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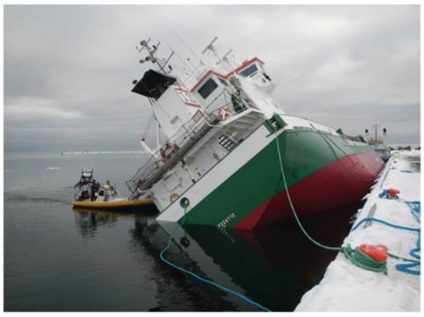
Swedish Accident Investigation Authority



Final Report RS 2017:04e

PHOENIX II/TERNVAG – Near collision in Gothenburg's archipelago on 14 July 2016

Reference no. S-116/16

5 July 2017

SHK investigates accidents and incidents from a safety perspective. Its investigations are aimed at preventing a similar event from occurring in the future, or limiting the effects of such an event. The investigations do not deal with issues of guilt, blame or liability for damages.

The report is also available on SHK´s web site: www.havkom.se

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General points of departure and limitations

The Swedish Accident Investigation Authority (Statens haverikommission, SHK) is a central government authority with the task of investigating accidents and incidents with the aim of improving safety. SHK accident investigations aim to, as far as possible, determine both the sequence of events and the cause of the events, along with the damage and effects in general. An investigation shall provide the basis for decisions which are aimed at preventing similar events from happening in the future, or to limit the effects of such an event. At the same time the investigation provides a basis for an assessment of the operations performed by the public emergency services in connection with the event and, if there is a need for them, improvements to the emergency services.

SHK accident investigations thus aim to answer three questions: *What happened? Why did this happen? How can a similar event be avoided in future?*

SHK does not have any inspection remit, nor is it any part of its task to apportion blame or liability concerning damages. This means that issues concerning liability are neither investigated nor described in association with its investigations. Issues concerning blame, responsibility and damages are dealt with by the judicial system or, for example, by insurance companies.

Furthermore, SHK's remit does not include, aside from that part of the investigation that concerns the rescue operation, an investigation into how people transported to hospital have been treated there. Nor does it include public actions in the form of social care or crisis management after the event.

The investigation

SHK was informed on 14 July 2016 that a near collision had occurred between the vessels PHOENIX II – TERNVAG. The incident has been investigated by SHK, which has been represented by Mr Mikael Karanikas, Chair, Mr Rikard Sahl, investigator in charge, Mr Dennis Dahlberg, operations investigator and Mr Alexander Hurtig, behavioural sciences investigator.

SHK has been assisted by Magnic AB, as audio experts with respect to VDR[1] recordings.

Mr Patrik Jönsson has participated as coordinator for the Swedish Transport Agency.

Mr Ulf Holmgren has participated as coordinator for the Swedish Maritime Administration.

[1] VDR – Voyage data recorder.

Investigation material

Interviews have been conducted with the concerned crew members from both vessels, the pilot, the VTS [2] operator and the person responsible for VTS operations. In addition, there have been conversations and correspondence with both shipping companies' safety departments and representatives of both the Swedish Pilots' Association and the Swedish Maritime Administration. SHK has followed a pilotage operation in the pilotage area in question. Both vessels have been visited and the VDR recordings from the vessels has been obtained by SHK.

A meeting of the interested parties was held on 22 March 2017. At the meeting, SHK presented the facts discovered during the investigation that were available at the time.

[2] VTS – Vessel Traffic Service.

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Information about the incident	
Type of incident	Near-miss to a very serious accident.
Date and time	14 July 2016 02:10
Position and site of the incident	57° 36´N 011° 40´E
Weather	South-westerly wind 10 m/s, good visibility, significant wave height ca. 1.1 m.
Other circumstances	In conjunction with the pilot disembarking.
Consequences	
Injuries to persons	None
Environment	None
Vessel	None

Ship particulars – vessel 1	
Vessel´s name	PHOENIX II
Flag state/register of shipping	Portugal
Identity	
IMO number/call sign	9186405 / CQCR
Vessel data	
Type of vessel	Container
Yard/year of build	JJ Sietas schiffswerft, Hamburg / 1998
Gross tonnage	5,056
Length overall	118.25 metres
Beam	18.16 metres
Draft, max.	7.10 metres
Deadweight at max. draft	6,859 mt
Main engine, output	5,760 kW
Propulsion system	One pitch propeller
Lateral propeller	One bow propeller 550 kW.
Rudder system	Becker flap rudder
Service speed	17 knots
Registered owner and manager	Bovicom (owner), Peter Döhle Schiffahrts-kg (ISM management)
Classification society	RINA

Voyage particulars	
Ports of call	Gothenburg - Gdansk
Type of voyage	Normal sea voyage
Cargo information	Ballast voyage
Crew	11


Figure 1. M/S PHOENIX II. Photo: Swedish Armed Forces.

Figure 2. M/T TERNVAG. Photo: Terntank ship management AB.

Ship particulars – vessel 2	
Vessel´s name	TERNVAG
Flag state/register of shipping	Denmark
Identity	
IMO number/call sign	9277371 / OWIP2
Vessel data	
Type of vessel	Chemical tanker
Yard/year of build	Edward shipyard, Shanghai / 2003
Gross tonnage	9,993
Length overall	141.2 metres
Beam	21.94 metres
Draft, max.	9.0 metres
Deadweight at max. draft	14,796 mt
Main engine, output	6,300 kW
Propulsion system	One pitch propeller
Lateral propeller	One bow propeller 800 kW.
Rudder system	Shilling rudder
Service speed	15 knots
Registered owner and manager	Terntank Ship Management AB
Classification society	DNV GL

Voyage particulars	
Ports of call	Gävle - Gothenburg
Type of voyage	Normal sea voyage
Cargo information	Ballast voyage
Crew	13

SUMMARY

During a pilot transfer between the container vessel PHOENIX II and the tanker TERNVAG in Gothenburg's pilot area, the vessels came to pass each other in a short distance and in an unplanned manner. When the incident occurred, the Masters of PHOENIX II and TERNVAG were both alone on the bridge because the lookout and the officer on duty had left the bridge before disembarking respectively embarking of the pilot. The agreed passage plan was not followed because the master of PHOENIX II was surprised by TERNVAG was passing the pilot boarding position and he perceived that the margins for the planned port-to-port meeting were too short. The master aboard TERNVAG, who did not understand PHOENIX II intentions, initiated full astern with the engine and PHOENIX II passed a short distance ahead of the tanker.

The incident was caused by shortcomings in the planning of the vessels route when passing each other in conjunction with the debarkation of the pilot, which led to an excessively small margin of safety.

Contributory causes were probably the insufficient manning of the vessels’ bridges, combined with the VTS not having informed the tanker about, and that she had passed the boarding position.

Safety recommendations

In view of the action taken by the Swedish Maritime Administration and Terntank Ship Management AB, SHK finds no reason to address any recommendations to them.

Peter Döhle Group is recommended to:

- Consider developing its ISM manual, primarily with respect to bridge manning during embarkation and disembarkation of pilots. See section 3.3. *(RS 2017:04 R1)*

1. FACTUAL INFORMATION

1.1 Sequence of events

The container vessel PHOENIX II departed Skandiahamnen in Gothenburg with a pilot on board at 01:00 hours on 14 July 2016, bound for Gdansk in Poland. At that same time, the tanker TERNVAG was on her way from Gävle towards Gothenburg in ballast condition. The cargo tanks were not empty of gas and there was no inert gas system[3] on board. The vessels met in a close-quarter situation in conjunction with the time when the pilot was to transfer from the outgoing to the incoming vessel. PHOENIX II passed ca. 100 m fore of the stem of TERNVAG, which had engaged full astern at the same time.

1.1.1 Background

TERNVAG had ordered a pilot at boarding point 1 for the fairway in towards Skarvikshamnen in Gothenburg and both vessels were estimated to arrive at around the same time in the area around the light buoy Sänkberget, where the compulsory pilotage line is located. This means that it was planned in advance that the pilot who was to pilot out PHOENIX II to Sänkberget would also pilot TERNAG in to Skarvikshamnen, a fact of which both the VTS operator and the master of TERNVAG were aware. The pilotage distance between Skandiahamnen and Sänkberget is 8 M[4].

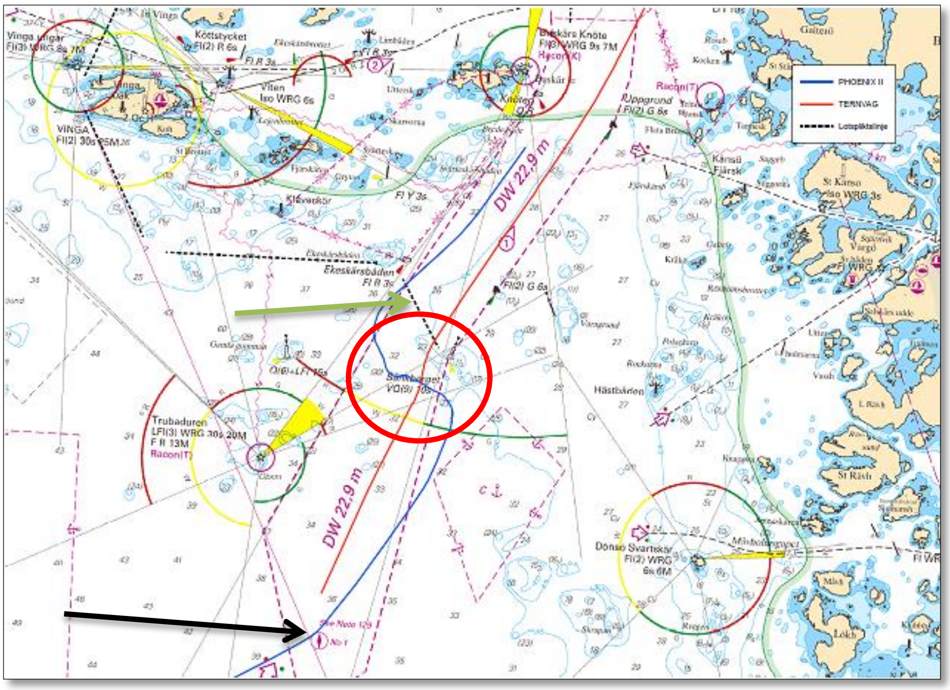

Figure 3. Excerpt from the chart showing AIS tracks, the blue track is PHOENIX II, the red TERNVAG. The location of the occurrence is circled. Compulsory pilotage lines (green arrow), boarding position (black arrow) south Trubaduren and anchorages area also shown. Image: Swedish Maritime Administration no.: 10-01518.

