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SAFETY BOARD

Accident in loading pipe of trailing suction hopper dredger Scelveringhe

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The Dutch Safety Board

When accidents or disasters happen, the Dutch Safety Board investigates how it was possible for these to occur, with the aim of learning lessons for the future and, ultimately, improving safety in the Netherlands. The Safety Board is independent and is free to decide which incidents to investigate. In particular, it focuses on situations in which people's personal safety is dependent on third parties, such as the government or companies. In certain cases the Board is under an obligation to carry out an investigation. Its investigations do not address issues of blame or liability.

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N.B. This report is published in the English language with a separate Dutch summary. If there is a difference in interpretation between the report and the summary, the report text wil prevail.

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1 INTRODUCTION

On 17 March 2017, a crew member was killed on board the Dutch trailing suction hopper dredger Scelveringhe, while the vessel was sailing from the port of Esbjerg in Denmark towards its loading area on the North Sea. When the water pump was started on the bridge to pump more seawater into the hold to reduce the ship's movement through the waves, the crew member was washed into the hold together with the seawater. The crew member eventually drowned in the hold.

This involved a very serious accident as specified in the Casualty Investigation Code of the International Maritime Organisation (IMO) and EU Directive 2009/18/EC. Pursuant to the above, as the flag state, the Netherlands has the duty to conduct a safety investigation. This investigative duty is also set out in the Dutch Safety Board Decree (Besluit Onderzoeksraad).

The investigation was conducted to draw safety lessons from this accident and focused on the following questions:

1. How could the accident happen?
2. How were the risks associated with this type of accident identified and managed?

Investigation method

The investigation began one day after the accident, with the collection of information in the port of Esbjerg (Denmark), the port to which the ship sailed following the accident. In light of the investigation, two investigators from the Dutch Safety Board began their investigation on board. Interviews were held on board with crew members directly involved, with a representative of the operator and with support companies. Documentation was also examined in respect of the safety management for the vessel Scelveringhe.

One important point for attention in this investigation is the functioning of the Safety Management System (SMS) drawn up in the framework of the International Safety Management (ISM) code. The investigation examined the situation on board the ship, at the operator and the company that designed the SMS.

2 BACKGROUND INFORMATION

Ship and crew

The Scelveringhe was built in 2004 by Vard RO Offshore Braila SA in Braila in Romania, and is owned by Scelveringhe Scheepvaart B.V. The ship is managed by Den Herder Seaworks (DHS). In total, DHS operates three suction hopper dredgers (see Appendix A for further ship data).

The Scelveringhe is a trailing suction hopper dredger: a vessel that sucks material (mainly sand and gravel) from the seabed. On board the vessel is a suction installation, consisting of a large suction pipe with suction head through which sand and gravel are pumped from the seabed together with seawater via the loading installation (sieve and loading pipe) into the hold (also known as the barge) using a sand pump (see Figure 1).

