to get the job over and done with in an efficient manner. If the job had been subject to, for example, overtime pay, it would have been an incentive to work some extra hours in order to receive more pay. The AIBN assumes, therefore, that one of the norms within the team was to complete the task in an efficient manner. The motorman was 61 years old, retired and hired for this specific voyage. He may therefore have been particularly eager to prove that he was still able to work efficiently, in accordance with his colleagues' expectations. As a pensioner on temporary hire, he may also have felt less bound by the management's safety rules than crew who were permanently employed.

2.4.3 Control beliefs

The ladder was secured by rope at the top and a colleague who held the ladder in place at the bottom. A safety line was used as an additional precaution. The motorman had extensive experience of mastering these types of tasks. Thus, the AIBN has reason to assume that he felt assured that he was able to carry out the tasks in a safe manner, and that he felt that he had the necessary tools and skills. His feeling of autonomy is assumed to have been great, as there were no officers present with responsibility for supervising the execution of the work (one engine officer participated in the cleaning, but he was not responsible for the execution of the work). The above circumstances suggest that his perception of control was relatively great in the relevant situation.

2.4.4 Overall assessment

Based on an overall assessment, the motorman may have concluded that there was more reason to remove the safety line early than to wait until he had climbed all the way down. It may have taken him just a few seconds to reach this conclusion; the process was probably far from the systematic and conscious process described here.

The effect of optimistic bias in relation to not suffering accidents oneself may also have contributed to the motorman considering it advisable to disconnect the line before reaching the bottom of the ladder. The AIBN deems it likely that the motorman had a relatively high degree of perceived control of the situation, even when he stood at the top of the ladder. The reason was that he was physically well secured and had extensive experience of carrying out this type of work. When he had almost reached the bottom of the ladder, he probably perceived the risk to be very low, and therefore chose to disconnect the line to achieve a more advantageous work execution.

Another contributory cause of the accident may have been that the motorman, at a time when the perceived risk was low, had already shifted focus to something other than the safe movement of people and equipment. He may, for example, have been focusing on the next work operation.

A similar reasoning can be applied to understand why the motorman chose to work without fastening the chin strap on his helmet. In this case, applicable norms and practice

within the work team and among the crew as a whole concerning the use of chin straps were probably among the most important input values.

2.5 Assessment of equipment for work and access to cleaning of the cargo holds

In this section, the AIBN has chosen to focus on safety issues relating to the use of ladders as work tools for work at height in connection with the cleaning of cargo holds. Ladders were used where necessary to get close to the tank surfaces with the jet cleaner and where it was not possible to use scaffoldings or a crane-held basket for the work. In this case, the above practice is assessed in relation to the regulatory framework for the use of ladders in this type of activity. The investigation has also looked at alternative solutions and considered how they compare to the use of ladders.

2.5.1 Assessment of the shipping company's practice

It was standard practice on *Favorita* to use ladders on sloping surfaces in connection with cleaning. This type of work was physically demanding and, time-wise, it depended on what surfaces and the extent of the areas to be cleaned. When coatings used during the carriage of salt were to be removed, the work sessions could last for many hours and the crew took it in turns to carry out the work, which sometimes went on for several days. The work required both hands to be free to operate and control the jet cleaner. In order to achieve this, one had to stand up straight, possibly supporting one's knees in the ladder, with a piece of rope strung between the body and ladder to achieve a stable position. The safety line from the harness was used as security and to provide extra stability.

Cargo holds 1 to 4 were cleaned by the deck crew, while cargo hold 5 was always cleaned by the engine crew. The working conditions in the different cargo holds were largely the same, except that cargo hold 5 at the stern had more sloping sides. The geometry of cargo hold 5 meant that the ladders had to be extended a little further and placed at an angle approaching 45 degrees. The investigation did not find any major differences in the way the work was carried out, and the work execution methods were the same in the different cargo holds. Interviews with the crew suggest, however, that deck crew members took somewhat shorter turns on the ladder than engine crew members. This may be related to the fact that there were more deck crew members than engine crew members.

2.5.2 Assessment of the use of ladders for access compared with the use of ladders as work platforms

Ladders are a common aid for access to and work at height. There are rules and regulations relating to the use of ladders, both for onshore work and for shipboard work, and they largely concur. Ladders are mainly to be used for access and only in exceptional cases for work. The Regulations on Safety Measures permit work of short duration to be carried out from ladders, provided that the associated risk is low. Work of short duration may also be carried out where there are conditions in the workplace that cannot be changed.

Based on the applicable safety measures on *Favorita*, the risk associated with working from ladders in connection with cleaning the cargo holds was considered to be low. The ladder was secured with rope from above, and with one person holding the ladder at the bottom. The crew member who stood on the ladder used a safety line. There was good security against falling from a height. The work itself was physically demanding,

however, and went on for some time. Moreover, in the AIBN's opinion, it would have been possible to change this physically strenuous work situation by introducing more expedient and efficient solutions. This could have made the work less physically demanding and also contributed to better safety conditions in connection with the work.

Given that a scaffold system was used for the same type of work, its introduction throughout the fleet should have been considered. In the AIBN's opinion, solutions were available that could have been used instead of the improvised ladder solution. A personnel lift has also been mentioned as a possible solution, but the crew did not propose such a solution on the basis of what they foresaw as a problem. This should have been formally proposed on the part of the vessel, and the possibilities explored by the shipping company. The most essential consideration is that the equipment to be used for access and as a work platform must be adapted to the geometry of the hold and to the tasks in question. The use of a ladder as a work platform was not the immediate cause of the accident, however, as the accident occurred while the motorman was climbing down the ladder. The fact that the ladder was at an angle of approximately 45 degrees, and that it lay flat against the supporting surface, represented a bigger safety challenge in relation to grip and foothold than if it had been a free-standing ladder positioned at a steeper angle, and this widened the gap between the perceived risk as mentioned in section 2.4 and the actual risk.

In the AIBN's opinion, a ladder can never be a satisfactory work platform. The work of cleaning a cargo hold is never work of short duration for which a ladder can be used pursuant to applicable regulations, and known solutions are already available that can be used instead of a ladder. In the AIBN's opinion, work procedures and equipment for work at height should be introduced whereby ladders are only used for access and not, as a rule, as work platforms.

3. CONCLUSION

a) The accident occurred as a consequence of the motorman removing the safety line and losing his balance on the ladder, which caused him to fall and hit his head on the tank top.

b) Because of a high degree of perceived control and a low degree of perceived risk of an accident so near the bottom of the ladder, the motorman may have chosen to disconnect the line a little too early to allow for a more unhampered descent.

c) The chin strap on his helmet was not fastened, which caused the helmet to fall off and the head injuries sustained in the fall became fatal.

d) The shipping company's safety management system and procedures appear to have been well implemented, and the AIBN felt that the way the system was managed from the shipping company's office concurred with how it was implemented in practise on board.

e) The use of ladders for work at height should be avoided and more expedient methods for cleaning cargo holds should be considered.

4. SAFETY RECOMMENDATIONS

The AIBN does not propose any safety recommendations as a result of this investigation.

Accident Investigation Board Norway
Lillestrøm, 24 September 2014