[3] Inert gas works by diluting the air and thus reducing the oxygen content of the cargo tanks from the normal 20.9 % to less than 8 %, thus minimising the risk of an explosion.
[4]M – Nautical mile = 1,852 metres.

1.1.2 *The pilotage of PHOENIX II*

At the time of departure, the bridge was manned by the pilot and the master. The vessel’s second officer was on the mooring deck (forecastle) at the time of departure. Once the master has manoeuvred PHOENIX II out from the quay, the second officer came up to the bridge and the pilot took over operation of the vessel. Prior to this, the master had, according to an interview with the pilot, described to him that when changing heading, you only needed to turn a knob in order to change the heading in the autopilot (automatic steering) and that it was not necessary to press the knob down in order to confirm the heading. The pilot was somewhat doubtful of this information based on his experience of automatic steering systems and at the first change of heading the pilot performed, the vessel failed to turn when he turned the knob. The pilot was mentally prepared for this so he pressed down the knob and the vessel began to turn. The pilot pointed this out to the master. The second officer then confirmed that the knob must be pressed down in order for the change in heading to be activated.

The pilotage was otherwise perceived by both the master and the pilot as completely normal. When the vessel passed the light buoy Ekeskärsbåden and the compulsory pilotage line, the master, on the advice of the pilot, began reducing speed prior to the pilot’s disembarkation. Just after 02:06, the pilot called up TERNVAG on the traffic area’s VHF working channel 13. The call took place in English as follows:

- *TERNVAG, TERNVAG - PHOENIX II (pilot)*
- *PHOENIX II – TERNVAG. Good morning (master TERNVAG)*
- *Good morning, we are just to be leave pilot, we will change our course a bit to port, to south easterly course to make lee and then we go back to southerly course and I will board you as soon as I am of this ship. (pilot)*
- *Very good, you are welcome. We are keeping quite slow here so we stay on this heading and you are welcome. (master TERNVAG)*
- *Thank you.(pilot)*

It appears from the VDR recording that at 02:07, following the VHF call, the pilot instructed the master on board PHOENIX II as follows:

- *Well captain, we are proceeding on 9 knots, 9 knots it should be, and you change course to 156°. I will go down. All the best, bye bye. (pilot)*
- *Yes, thank you. (master)*

After this, the pilot left the bridge with the second officer in order to go down to the pilot ladder where the able seaman (the lookout) had already rigged the pilot ladder. The vessel was being steered using the autopilot when the pilot left the bridge. The master was then alone on the bridge and states that he went out onto the port bridge wing in order to monitor the pilot's disembarkation. The vessel's position at this point is marked on Figure 4.

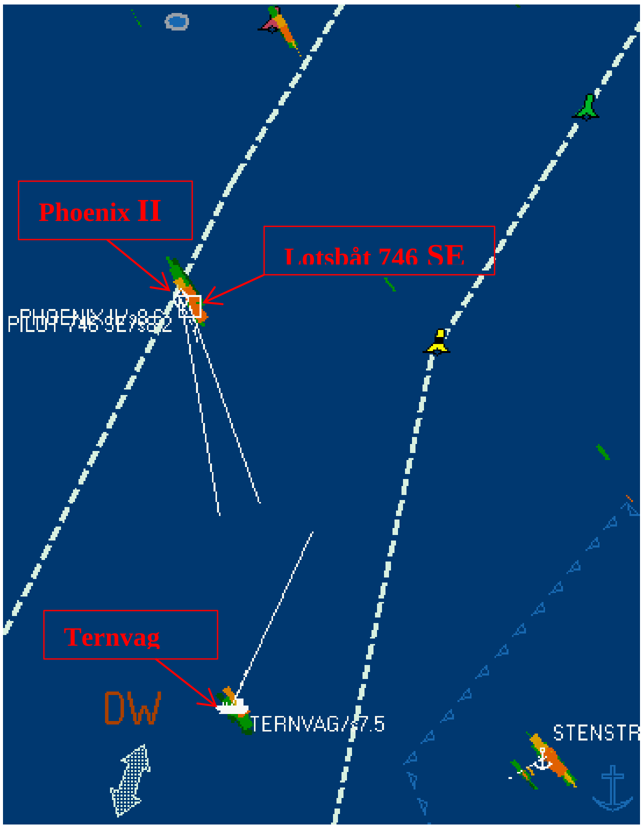

Figure 4. The position of the vessels and pilot boat with 3-minute vectors at 02:08, when the pilot disembarks.

Accordingly, the predetermined plan based on the call between the vessels, which has been confirmed by the interviews SHK has conducted, was for PHOENIX II to turn to port to heading 156° in conjunction with the pilot disembarking, before turning to starboard to a southerly heading in order to then meet TERNVAG port to port.

In interviews, the master of PHOENIX II has stated that he has understood that TERNVAG was to wait at the pilot boarding point, marked on the chart, just over 1 M to the south. According to his understanding, that would mean there would be no problems meeting port to port.

In interviews, the master of TERNVAG has stated that PHOENIX II was somewhat delayed, which meant that he kept somewhat to starboard in the fairway and altered the speed so that the pilot would be able to board outside of the compulsory pilotage line, but after having passed the pilot boarding point. He saw that PHOENIX II was reducing speed and turning to port and then the pilot left the vessel. When the pilot boat left PHOENIX II, he saw that both masthead lights on PHOENIX II were even and that the vessel was therefore headed directly for TERNVAG. The master felt that both the situation and the distance as normal in this stage. The master of TERNVAG was also alone on the bridge at this stage as both the officer on the watch and the lookout were down by the pilot ladder in order to prepare to receive the pilot.

1.1.3 *Following the pilot's disembarkation*

When the pilot had disembarked and came on board the pilot boat (Figure 5), PHOENIX II's heading was 150° and the distance between the vessels was 0.5 M, which is equivalent to ca. 925 m. The master has stated that he returned to the conning position[5] on the centre line and changed heading to starboard, but that the turn was slow.

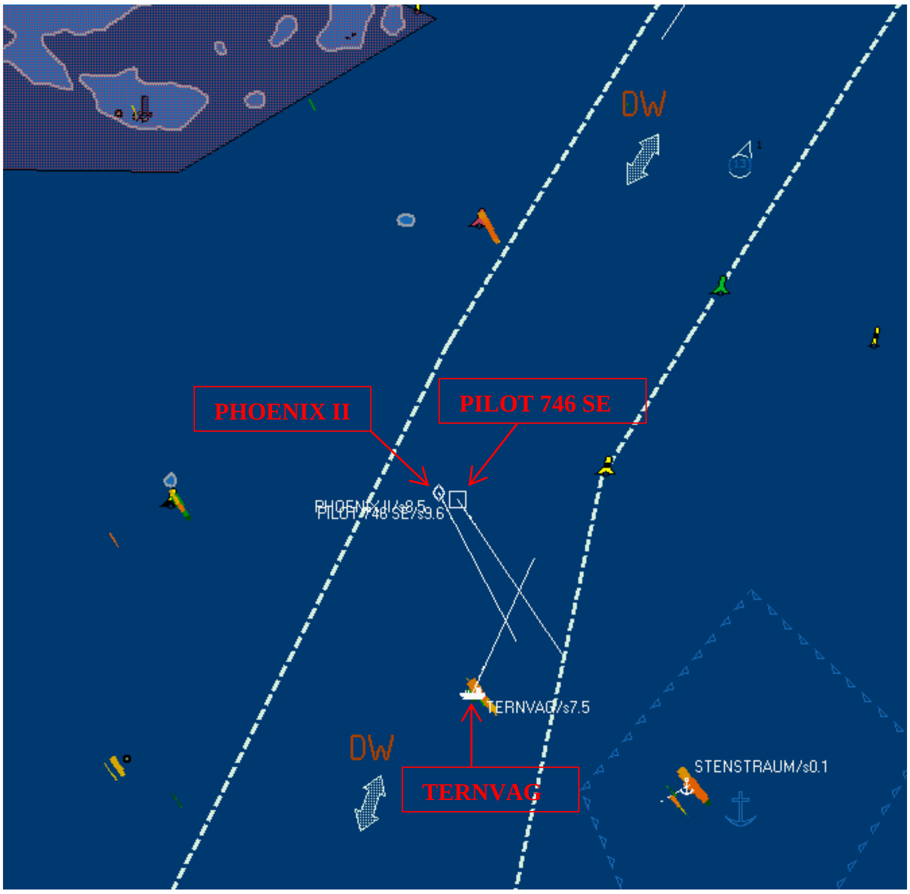

Figure 5. The vessels position, heading and speed at 02:09 when the pilot has disembarked. PHOENIX II is making 8.5 knots and is the left-had vector. The vector to the right of PHOENIX II is that of the pilot boat. TERNVAG is making a speed of 7.5 knots. The length of the vectors is equivalent to 3 minutes running time for each vessel.

At 02:10, TERNVAG called the pilot boat on VHF:

- *PILOT BOAT, TERNVAG (master TERNVAG)*
- *Yes, come back. (pilot boat)*
- *As soon as I am clear of PHOENIX here I will come a little to port in order to get on the leeward side. (master TERNVAG)*
- *Yes, that's fine. (pilot boat)*
- *He has not come back to his heading yet. We have to wait a little. (master TERNVAG)*

[5]The conning position is the central navigator's places.

When the pilot came on board the pilot boat at 02:11, he called PHOENIX II.