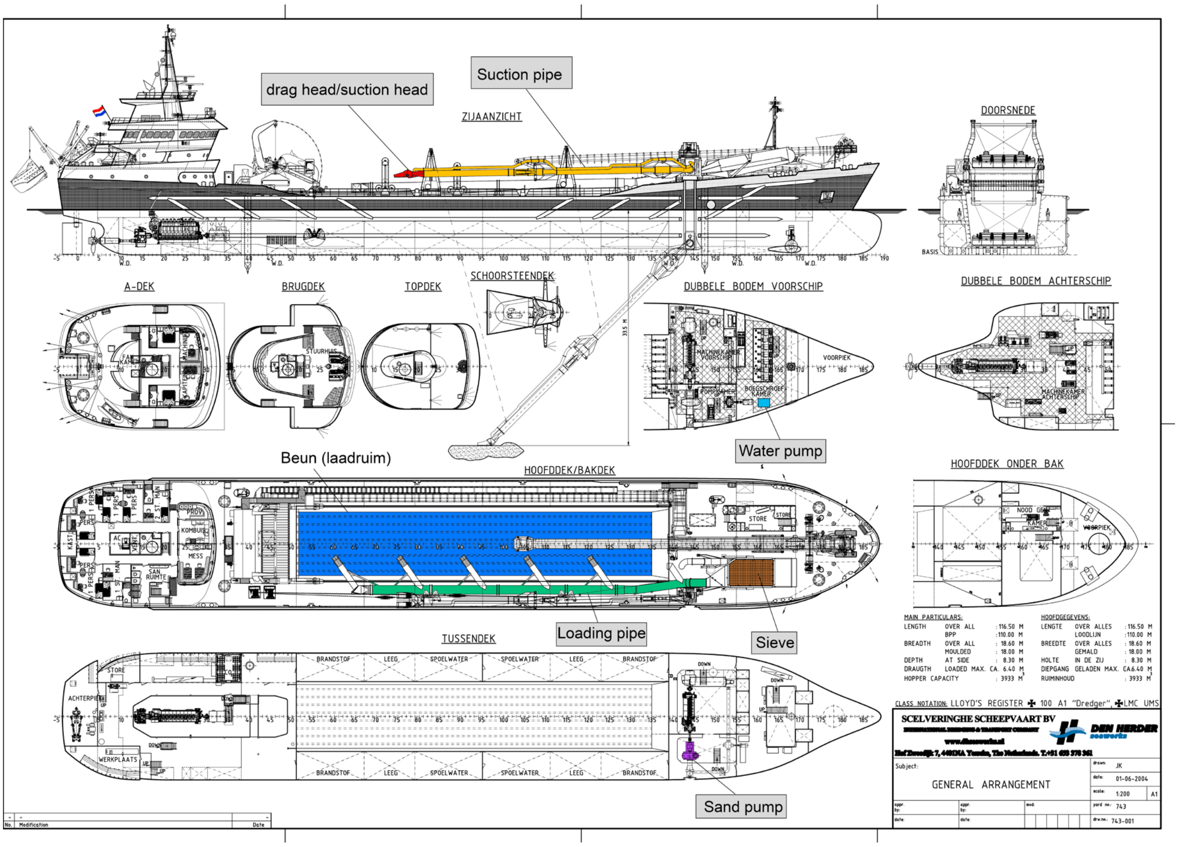

Figure 1: Drawing of the Scelveringhe showing the suction installation (suction head, suction pipe and sand pump) and the loading installation (sieve and loading pipe). (Source: DHS)

The installation can also be used to pump seawater into the hold as ballast when the ship is unloaded. By pumping seawater into the hold, the ship settles deeper and more stable into the water.

The abrasive action of the mixture of sand and water means the system is very maintenance intensive. Welders are regularly required to carry out maintenance work on the loading installation (see Figure 2).

Figure 2: Inside of the loading pipe, during welding.

According to the safe manning certificate, the minimum crew consists of seven crew members. During the accident there were nine crew members on board, because two new crew members (a welder and a captain) were receiving introductory training. Five crew members were Dutch nationals, namely both captains, the first officer, the chief engineer and one of the able-bodied seamen (ABS). The other ABS, including the victim, were Philippine nationals. All crew members had the correct certificates of competency. The victim was one of the two welders on board; he had more than one year of experience on board the Scelveringhe. The second welder had only been on board for two days.

Safety Management System

The SMS in use on board the Scelveringhe was designed by the company Amsys. Amsys was also responsible for updating the system for the Scelveringhe. Amsys is a company that supplies Safety Management Systems (SMS) mostly to small operators and captains/owners. The company has supplied systems to around 70 ships, and updates the systems for around 30 ships. The SMS on board the Scelveringhe was approved by ISM auditor Det Norske Veritas.

For ships larger than 500GT, including the ship Scelveringhe, a SMS must be present on board[1] that satisfies the standards laid down in the ISM code[2].

The ISM code specifies the requirements which must be satisfied by the Safety Management System (SMS) for ships. The code for example describes the responsibilities of the company operating a ship:

- The employer, in this case the operator, must formulate safety management targets.
- As part of that process, the operator must ensure safe implementation of the ship's operations and a safe working environment.
- The operator must also supply suitable barriers for a number of the ship's procedures laid down in the ISM code.
- The operator must also ensure continuous improvement.

The ship's captain is responsible for implementation and execution of the operator's safety policy on board his ship. He is also responsible for informing the operator of any shortcomings.

An operator must operate a systematic approach to mitigate risks on board. To make that possible, the processes and risks on board must first be mapped out. A good systematic approach for example is to follow an occupational safety and health strategy:

1. Start with the source of the risk. The operator must first eliminate the cause of the risk. Should any work at all be carried out in the loading pipe? Should the work be carried out at that moment and under those circumstances? Are there possible alternatives?
2. Collective measures: if measures at source are not applicable or if they do not eliminate the risk entirely, the operator must consider measures to protect everyone against those risks. For example, is it possible to switch off the pump in a safe manner with a log out/tag out system, in other words fitting a safety switch in such a way that it cannot be bridged?

1 Shipping Decree 2004, Art. 49.

2 ISM code: International Safety Management Code, adopted by the IMO Assembly in Resolution A.741(18), as amended by Resolutions MSC.104(73), MSC. 179(79), MSC. 195(80 and MSC.273(85). This Code is made compulsory in Chapter IX of the annex to the 1974 SOLAS Convention, Management for the safe operation of ships.

3. Individual measures: if the risk is still not sufficiently mitigated by the measures taken, the operator must further limit the risk for individual employees by reducing their exposure to the risk. This can for example be achieved by organisational measures such as introducing a procedure.
4. The final possibility open to the operator is to supply personal protective equipment, such as a lifejacket. The employer must supervise the use of this equipment, but employees are required to use the personal protective equipment and to follow the relevant instructions.

The SMS on board the Scelveringhe consisted of a series of standard procedures for general work on board ships, divided into four annexes:

- Annex 1 listed the procedures for normal conditions, such as procedures for mooring and unmooring, and starting various engines. There were also work permit forms, for example for hot work and entering enclosed spaces and Safe Working Instructions, for example for working with electricity and chemical substances.
- Annex 2 listed the procedures that have to be followed in the event of an emergency or extraordinary situations on board.
- Annex 3 listed the risk assessment. This included a limited standard list of risks which can occur on board any vessel.
- Annex 4 listed the standard procedures required according to the Maritime Labour Convention (MLC). These are procedures aimed at guaranteeing the MLC standard for the living environment of the crew.
- Sector risk inventory and evaluation (RI&E).

For activities not described in the standard procedures, new crew members received introductory training in practice, on board. Each crew member was also provided with a folder of procedures specifically applicable to his/her position. In this way, each crew member was expected to learn the procedures.

3 THE ACCIDENT

Accident

On 17 March 2017 at 14.35[3] hours, the Scelveringhe set sail from the port of Esbjerg (Denmark) to a loading zone on the North Sea, off the coast of Denmark, to suck gravel on board. According to the schedule, the vessel was due to arrive at the loading zone around 23.00 hours.

While sailing to the loading zone, the wind rose in strength and the waves grew higher. At the time of the accident, a westerly wind was blowing at force 7 Beaufort. The skies were cloudy, with the occasional rain shower. Wave height was around 2.5 metres. The seawater temperature was around 5 degrees Celsius.

The first officer had put two welders to work. They were instructed to replace teeth on the suction head, and to weld several holes on a T-section of the pipes on deck. The first officer assumed that this work could be carried out on the outside, from the deck, and that the welders did not need to enter the loading installation. The work had to be completed before the vessel arrived in its loading zone. Once the welders had finished the work, they were to produce new spare teeth for the suction head in the on-board workshop. In addition to the work instructions for the day, the first officer instructed the experienced welder to explain the on-board working methods on the ship to his fellow welder who had just arrived on board.