- *PHOENIX II, PILOT BOAT Channel 13 (pilot)*
- *Phoenix II reply (master PHOENIX II)*
- *Yes good morning again captain this is the pilot. Do you come back to southerly course now? (pilot)*
- *Yes I will go back but I am very close here to the other vessel I will just turn around. (master PHOENIX II)*
- *Yes, that's my point you are getting very close so you should go starboard now. (pilot)*
- Silence from the master for about 5 seconds. *Yes, I will do that, one moment I will just go ahead a little bit and then I turn to the south. (master PHOENIX II)*
- *Yes, but you plan to go astern of TERNVAG, astern of TERNVAG, correct? (pilot)*
- *That's correct. (master PHOENIX II). [This is not heard on the VHF channel, but is heard on PHOENIX II's VDR*.]

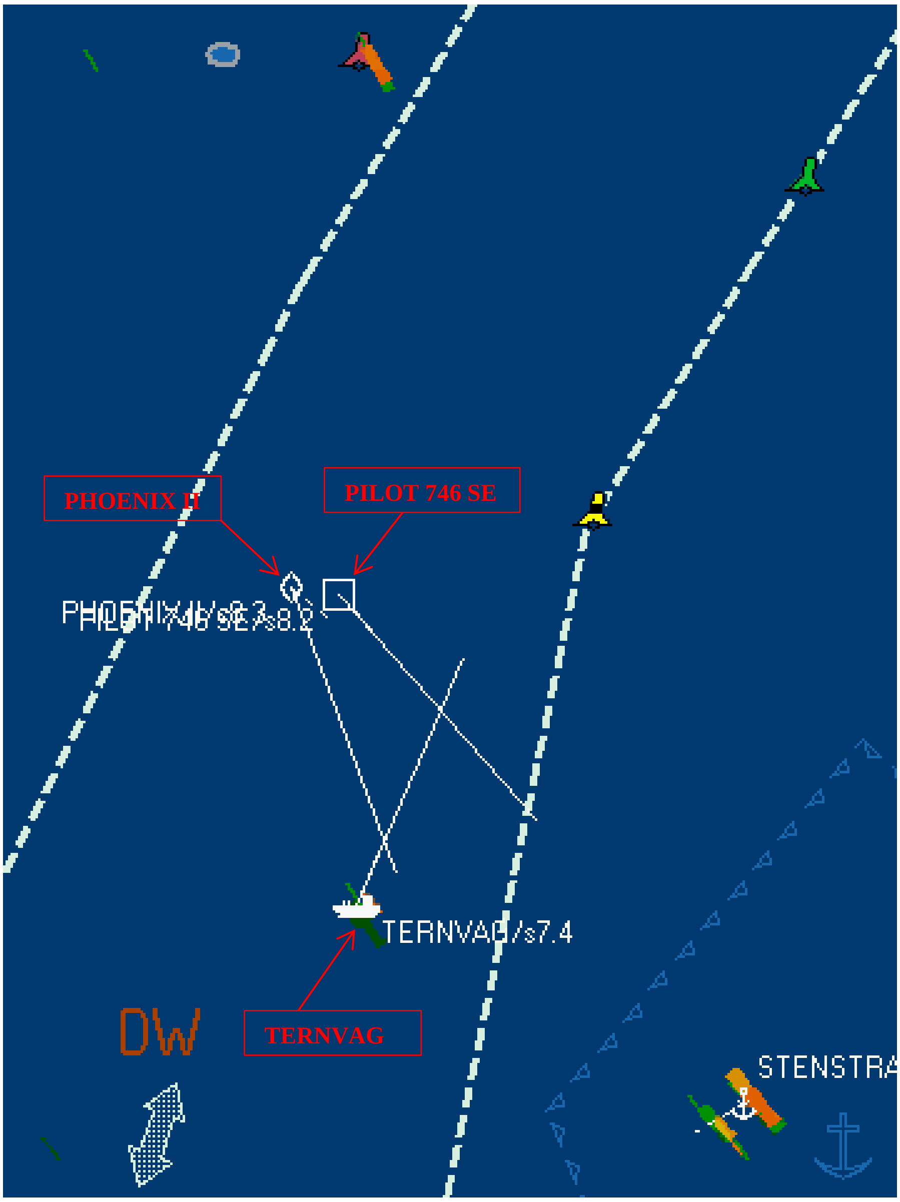

Figure 6. The vessels' positions, headings and speed at 02:11, when the pilot calls PHOENIX II from the pilot boat.

The radar recording from the VTS shows that PHOENIX II initially turned a little to starboard after the pilot had disembarked. However, the vessel's VDR does not show any starboard turn. According to the master of PHOENIX II, he perceived the proximity situation with TERNVAG as critical and decided to turn to port instead at the same time as he increased the speed somewhat. The reason why he changed his mind and chose a starboard to starboard meeting instead was that TERNVAG was approaching faster than he had expected and that the pilot's disembarkation took longer than he had anticipated.

The master on board TERNVAG, who also was alone on the bridge, noticed that PHOENIX II was turning to port, which he had not been expecting. At this time, the speed was adapted for pilot embarkation (7.4 knots). He switched over to manual steering and started the bow for preventive purposes and the situation was perceived to be critical, with a risk of collision. According to TERNVAG's VDR, the engine was set to full astern at 02:11:32. In addition, the bow propeller was driven full to port in order to counteract the vessel's natural turn to starboard due to the propellers' turning moment.

Around 30 seconds later, the pilot boat contacted TERNVAG in Swedish, who then announced that TERNVAG's engine was set to full astern.

Immediately after this call, the pilot called PHOENIX II and asked:

- *Are you planning to go ahead of TERNVAG?*

After nine seconds of silence, PHOENIX II responded:

- *One moment.*

At the same time, the second officer arrived on the bridge of PHOENIX II. On the VDR recording, the master is heard saying "*take the rudder*" to the second officer. The time was then 02:12:30.

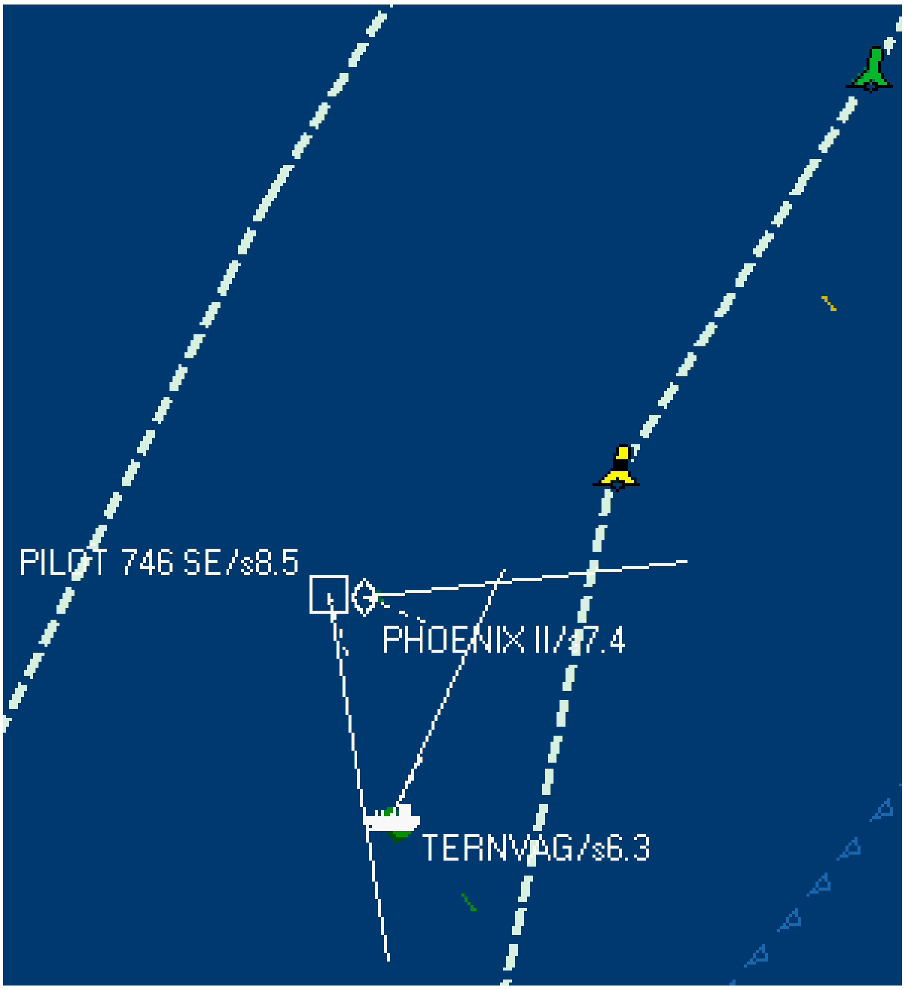

Figure 7. The vessels' positions, headings and speed at 02:12:30, when the pilot calls PHOENIX II from the pilot boat. TERNVAG has its engine set to full astern and PHOENIX II has turned heavy to port.

At this stage, another vessel in the traffic area, STENA JUTLANDICA, calls VTS Gothenburg on VHF channel 13. The VTS operator responds immediately:

- *STENA JUTLANDICA, please stand by!*

As the VTS operator does not want to have disrupting VHF traffic during the ongoing proximity situation, he asks other radio traffic to stand by, which was also repeated and complied with by STENA JUTLANDICA.

TERNVAG continued running its engine full astern and the bow propeller full to port at the same time as PHOENIX II increased speed somewhat and passed just ahead of TERNVAG. Several of those involved thought that the vessels would collide and the minimum distance between the vessels was estimated at ca. 100 m. The master on board PHOENIX II subsequently ordered the second officer to turn hard to starboard and the vessel then turned south and continued its voyage towards Gdansk.

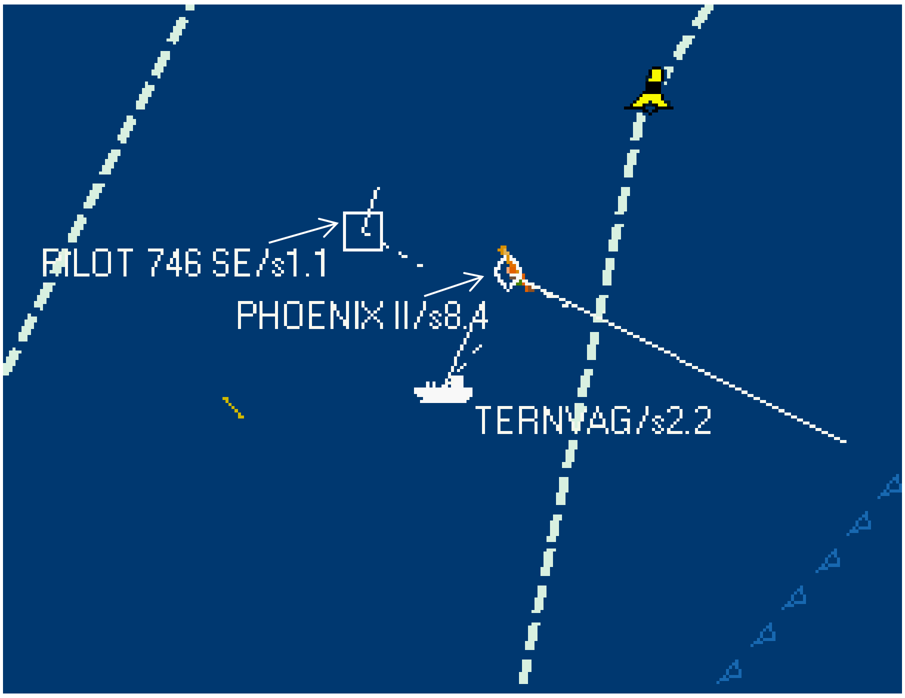

Figure 8. The vessels' position, heading and speed at 02:14.

VTS Gothenburg then called TERNVAG and asked in English if everything was OK and if the vessels were clear of each other. TERNVAG also responded in English:

> *"Yes, we went clear. I had full astern, otherwise I don't know what would happened." and "Yes we are clear but I don't understand his manoeuvre."*

The pilot embarked TERNVAG, which continued her voyage in towards Skarvikshamnen, Gothenburg.

The master of PHOENIX II has retrospectively stated that it would have been better if he had waited a few more minutes with the pilot's disembarkation and turned astern of TERNVAG. He could have contributed to this himself in his communication with the pilot. In addition, he felt alone on the bridge and realised that the presence of another officer on the bridge in this critical situation would have been helpful.

1.2 Location of the occurrence

The incident occurred in the outer reaches of Gothenburg's archipelago, just outside of the area in which pilotage is compulsory, a few hundred metres to the south-west of the buoy Sänkberget (Figure 9). Both vessels were subject to compulsory pilotage in the fairway in towards Gothenburg. This location is within Gothenburg's VTS area.

In 2016, the number of pilotage operations in Gothenburg was 5,467. In addition, there are a large number of pilotage operations in which the master has a pilotage exemption and pilots their vessel in the fairway themselves. The Port of Gothenburg is the largest port in the Nordic countries. The fairways are used by ca. 15,500 large merchant vessels each year, which are either passing or calling at the port. The Port of Gothenburg's figures also include all the vessel movements within the port area by smaller vessels and boats such as local water-borne passenger transport, sightseeing boats, fishing boats, tugboats, working boats and recreational boats.

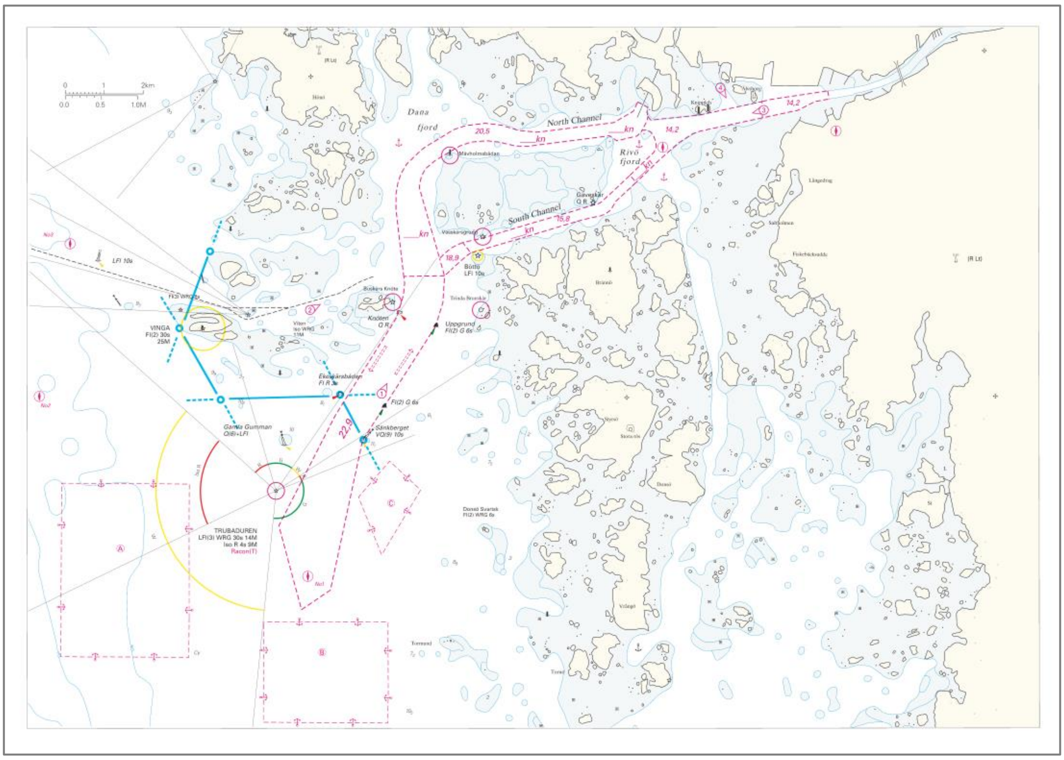

Figure 9. Excerpt from a chart showing the main fairways, report points, compulsory pilotage lines (blue lines), boarding position south Trubaduren and anchorages. The incident occurred just south-west of Sänkberget and outside of the compulsory pilotage line. Image: Swedish Maritime Administration no.: 10-01518.

1.3 PHOENIX II

1.3.1 General

The vessel is a container vessel with a single hull, ice class 1A, built in 1998 and registered in Portugal. The vessel has a high-performance Becker rudder with a flap on the stern edge of the rudder blade and one propeller with adjustable-pitch blades for propulsion. In addition, there is a bow propeller fore intended for manoeuvring to and from the quayside and at low speed. On the voyage in question, the vessel had no containers loaded on deck.

1.3.2 The bridge

The bridge was well equipped and of a cockpit model. The central part of the bridge was extended to the fore with a pulpit in the middle between the two navigation positions and with a good visual view ahead and to the sides. A rudder angle indicator was located in the centre of the ceiling. There were three different radar sets, two of which were of a recent model and were used daily (figure 10). Ahead of the centre console was a digital chart ECS[6]. Aft of the navigation positions was a chart table. Both bridge wings were suitably equipped for manoeuvring the vessel.

Figure 10. The bridge's navigation positions – PHOENIX II.

The centre console was equipped with VHF, manual steering on the port side of the console, override[7] on the starboard side of the console and centred automatic steering. All easily reachable from both navigation positions. The steering lever for the override steering was labelled with the text “Override”, but was otherwise identical to the manual steering level. In addition, there was also an alternative manual steering facility by the aft edge of the centre console that was intended for use in the event of there being a helmsman. To change heading using the automatic steering, you either set the desired heading with the round wheel and then press the same wheel down to initiate the turn or you press the round

[6] ECS – electronic chart system that cannot replace paper charts.
[7] Override – emergency steering intended for rapid evasive manoeuvres at sea.

wheel down and turn it to the desired heading and the vessel turns immediately (Figure 11).

The bridge wings were equipped with relevant aids for manoeuvring the vessel to and from the quayside, e.g. engine manoeuvre controls, VHF, manual steering and bow propeller controls. However, it was not possible to steer using the autopilot or switch over to autopilot from the bridge wing. Switch over from autopilot to manual steering was, as is normal, entirely possible from the bridge wings.

Figure 11. Centre console with manual steering facilities and automatic steering (red arrow).

1.3.3 The crew

The crew consisted of 11 men, three of whom were nautical officers including the master.

The master had been working at sea for 35 years, 16 of which as a master on various vessels of various sizes and operating areas. He had served for 19 years with the same shipping company and had a master mariner's qualification. On board PHOENIX II, he had been master for six months, following a short introductory period as first officer. At sea, the master took the 8–12 watch on the bridge.

1.3.4 *VDR – Voyage data recorder*

PHOENIX II was equipped with an S-VDR[8], the main purpose of which is to automatically record relevant data about the voyage in order to make inquiries and accident investigations easier. The vessel's S-VDR was of the Furuno VR-3000S model and was installed in 2007.

SHK has studied the information from PHOENIX II's S-VDR. With the assistance of a technician from the manufacturer, SHK have been able to remove information from the unit. Downloading the information required a specific piece of software and a connection using a FireWire interface. The time taken to do this by a trained technician was about 2 hours.

The quality of the sound recording from the bridge on the S-VDR was substandard. During the first of the two hours, there was a disruptive sound that made a satisfactory analysis of what was said on the bridge impossible. The quality was also insufficient during the remaining part of the time, with a low volume and dissonance. It was possible to improve some parts with the help of a sound expert. It was possible to obtain the other information required from an S-VDR.

A technician from the manufacturer services the vessel's S-VDR following in the occurrence and found dissonance in the sound recording on the bridge. The vessel's S-VDR had at that time been in service for nine years and over 8,000 hours. The technician was able to establish that the fault was with the S-VDR and not the microphones. He therefore reinstalled the sound card and replaced the recording medium. Following the service, the vessel's S-VDR worked as it should, with a good, clear sound. The latest annual check was conducted on 7 April 2016, just over three months prior to the occurrence. No faults with the vessel's S-VDR were detected during the check.