The captain was present on the bridge, together with the relief captain who still had to receive introductory training. At around 15.30 hours, the vessel left the Esbjerg channel and set course to the north, towards the loading zone.

At around 16.00 hours, after the welders had replaced the teeth on the suction head, they entered the loading pipe, to carry out the repair work.

In the meantime, the wind had risen further, and the waves had grown higher, causing the vessel to roll moderately. In deeper water, the swell grew heavier at which point the captain suggested to the relief captain that the vessel could be settled more stably, by pumping more ballast water into the hold.

3 All times referred to are shown in local time.

At 17.35 hours, the captain supervised the starting up of the water pump and examined the hold, to point out where the water would emerge from. A few seconds after water started flowing into the hold via the loading pipe, the captain saw a person (the experienced welder) being washed into the hold through one of the water jets (from loading pipe number 4, see Figure 3). The captain immediately ordered the water pump to be shut down, and approximately 2 seconds later, the water stopped flowing. The captain then ordered the relief captain to go down from the bridge and to throw a lifebuoy into the hold, and the general alarm was sounded.

Due to the oscillation of the vessel, the water in the hold was washed backwards and forwards, and the victim disappeared under water, after having risen to the surface several times. Despite repeated attempts to dredge the hold, the crew was unable to retrieve the crew member from the hold. After approximately 45 minutes, the crew halted its efforts. By this time it had also become clear that the other welder had managed to find a secure handhold in the pipe, as a result of which he had not been washed into the hold and had been able to pull himself to safety.

Figure 3: Suction head (left) and cargo hold with loading pipe (right).

In the meantime, the captain had set course for Esbjerg, and had contacted the emergency services via the ship's agent. At 21.43 hours, the vessel once again moored in port and the emergency services came on board. Divers searched the hold and found the victim after approximately thirty minutes. The victim was dead.

4 ANALYSIS

Occurrence of the accident

The accident occurred when the water pump was started to fill the hold with ballast water, while the crew on the bridge were unaware that two welders were present in the loading pipe. They had been instructed earlier that day to carry out a number of tasks. To carry out those tasks they were not required to enter the loading pipe.

For ship-specific tasks that are part of the core activities on a trailing suction hopper dredger, such as welding work in the suction and loading installation, there were no procedures in the SMS. A Safety Committee Meeting had been held, during which among other items, the procedure for welding in the loading pipe was discussed. Minutes of this meeting were prepared and signed by the crew (including the victim). There was an agreed method on board for entering and working on the suction and loading installation.

Agreements for working on the loading installation

At the time of the accident, two agreements were in place for working in the loading installations:

1. Agreement on welding work: Following a personal inspection, the first officer issues an instruction to weld and together with the welder(s) visits the location where welding must be carried out. The first officer then notifies the bridge that work is due to be carried out in the loading pipe. The captain then places a note by the pump operating button on the bridge, so that the water pump is not started. Once the work is completed and the crew members are no longer in the loading pipe, the captain receives a signal. He then removes the note, to show that the pump can once again be used.
2. If the captain wishes to ballast the vessel, and there are people in the loading pipe: The captain sends a crew member to the loading pipe to announce his intention to start the water pump. The captain then receives a signal when the pipe has been evacuated, so that he can use the pump to ballast the vessel.

Communication for this procedure can also take place via walkie-talkie.

No work permit was issued for the welding work in the loading pipe. The ship's management indicated that no hot work permit was issued for the welding work, in connection with the large volume of welding work carried out on board each week.

The agreed procedure was not implemented, so that the duty crew on the bridge were not aware of the presence of the welders in the loading pipe. It did not become clear from the investigation why the first welder decided to carry out work in the loading pipe. The second welder was not fully informed of the procedure because he had only been on board two days. He assumed that the victim had spoken to the first officer about the welding work in the loading pipe. For the welders, there was no possibility of preventing the water pump being switched on during the welding work in the pipe, for example by shutting off the electricity to the pump.