1.4 TERNVAG

1.4.1 *General*

The combined product and chemical tanker was built in Shanghai, China in 2003. The vessel has a high-performance Shilling rudder and one propeller with adjustable-pitch blades for propulsion. In addition, there is a bow propeller fore intended for manoeuvring to and from the quayside and at low speed. The vessel has both a double hull and a double bottom, which means that the ballast tanks (water tanks) surround the cargo hold both towards the outside and the bottom of the vessel. The cargo hold encompassed 14 different cargo tanks divided up into seven wing pairs with a loading capacity of 15,806 m^3 at a fill factor of 98 %. The bunker tanks were placed aft of the cargo hold.

The vessel was on a ballast voyage between Gävle and Gothenburg at the time of the occurrence. On her previous voyage she was loaded with RME (rapeseed oil fatty acid methyl esters) and gas oil. No ventilation

[8] S-VDR – simplified voyage data recorder.

was conducted following the cargo being unloaded in Gävle. All the pipes in question were drained and the tanks were super stripped so the final litres under the pump were also brought up. The starboard SLOP tank[9] was empty, but before it has contained sludge and bilge water. The port SLOP tank contained 17.5 m^3 of sludge from diesel and gas oil. There was no explosive residual cargo on board. RME has a flash point of 175° and should be protected from heat, according to the cargo documents. Gas oil has a flash point of over 60° and should be kept away from heat, sparks, naked flames and hot surfaces, according to the cargo documents. TERNVAG did not have an inert gas system on board and it did not need one according to the applicable regulations.

1.4.2 The bridge

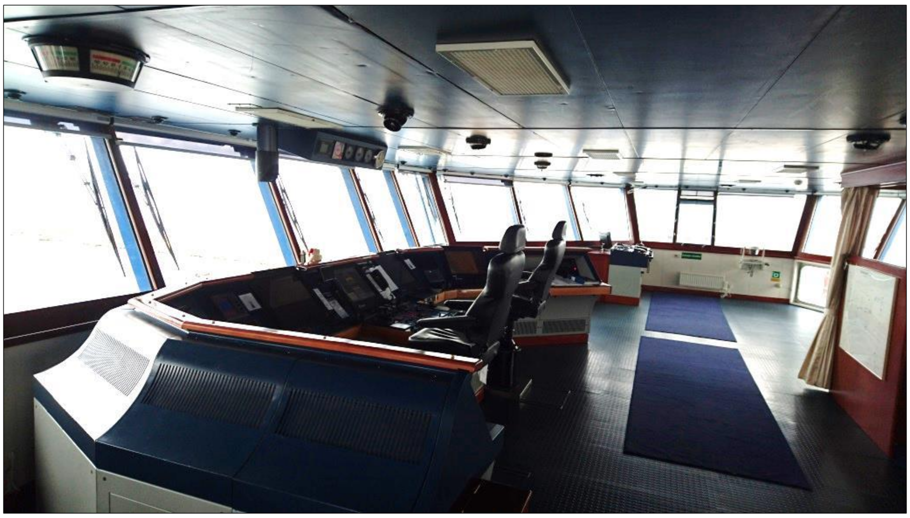

Figure 12. The bridge with navigation positions – TERNVAG.

The bridge was well equipped and of the cockpit model. There was a pulpit in the middle, between the two navigation positions, with a good view fore and to the sides. A rudder angle indicator was located on the ceiling. There were two different well-functioning radar sets. There was an ECDIS digital chart on the starboard side. Aft of the navigation positions was a chart table. Both bridge wings were suitably equipped for manoeuvring the vessel.

[9] SLOP tank – a tank specifically intended for collecting oil from the draining of tanks and cleaning of cargo tanks.


Figure 13. TERNVAG's centre console with manual steering facilities and automatic steering.

The centre console was equipped with VHF, a manoeuvring console for the engine and bow propeller, manual steering, override and automatic steering centred and easily reachable from the navigation positions. A conning display was located in front of the pulpit.

1.4.3 The crew

The crew consisted of 13 men, four of whom were nautical officers including the master, who was not watchgoing.

The master

The master had been working at sea for more than 40 years, during the last eight years as a master in the same shipping company. He had a master mariner's qualification and had served on board TERNVAG for the past six years.

1.4.4 VDR – Voyage data recorder

TERNVAG was equipped with a VDR, the main purpose of which is to automatically record relevant data about the voyage in order to make inquiries and accident investigations easier. SHK has obtained data from the vessel's VDR via the shipping company.

1.5 Vessel traffic service (VTS)

1.5.1 General

There are nine VTS areas in Sweden: Luleå, Öregrund, Stockholm, Landsort, Mälaren, Bråviken, Gothenburg, Marstrand and Lysekil.

The Swedish Transport Agency's regulations and general advice concerning vessel traffic services (TSFS 2009:56) applicable at the time of the occurrence indicates how vessels are to cooperate with the VTS.

More detailed provisions concerning the service and its content can be found in Section 6 of the aforementioned regulations.

> *Section 6 The service is provided to a vessel when it registers itself, at set times, as required or when the vessel requests it.*
>
> *The service is able to provide the vessel with information about:*
> *1. other vessels within the VTS area that may have an impact on its operation,*
> *2. errors or shortcomings in maritime safety devices or facilities,*
> *3. restrictions on navigability,*
> *4. weather and ice conditions,*
> *5. water level and other hydrological conditions,*
> *6. altered conditions for VHF communication, reporting points and other obligatory reporting procedures, and*
> *7. other circumstances that may be of significance to the safety of maritime traffic.*
>
> *When required for safety reasons, a certain vessel can be given warnings and advice of significance to its operation.*

The VTS regulations are primarily targeted at vessels that are users of the VTS service. According to the Transport Agency and the Swedish Maritime Administration, they do not have the authority to stipulate how the Maritime Administration's VTS operations are to be conducted in more detail.

The Maritime Administration is responsible for delivery of the VTS in Sweden and its VTS operational procedures (Version 11.0, dated 11 June 2015) describe how this is done in purely practical terms. This document states that the principal aim is to "provide shipping with relevant information so that those on board can make correct decisions at the right time in order to prevent grounding, collisions and environmental impact". Furthermore, it states that, when necessary, a certain vessel may receive warnings and advice and that communication is to take place in English (exceptions are only granted in exceptional circumstances). Under the heading "Deprecatory intervention", it is also stated that "the VTS operator must use all available means by which to prevent a suspected future grounding, collision or other hazard and, in the event of doubt, the VTS operator must regard the suspected situation as a coming certainty and act accordingly".

When developing the VTS operation, there has been a discussion within the Maritime Administration about how an intervention is to be implemented without disrupting operations on board or stealing the attention of the vessel's crew unnecessarily. The instructions are that in such situations, use can be made of what is known as a "blind call", i.e. a vessel is called by name and with a message (e.g. "you are heading for shallow waters") that does not require a response. Alternatively the operator can adapt their voice and tone to the situation (as an example, it states that a neutral tone is less likely to steal attention, while a more urgent or challenging tone can have the opposite effect).

As there is no authority to stipulate in more detail how the Maritime Administration's VTS operations are to be conducted, the Transport Agency and the Maritime Administration would like the division of responsibility between the authorities with respect to how the VTS is to be regulated. These authorities have jointly drawn up a proposal indicating what a national regulatory framework should look like, taking into account SOLAS Chapter V Rules 11 and 12, IMO Resolution A.857(20) Guidelines for Vessel Traffic Services and MSC.43(64) SRS-Ship Reporting System. It is planned that a request pertaining to this matter will be submitted to the Swedish Government by these authorities in summer 2017 for further preparatory work on this issue.

1.5.2 VTS Gothenburg

Because traffic in this area has to be informed about other traffic and activities in the area, all vessels with a gross tonnage greater than 300 are to report to VTS Gothenburg, which in turn responds to the call with current information.

On the way out of any of Gothenburg's ports, reporting is to take place prior to departure, at the time of departure and when passing Nya Älvsborg. Following this, the voyage continues in either the northern or the southern fairway until these converge at Vinga Sand, i.e. by Böttö. The compulsory pilotage line for outgoing traffic is the same as that for incoming traffic, i.e. between the buoys Ekeskärsbåden and Sänkberget. After that, the destination determines whether the vessel heads west, i.e. turns around Ekeskärsbåden or potentially Gamla Gumman, or south, proceeding to the east of Trubaduren down towards Vanguards Grund.

On the way in, reporting is to take place when the vessel enters the VTS area, which is defined as 6 M from Vinga. Boarding point 1, i.e. the pilot embarkation position in question, is marked in the chart north of anchorage B, but south of the light Trubaduren. The next reporting point for incoming traffic is just after passing Ekeskärsbåden. Once at Böttö, there is a choice between the north or the south fairway.

There are three different anchorages in the area around Trubaduren. At the time in question, there was one vessel anchored at anchorage C, which is the closest to the site of the occurrence.

VTS Gothenburg monitors the area using radar and has access to AIS[10]. The AIS tracks are recorded, together with the radio traffic that takes place in the VTS area. Radio communication within the VTS area is to be conducted in English on VHF channel 13[11]. Exemptions from the use of English are only permitted when there are specific grounds. The commu-

[10] AIS – automatic identification system – is a system that makes it possible to identify a vessel and track its movements.
[11] Between ships and VTS center and between ships and ships.

nication between the pilot and the pilot boat usually occurs on VHF channel 11[12].

The VTS centre in Gothenburg is physically co-located with both the port's monitoring centre (port control) and the pilot operators. In the event of bad weather, the VTS is provided with additional resources over and above the normal VTS crew in the form of a pilot, which is something the VTS operators consider to be positive.

VTS Gothenburg also holds annual joint workplace meetings with the pilots.

1.5.3 The VTS operator

The VTS operator obtained a master mariner's qualification in 2000 and then served as an officer on merchant vessels for 11 years. He had been serving as a VTS operator for four years within the Maritime Administration. At the time of the incident, he was the VTS operator on duty, together with a pilot operator and an on-duty port control operator. The VTS operator saw that TERNVAG was passing the pilot boarding point. He realised that a critical situation could arise when PHOENIX II had turned and steered directly towards TERNVAG. In conjunction with this, the pilot called PHOENIX II from the pilot boat, which meant that he chose not to join the conversation on VHF.

The incident was reported to Sweden Traffic[13] with the information that the VTS operator consciously avoided joining in with the radio traffic on VHF in order not to disrupt the conversation between the pilot and the two vessels in this critical situation.

1.6 Pilotage

1.6.1 General

Provisions concerning pilotage are mainly contained within the Transport Agency's regulations and general advice (TSFS 2013:38) on pilotage and the Maritime Administration's regulations (SJÖFS 2016:3) on the provision of pilots, ordering of pilots, assignment of pilots and pilot fees.

Somewhat simplified, the division of responsibility between these authorities can be described as that the Transport Agency decides which vessels and in which area a pilot is required (compulsory pilotage), while the Maritime Administration provides pilotage and determines the more detailed prerequisites for a vessel to obtain a pilot.

[12] See previously submitted recommendation to the Swedish Maritime Administration - KERTU - RS2016:10 R4

[13] Sweden Traffic is a function within the Maritime Administration that is tasked with coordinating maritime safety information, monitoring traffic separations systems, being a national node for the European reporting system SafeSeaNet, providing information to the general public in the event of emergencies and dealing with nautical error reporting in the fairway system.

According to Section 31 of SJÖFS 2016:3, the master is to make it possible for the pilot to embark and disembark the vessel at the boarding locations indicated in an appendix to the regulations or at a boarding location specifically indicated by the Maritime Administration.

The Maritime Administration employs approximately 200 pilots and around 33,000 pilotage operations are conducted each year. Thanks to the pilot's knowledge of the fairway and experience of manoeuvring many different types of vessel, they make a contribution to maritime and environmental safety and accessibility can be maintained when vessels travel through Swedish internal waters.

1.6.2 The pilot

The pilot has served as a pilot in Gothenburg for eight years. Before becoming a pilot, he had held posts including as a master and had been at sea for more than 15 years.

1.7 Incident reporting within the Swedish Maritime Administration

The Maritime Administration's incident report system is called PRIS[14]/ C2. This system gives all pilots and pilotage area heads, as well as the head of Business Area Pilotage and the process manager access to the reports. There are three types of report: accident, incident and safety failing. The latter is used to report "non-conformities on vessels in conjunction with pilotage" to the Transport Agency pursuant to Chapter 5, Section 16 of the Ship Safety Act (2003:364). When a pilot writes a report, it is automatically sent to the head of the pilotage area in which the pilot works. The pilot are also able to send the report to the colleagues by using distribution lists, either within the pilotage area or to all pilots in the entire country. The pilot cannot submit reports anonymously using this system. It is also possible to send these reports to external addresses that are pre-programmed for the Transport Administration and Sweden Traffic.

In the present case and in other occurrences in which pilots were involved, SHK has obtained the pilots' incident reports only after applying pressure, several weeks after the occurrence.

[14] PRIS – Pilot Report Incident System.

1.8 Meteorological information

Case S-116/16: incident between Phoenix II and Ternvag between 01:00 hrs and 02:30hrs local time, at Trubaduren, N37º 36,1 E011º 39,8

Overview
A low-pressure area covered Scandinavia. In the area concerned at Trubaduren, the wind was from SW and around 10 m/s, no rain and good visibility.

Observations from Vinga *N 57 37,94 E 011 36,46 2016-07-14*

Time/LT	Wind direction	Average wind Force at 10m height (m/s)	Maximum wind (m/s)	Visibility at 2m height (M)	Rain
2016-07-14 01:00	SV	9,7	11,9	10,5	0
2016-07-14 02:00	SV	10,4	12,0	8,4	0
2016-07-14 03:00	SV	9,6	11,9	9,4	0

1.9 Relevant regulations

1.9.1 Navigation rules

Applicable navigation rules can be found in the Transport Agency's regulations and general advice (TSFS 2009:44) on navigation rules. Those that are relevant to this occurrence include Rule 2, which states that nothing exempts the master or the crew from their responsibility for having neglected to take precautionary action that is considered to constitute good seamanship. In addition, Rule 7 (Risk of collision) states that in the event of the smallest amount of uncertainty as to whether there is a risk of collision, such a risk is considered to exist and all available means shall be used at an early stage to determine whether there is a risk of collision.

In addition, the following rules are of significance to the occurrence.

Rule 5 – Lookout

> *On vessels, constant careful lookout is to be kept using sight, hearing and all other available means appropriate to the prevailing circumstances and conditions so that it is possible to make a full appraisal of the situation and the risk of collision.*

Rule 8 – Action to avoid collision

a. *All action to avoid collision is to be taken in accordance with the rules in this chapter and must, when the circumstances so allow, be taken determinedly, in good time and with careful observance of the rules of good seamanship.*

b. *All changes of heading and/or speed made in order to avoid collision are, when the circumstances so allow, be so great that they are easy for another vessel to detect visually or by means of radar; repeated small changes of heading and/or speed should be avoided.*

c. *If there is sufficient free water, a change of heading only may be the most effective course of action in order to avoid a proximity situation, provided that the change in heading is made in good time, is substantial and does not lead to another proximity situation.*

d. *Action that is taken in order to avoid a collision with another vessel is to be such that is leads to passage at a safe distance. The effect of the action is to be carefully monitored until such time as the other vessel has passed completely and is clear.*

e. *If required in order to avoid collision or to gain more time to assess the situation, a vessel is to reduce speed or come to a complete stop by stopping the means of propulsion or engaging astern.*

Rule 15 – Crossing situation

When two engine-driven vessels are crossing so as to involve a risk of collision, the vessel that has the other on her own starboard side shall give way and shall, if the prevailing circumstances so allow, avoid crossing ahead of the other vessel.

Rule 16 – Action by give-way vessel

A vessel that is obliged to give way to another vessel shall, as far as is possible, take substantial action in good time in order to keep well clear.

Rule 17 – Action by stand-on vessel

a. 1) When one of the two vessels is obliged to give way, the other shall maintain her course and speed.

2) The latter vessel may, however, take action in order to avoid a collision by manoeuvring as soon as it is clear that the give-way vessel is not taking appropriate action in accordance with these rules.

b. When, for whatever reason, the stand-on vessel comes so close that a collision cannot be avoided simply through the action of the give-way vessel alone, the stand-on vessel shall take such action as is most likely to lead to the avoidance of a collision.

c. A engine-driven vessel that takes action in a crossing situation in accordance with a 2 in order to avoid collision with another engine-

driven vessel shall, if the circumstances allow, not alter course to port for a vessel on her own port side.

d. This rule does not relieve the give-way vessel of her obligation to give way.

1.9.2 Pilot boarding point

According to Annex 2 to IMO Resolution A.960 *Recommendations on training and certification and operational procedures for maritime pilots other than deep-sea pilots*, the authority that is responsible for pilotage is to determine and give notice of positions for safe embarkation and disembarkation. The pilot's boarding position should be a sufficient distance from the beginning of the pilotage operation so as to ensure safe boarding conditions and provide sufficient time and space in order to comply with the requirements for information exchange between the master and the pilot.

1.9.3 Rules for rigging and manning pilot ladders

Pursuant to Chapter 4, Section 2 of the Transport Agency's regulations and general advice (TSFS 2009:38) on pilotage, the master, when a pilot embarks or disembarks from a vessel, is to take such action as is necessary to minimise the risks associated with embarkation or disembarkation.

Pursuant to SOLAS, Chapter V, Regulation 23, the rigging of pilot ladders, disembarkation and embarkation are to take place under the supervision of a responsible officer who is in communication with the bridge. In addition, a responsible officer is to escort the pilot to and from the bridge.

According to the Maritime Administration, all vessels that make use of the Maritime Administration's pilotage service are to rig the pilot ladder, see appendix 1, strictly in accordance with the provisions of SOLAS and the International Maritime Pilots' Association. This means that when the freeboard is in excess of 9 metres, an accommodation ladder is to be rigged. According to the Maritime Administration's local website for Gothenburg's pilotage area, vessels are to maintain a speed of ca. 8 knots and arrange a good lee during the boarding operation. The pilot ladder is rigged such that its lower part is 2 metres above the surface of the water. In winter, when the ice situation means that smaller pilot boats must be used, the appropriate height may be 1.5 metres.

1.9.4 Rules for manning of the bridge etc.

General

STCW – International Convention on Standards of Training**,** Certification and Watchkeeping contains both rules and recommendation concerning maritime safety. Section A-VIII/2, concerning the master and deck section sets out the basic principles that are to be observed with respect to watchkeeping, covering such matters as watch arrangements, suitability for the post, navigation, navigation equipment, the navigator's duties and responsibilities, lookout, navigation with a pilot on board and protection of the marine environment.

The composition of the bridge watch

It is stated that the composition of the bridge watch is always to be suitable for purpose and adapted to the prevailing conditions and circumstances. The watch on the bridge is to encompass an appropriate number of deck personnel. When making decisions concerning the composition of the watch on the bridge, factors including the weather conditions, the visibility and whether it is daylight or dark and the proximity of hazards to navigation that may make it necessary for the officer of the watch to carry out additional navigational duties are to be taken into account.

Navigation with a pilot on board

Regardless of the duties and obligations a pilot has, their presence on board should never mean that the master or officer of the watch is relieved of their responsibility and obligations with respect to the safety of the vessel. The master and the pilot are to exchange information about navigational procedures, local conditions and the vessel's characteristics. The master or the officer on the watch is to collaborate closely with the pilot and maintain careful control of the vessel's position and movements.

The officer on the watch should ensure that the pilot is continually informed about forthcoming actions. If the officer on the watch has doubts about the pilot's actions or intentions, they are to request an explanation from the pilot. If the doubt persists, the master is to be informed immediately. Necessary action is to then be taken while waiting for the master to arrive.