SMS in practice

For the Scelveringhe, the standard ship's procedures as prescribed by the ISM code are part of the approved safety management system. The operator did not include ship-specific procedures in the safety management system; this is also not a requirement according to the ISM code. The approved risk inventory and evaluation (RI&E) also does not consider ship-specific procedures.

Welding in the loading pipe had been identified as a risk on board (the combination of welding and ballasting) but the approach to mitigate the risk was never systematically analysed, for example in accordance with the occupational safety and health strategy[4], or included in the SMS. The agreements as discussed at a Safety Committee Meeting were recorded in writing.

The procedure for welding work in the loading pipe was elaborated on board. Amsys was not aware of the agreement for entering the loading pipe on board the Scelveringhe, and therefore never assessed the procedure. As a result, an agreement was kept in place of which it was unclear whether it sufficiently managed the risks. The decision was also taken not to have a hot work permit procedure for welding in the loading pipe.

4 A step-by-step plan for risk management measures.

In addition, the agreement was entirely dependent on a chain of human behaviour, such as clear communication (telling each other that someone intended to work in the loading pipe) followed by actions (note on the pump operating button) and the resultant mutual expectations (on the bridge people expected that work in the pipe would be reported; if people started working in the pipe, they expected that the water pump on the bridge would not be activated). In order to work safely, this long chain had to function in its entirety, while there are clear possibilities for making this chain much shorter and therefore safer.

Furthermore, language and cultural differences on board can make agreements like these even more susceptible to mistakes. In a number of different ways, this agreement was susceptible to miscommunication: in the issuing of the instruction to the welders by the first officer and in passing on information to the bridge. Finally there was room for error in the note by the operating button for the water pump (forgetting to put the note by the button or leaving the note by the button for too long, et cetera).

The vulnerability of the selected method was reflected in this accident. After all, the welders started working in the loading pipe, while people on the bridge were not informed.

Actions by DHS following the accident

After the accident, in collaboration with Amsys, the operator started a review of the SMS. In the SMS, ship-specific agreements, such as agreements on entering the loading installation, have now been put down in writing. The intention is now that before starting work on board, crew members make a risk assessment and, based on the expected risk, take measures to minimise that risk. Exactly which measures the crew is required to take in respect of which working process is now described in the SMS.

The review of the SMS will no longer only be carried out by Amsys. A new ISM manager has now been appointed at the offices of DHS. The new SMS will be rolled out on all of the operated ships, with ship-specific amendments, wherever necessary.

In response to questioning, the operator announced that it would be making technical alterations to the vessel, as a result of the revision of the SMS system. In respect of procedures regarding the accident situation, the operator has taken the following measures. Now, before entering the loading pipe, crew members must follow the 'enclosed space' procedure. They are also required to place a flag which is visible from the bridge, as a visual indicator that people have entered the loading installation or sieving installation.

Design of the SMS

The design and updating of the ISM system was outsourced by DHS to Amsys, and Amsys was not aware of the ship-specific agreements on board the Scelveringhe. Although the SMS was approved by the auditor, the SMS contained not a single specific process in which the risks were mapped out, as a result of which none of the parties had made use of for example the occupational safety and health strategy, for further analysing the specific procedures.

Amsys had used a generic SMS to manage the risks on board the Scelveringhe. This is reflected in the layout and content of the SMS, which included the most commonly occurring activities on board ships, with the accompanying procedures, if required according to the ISM code. To develop a ship-specific SMS system, and to apply the occupational safety and health strategy, specific knowledge of the ship is required. Amsys and DHS are currently drawing up written versions of the ship-specific procedures which had already been agreed verbally, with a number of alterations.

The focus is on creating a written record of existing procedures with a number of improvements. The SMS will also include a written evaluation procedure that must be carried out by the crew members. Before work is carried out, a crew member will first be required to carry out a risk assessment. If the outcome of that assessment suggests unacceptable risks, it is up to the crew member himself to take measures to manage those risks.