1.9.5 Ship-to-ship communication

According to Section 9 of the Transport Agency's regulations and general advice (TSFS 2011:2) concerning navigation safety and navigation equipment, the English language is to be used on all vessels on international voyages in safety communications between vessels and between vessels and the shore. The same applies to on-board communication between pilots and watch personnel, provided those directly involved do not have a common language other than English. With regard to language in radio traffic in VTS operations, please refer to section 1.5.2.

According to the Transport Agency’s general advice to the same paragraph, the phrases in IMO Resolution A.918(22) are to be used[15]. According to this resolution, yes and no question from the sender are to be responded to with a clear “yes” or “no”, followed by a repetition of the phrase in question. Furthermore, ambiguous word, synonyms and abbreviations should be avoided.

1.9.6 Rules applicable to VDR

PHOENIX II was equipped with an S-VDR (simplified voyage data recorder), which is a voyage data recorder system for managing and storing information about various parts of a vessel’s equipment. The purpose of a VDR is to provide information in the event of an accident investigation.[16] An S-VDR saves date and time, the vessel’s position, speed, heading, sound recordings from the bridge, radio communication and radar data, as well as AIS information if possible.

An S-VDR differs from a VDR in that it is a simplified system in which the requirements concerning what information is to be saved are lower. In a VDR, further mandatory information is to be registered on board vessels such as echo sounder, engine and rudder order, watertight door status, fire and smoke alarms, etc.

A VDR’s function has to be completely automatic in normal operation. There has to be the opportunity to store data if an accident has taken place with minimal impact on the storage process.

As of 2008, there are now also requirements for new vessels concerning how the information in a VDR recording is to be downloaded. A VDR is to have an interface that allows saved information to be downloaded and played back on an external computer. The interface is to be compatible with an internationally recognisable format such as Ethernet, USB, FireWire or similar.

A copy of a piece of software that can download and play back information from a VDR is to be made available with every installed VDR. The software is to be compatible with an operating system that is found on computers that can be bought in a normal retail store. There is to be instructions for how this software is to be used and how to connect a laptop computer to it. The portable recording medium in a VDR that contains the software, instructions and other specific parts that are necessary in order to physically connect to a laptop computer are to be located in connection to the VDR’s main unit. If a VDR uses a non-standardised format, there is to be software on the portable recording medium or in the VDR’s main unit that can convert the information into an open standard format. PHOENIX II was built prior to these requirements being put in place and is therefore not subject to them. Should a VDR need to be replaced, the vessel is to be adapted to comply with the new regulations.

[15] A.918(22), IMO Standard Marine Communication Phrases (SMCP).
[16] SOLAS Chapter V Regulation 20 – Voyage Data Recorders.

Since 2014, the regulations state that a VDR on a new vessel is to save information from the past 30 days in the long-term recording medium. The requirement for the fixed recording medium is only 48 hours. S-VDRs are not encompassed by these requirements; they are to store information from the past twelve hours.

Each VDR should undergo annual checks or tests, which are to be performed by the manufacturer or a person appointed by them. During the annual testing, a performance check is to be conducted. For an S-VDR, the annual testing is to encompass a check of basic function, including recording. This means that functions such as sound recording are to be checked during the annual testing.

1.9.7 Rules pertaining to inertgas on board tankers

For tankers of 20,000 tonnes deadweight and upwards, built since 1 July 2002, but prior to 1 January 2016, the protection of the cargo tanks shall be achieved by a fixed inertgas system. TARNVAG is not encompassed by this requirement. For vessels built from 1 January 2016 the limit has been reduced to 8,000 tonnes deadweight. These rules can be found in "SOLAS II-2, Part B, Regulation 4 - Probability of ignition"

1.9.8 Rules pertaining to the work environment in Sweden

According to the Work Environment Act (1977: 1160) and AFS 2001:1, employers and employees must work together to achieve a good working environment. Furthermore, the employer must systematically plan, manage and control operations in such a way as to ensure that the working environment meets prescribed requirements for a good working environment. In addition, the employer must ensure that the employee is well-acquainted with the conditions under which the work is carried out and that the employee is informed of the risks that may be associated with the work. The employee shall participate in the work environment work and participate in the implementation of the measures needed to achieve a good working environment. A tool in the work environment work can be a deviation and incident reporting system, can be used to facilitate the identification of shortcomings in the business and enable a transfer of knowledge for both employer and employee risks in the operations. In order for such a system to be effective and achieving the goal, it is important to emphasize that both parties have a responsibility.

If an employee suffers ill-health or an accident at work and if a serious incident occurs at work, the employer is to investigate the causes so that risks of ill-health or accidents can be prevented in future. The aim of written documentation is to act as an aid to work environment management for both the employer and employees.

The AFS 2001:1 mentions the importance of written instructions for what to do in case of accidents, malfunctions, incidents and accidents. The assessment of risks needs to be done in the light of the general experience in the business and the procedures applied

1.10 Company organisation and management

1.10.1 Peter Döhle Group – PHOENIX II

The company controls ca. 500 different vessels, mainly container vessels, and has its head office in Hamburg, Germany. SHK has studied selected parts of the company's (operational management) ISM manual. This contains various section about lookouts, switch-over between manual and automatic steering and navigation with a pilot on board.

With regard to the section about lookouts, the ISM manual appears, in principal, to be a duplicate of applicable regulations and there is no reference to situations in which a pilot is to embark or disembark,

The section on automatic steering, states that the master and officer on the watch must be aware of how to switch from automatic to manual steering. In addition, instructions for this are to be posted in a place that is very visible from the location in which the vessel is steered.

Navigation with a pilot on board also appears, in principal, to be a duplicate of applicable regulations, which also lacks any reference to when a pilot is to embark or disembark the vessel. Aside from the ISM manual, the shipping company has provided SHK with company circulars from 2011 that contains recommendations and instructions that apply when a vessel has a pilot on board. The reason given for these circulars being issued was previous experience of accidents with a pilot on board caused by misunderstanding, the issue of responsibility and problems involving communication between pilots and masters/officers on the watch. These circulars state that the master is always (with the exception of in the Panama Canal) ultimately responsible for the safety of the vessel. The master and officer on the watch are therefore always to carefully monitor the pilot's work.

1.10.2 Terntank – TERNVAG

The company operates ca. ten tankers, and has offices in Skagen, Denmark and Donsö, Sweden. SHK has studied selected parts of the company's (operational management) ISM manual.

The ISM manual shows various sections about manual and automatic steering, pilot embarkation and navigation with a pilot on board. The section about manning the bridge on the basis of the situation does not refer to situations where a pilot is to embark or disembark the vessel. The ISM manual is based on and contains, in principal, the same content as that of the other vessel, PHOENIX II.

1.11 Additional information

1.11.1 Risks of fire and explosion in the event of a collision involving a tanker.

SHK has been searching for, both internationally and nationally, risk analyses pertaining to the risks of fire and explosion on board a tanker in the event of a collision. Around the Swedish coast there are tankers under 20,000 tonnes deadweight running daily that are empty of cargo and do not have gas-free cargo tanks.

However, some such risk analyzes with this or similar scenario has not been found.

INTERTANKO[17] recommend that if the ship is carrying a low flash point cargo of below 60c then the space should be inerted. In cases where breaches of the hull occur at sea, the issue of the carriage of an inert gas system (IGS) or not is fairly irrelevant, as the atmosphere in the tank will be inert due to it being outside of the flammable envelope. Following a breach of a tank, the cargo vapour mixing with the air outside of the ship creates an atmosphere that is within the flammable envelope and so combustion can occurs external of the ship. Whether the ship is fitted with an IGS or not is therefore not that relevant. Further the enhanced safety structure of a tanker with double hulls significantly reduces the risk of loss of containment of a cargo and hence the reduction in the possibility of an explosive atmosphere being created.

INTERTANKO has also referred to a new publication from OCIMF[18] (Oil Companies International Marine Forum) called Inert Gas Systems, see Annex 2.

1.12 Previous investigations of similar occurrences

- TÄRNFJORD–WELLAMO – Near collision on 13 August 1991 (SHK S-06/91). The tanker loaded with petrol was on her way into Stockholm and the passenger vessel was on her way out of Stockholm. The vessels were to meet during a large turn at Södernäs Light. The pilot of the tanker initiated the starboard turn via the autopilot and increased the rudder deflection limitation at the same time. In conjunction with this, the rudder was deflected to port. The investigation could not establish whether the tankers port turn has been caused by a technical fault or temporary human error. The vessels were very close to colliding.

[17] INTERTANKO - International Association of Independent Tanker Owners
[18] The Oil Companies lnternational Marine Forum (OCIMF) - is a voluntary association of oil companies having an interest in the shipment and terminalling of crude oil and oil products. OCIMF is organised to represent its membership before, and consult with, the lnternational Maritime Organization (IMO) and other government bodies on matters relating to the shipment and terminalling of crude oil and oil products, including marine pollution and safety.

- KERTU – Grounding on 29 October 2014 (SHK RS 2016:10) The cargo vessel was on her way from Bålsta in Mälaren to Kokkola in Finland. The vessel grounded just after the pilot had disembarked.

- STENA JUTLANDICA–TERNVIND – Collision at Trubaduren outside of Gothenburg 19 July 2015 (SHK RS 2016:05). The tanker was on her way out of Gothenburg and the passenger vessel on her way into Gothenburg. The collision occurred just after a pilot had disembarked the tanker.

1.13 Actions taken

Swedish Maritime Administration

The Maritime Administration’s pilotage area in Gothenburg initiated the project *“Trubaduren Traffic Area Management” - TTAM* in autumn 2016, following an accident and several incidents in the area. Close to all staff members working within pilotage operations have been involved, including representatives from the VTS operators’ crew, pilotage planning and crew from the pilot boats. The main aim of the project is to illuminate and evaluate existing routines, procedures and practices in order to increase maritime safety in the affected area. In addition, the project has investigated what can potentially be done with respect to changes to the regulations and infrastructure in order to optimise maritime safety in the area across a longer perspective. This review has been very successful and the corresponding safety review will be carried out for all pilot areas in Sweden, taking into account local conditions.