Room for improvement

The operator expects the crew members to carry out a risk assessment before they carry out work on board, without this expectation having been described in specific measures in the SMS. This cannot form the basis for the tasks identified in the SMS. A last minute risk assessment before the start of work, such as that expected by the operator, can only be used by the crew member in question to assess whether the measures taken as described in the SMS offer sufficient safety.

What is still missing is a good risk assessment procedure. This consists of an inventory of the ship-specific processes and the related activities that represent a risk. For the high-risk tasks, it is important to map out who is exposed to these risks and what the consequences of those risks can be for those individuals. It is then important to consider what measures can be taken in accordance with the industry hygiene and safety strategy.

At present, in the review of the SMS following the accident, as yet, consideration has not been given to implementing measures at source and collective measures. Thought is being given to effective measures such as technical alterations to interrupt the fuel supply to the water pump. Only by systematically analysing the risks and the related management measures, measures can be taken that go beyond what a crew member can achieve with a last minute risk assessment. The first step is to try and identify the measures to be taken at the highest level of the occupational safety and health strategy.

It is therefore recommended that the risk assessment be brought forward in the improvement process. In other words, in consultation with the crew members who carry out the risk assessment and take suitable measures in accordance with the industry hygiene and safety strategy. This should then be documented in the SMS so that when carrying out work on board, every crew member knows what further measures he or she should take (for example technical measures and personal protective equipment).

5 CONCLUSIONS

How could the accident happen?

The victim was found dead in the hold of the ship, after he had been washed out of the loading pipe of the loading installation when the water pump pumped additional ballast water into the hold.

For unexplained reasons, the victim decided to carry out work inside the loading pipe of the loading installation, together with a second welder, while the crew members on the bridge were not informed.

The installation was not secured against switching on during work in the loading pipe, as a result of which it could be switched on while crew members were welding in the loading pipe.

How were the risks associated with this type of accident identified and managed?

The crew who had identified the risks of working in the loading pipe relied on their own agreements, which were not designed according to an occupational safety and health strategy, and were not included in the SMS. The agreements were not examined for shortcomings, and were insufficiently guaranteed, so that it was possible for work to be carried out in the loading pipe without the bridge having been informed.

The SMS on board the Scelveringhe satisfied the statutory requirements. The ISM code however prescribes a generic system that is applicable to general work on board ships. A generic SMS does not consider specific tasks on board a trailing suction hopper dredger in general, and this trailing suction hopper dredger in particular. As a result, the SMS only made a limited contribution to safe working and a safe working environment on board the ship.

6 LESSONS

The Dutch Safety Board has drawn the following lessons.

To parties required to operate a safety management system

1. A safety management system can only make an active contribution to increasing or guaranteeing safety if it ties in with the practice on board the type of vessel for which it is intended.
2. The operator of a ship must supplement a safety management system that is based on standard shipping operations, in according with the minimum requirements of the ISO code, with ship-specific risks. Subsequently, in respect of those supplementary risks, an occupational safety and health strategy can serve as a guideline for correctly adapting procedures for ship-specific risks.
3. Safety awareness on board must be of a sufficiently high level so that crew members recognise written and agreed procedures as essential, and act accordingly.

APPENDIX A

Vessel data	Scelveringhe
Photo:	
Call sign:	PGAA
IMO number:	9285366
Flag state:	Netherlands
Home port:	Yerseke
Type of ship:	Trailing suction hopper dredger
Classification society:	Lloyd’s Register >P100 AI ‘dredger’, ri1LMC, UMS, self-discharging sand dredger
Year of construction:	2004
Shipyard:	Vard RO Offshore Braila SA
Length overall (Loa):	116.83 m.
Length between perpendiculars (Lpp):	110.44 m.
Breadth:	18.60 m.
Actual draft:	6.40 m.
Gross Tonnage:	5116
Engines:	MAK diesel engine, type 9M32C, power 4,320 kW, Flender reduction gearbox, type GRCA759, reduction 600:178
Propulsion:	1 propeller, 1 thruster
Maximum propulsion capacity:	4320 kW
Vessel’s certificates:	All valid

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