Reporting in C2 has increased in recent years, but the Swedish Maritime Administration has an action plan to further increase the reporting of improvement proposals and incidents/deviations in C2. The action plan includes that the process leader of the pilotage process in the Maritime Administration Management System will travel to all pilot areas and inform about the purpose and importance of reporting in C2 and how reporting is to be done. Handling of incidents with related reporting in C2 will be the subject of future continuing training for pilots where a test course is intended to be carried out in autumn 2017. C2 should be able to constitute a national system for exchange of experience between pilots similar to the former PRIS system and the Swedish Maritime Administration will continue to work for such a national system.

Terntank

The shipping company has begun conducting risk analyses with respect to the risk of explosive atmospheres for vessels in ballast with various sorts of cargo residues that are commonly on board of the type petrol, diesel, gas oil, etc. without inert gas in the vessel's tanks.

In addition, the shipping company has developed its ISM manual and ensures that continuous look out is kept on the bridge even during pilot launch phases. At the company's latest officers conference, the focus was mainly on safe navigation and Maritime Resource Management[19].

Peter Döhle Schiffahrts-KG

The company has not indicated any action taken.

2. ANALYSIS

2.1 Introduction

The incident brought a number of issues pertaining to the methods and procedures used in conjunction with the embarkation and disembarkation of pilots. In spite of the fact that the area surrounding the pilot boarding position cannot be regarded as cramped and as the distance to the compulsory pilotage line may be regarded as sufficient to comply with the recommendations in IMO Resolution A960, a situation still occurred in which two vessels came very close to colliding.

Another question is whether the VTS has a role to play in a situation such as this, and if so, in what way can or should they act.

Questions have also been raised concerning the Maritime Administration's incident reporting system for pilots and how information and lessons learned from accidents and incidents are spread to people who may be affected.

Finally, questions are raised about the reliability of VDR equipment and the knowledge situation within the shipping industry about collisions involving tankers

[19] Maritime Resource Management is a training programme concerning human behaviour within the shipping industry.

2.2 The pilotage operation and the occurrence

Just after departure, the master informed the pilot about how the autopilot worked. At the time of the first change in heading, it was found that this information appeared to be incorrect. This could indicate that the master was not completely familiar with the function of the autopilot, but it could also be a question of a misunderstanding in the communication between the master and the pilot.

When the vessel was approaching the pilotage line, the pilot informed TERNVAG in English on VHF of his intentions concerning the forthcoming disembarkation. He intended to turn to port in order to find lee for the pilot boat before the passage of TERNVAG. Subsequently, the master of PHOENIX II obtained the same information, which he had not objection to, prior to the pilot leaving the bridge.

At this time, TERNVAG had passed the pilot boarding position and was on her way towards the compulsory pilotage line and the fairway into Gothenburg. According to information obtained through interviews with the pilot and the master of TERNVAG, this was not something that was uncommon in the area. However, this meant that the distance between the two vessels decreased and thus so did the safety margin in the event of misunderstanding, mistake, technical fault or in the event that pilot disembarkation had been delayed. The explanation is probably that the master of TERNVAG was well acquainted with the area and the fairway in to Gothenburg. No information or opinion pertaining to the fact that the pilot boarding point had been passed was issued from the VTS or the pilot either. It is SHK's understanding that this is the sort of information that should be appropriate for the VTS to provide to vessels in order to ensure both safe margins during meetings and to provide the pilot with the opportunity to gain sufficient time to prepare together with the master prior to passing the compulsory pilotage line. When the pilot left the bridge on PHOENIX II together with the officer on the watch, the master, who was alone on the bridge, used the autopilot to initiate the port turn to the heading the pilot had stated. He then moved to the bridge wing in order to monitor the pilot's disembarkation and states that when there he switched off the autopilot and steered manually from the bridge wing. When the pilot had come on board the pilot boat, the master moved back to the conning position in the centre line in order to begin the agreed starboard turn so as to meet TERNVAG port to port. No starboard turn has been recorded by the vessel's VDR, but a weak starboard turn can be discerned from the radar recording.

SHK believes that it is difficult to see any reasonable explanation why the vessel did not respond immediately to the starboard turn in the event that manual steering was used. The only reasonable explanations are either that the starboard turn was terminated after only a few seconds and thus had not had time to have any impact on the vessel's course or that the autopilot was, in spite of everything, connected and did not respond as a result of its settings or some error in the stressful situation. What is clear, however, is that the master initiated and completed the final port turn using manual steering. Nothing has emerged to indicate that the vessel responded slowly to the rudder order at this time. When the officer returned to the bridge, he was told to steer manually, which means that the master's workload was reduced and he was able to focus fully on the continued navigation of the vessel.

In the situation that arose, one alternative course of action to increase the margin of safety would have been to initiate the port turn prior to the pilot disembarking a few minutes later, once TERNVAG had passed. This would certainly have resulted in the pilot boarding TERNVAG closer to the compulsory pilotage line, but the risk of collision would have been avoided. In the event of pilotage, the master is not relieved of their ultimate responsibility for the vessel and its safety. During the interviews following the occurrence, the master has stated that he should have acted and made sure to hold off on the port turn until such time as the tanker had passed. This is a view shared by SHK.

As the meeting approached, the master of TERNVAG was also alone on the bridge as the officer on the watch had gone down in order to receive the pilot. When the master saw that PHOENIX II was turning to port – and not to starboard as had been agreed – he set the engine to full astern immediately. This action was probably a contributory factor in preventing the collision between the two vessels.

When the near miss occurred, the VTS operator acted appropriately when he actively chose not to get involved in the ongoing VHF conversation and took action to not allow other VHF traffic to disrupt the critical situation that was ongoing.

2.3 Manning of the bridge and at the pilot ladder

In the critical situation that arose, the masters of each of the vessels were alone on their respective bridges, without the support of a lookout or any other crew member.

Regulation 5 of the International Regulations for Preventing Collisions at Sea states that *"Every vessel shall at all times maintain a proper lookout by sight and hearing as well as by all available means appropriate in the prevailing circumstances and conditions so as to make a full appraisal of the situation and of the risk of collision".* According to Chapter VII of the STCW Convention, a proper lookout shall be maintained at all times. The lookout is to devote themselves entirely to keeping careful lookout and may not be allocated or perform any duties that could interfere with this duty. The officer of the watch on the bridge can be sole lookout in daylight, provided that the situation has been carefully assessed that it has been established without doubt that it is safe to do so and that all prevailing circumstances have been taken into account fully.

It is the SHK's belief that the requirements concerning lookout were not fulfilled on either of the vessels. The explanation for this can be found primarily in the SOLAS regulations' requirements pertaining to rigging pilot ladders and embarkation and disembarkation of pilots, which include the requirement that this be supervised by a responsible officer who is in radio contact with the bridge and who also accompanies the pilot from the bridge to the pilot ladder and vice versa.

In practice, this means that one or two able seamen rig the pilot ladder at the appropriate time. When it is time for the pilot to disembark or embark, the able seamen on watch (lookout) leaves the bridge in order to go down to the pilot ladder. Following this, the officer on watch also removes themselves from the bridge in order to supervise the pilot's embarkation or disembarkation. The master is then alone on the bridge in a critical and vulnerable situation where he is expected to single-handedly manage navigation, manoeuvring, anti-collision management, steering, fire alarms, VHF traffic and internal telephone. Should anything abnormal occur in this situation, there is a risk of it becoming too much for a master alone on the bridge.

This was the situation in which both vessels found themselves at the time of the occurrence; a master alone on the bridge in a critical situation at the same time as the officer of the watch was at the pilot ladder. SHK believes that a master alone does not have the necessary capabilities to safely manage all the possible critical situations that may arise in this situation.

However, this procedure is common within the shipping industry in conjunction with the embarkation and disembarkation of pilots, which is often the result of conflicts between rest period rules and manning. SHK is of the opinion that there are grounds to review the ISM manual in order to ensure that the master is not left alone on the bridge in conjunction with the embarkation or disembarkation of a pilot.

In summary, SHK is of the opinion that both of the shipping companies involved (which Terntank already has done, see action taken section 2.13.) should develop and clarify their ISM manuals with respect to bridge manning in the event of situations involving the embarkation and disembarkation of a pilot.

2.4 Swedish Maritime Administration – organisational issues

As mentioned above, neither the VTS nor the pilot reacted to TERNVAG continuing past the pilot boarding location. This indicates that there may be grounds for the Maritime Administration to run through in more detail with both the VTS and the pilotage areas at how similar situations should be managed. A process of this kind has already begun within pilotage area Gothenburg (Section 1.12) and SHK believes that the Maritime Administration should consider undertaking similar projects in the other pilotage areas on the basis of the conditions that exist there.

During the investigation, shortcomings in the Maritime Administration's incident and non-conformity system have also been noted. The fact that the Maritime Administration has a national incident and non-conformity system in which pilots across Sweden can read about and learn from others' incidents and accidents is very favourable. However, it questions have emerged concerning the extent to which the Maritime Administration's personnel, including pilots, report non-conformities and incidents using the system. In the present case, the incident was not reported immediately after the incident and it has come out in interviews with pilots that the inability to report anonymously may prevent them from reporting incidents and non-conformities using the service, especially in those cases where the pilot themselves has felt that their actions may be questionable. At the same time, it can be important to inform the entire pilot community of just these types of occurrence. SHK believes that the Maritime Administration should review the system and make the necessary changes and also take action to ensure that there is greater engagement with respect to reporting.

2.5 VDR

The sound recordings from the bridge on board PHOENIX II from prior to, during and after the occurrence were not of a sufficiently good quality to permit a clear understanding of what was said on the bridge. Following the occurrence, a problem with the sound card in the vessel's VDR was detected by a technician from the manufacturer. The vessel's VDR had undergone a service just over three months previously without any faults being registered. This indicates that the service did not ensure that the VDR would be fully function until the next service. SHK has noted similar problems in previous investigations[20].

With new VDRs it should be easier to download stored data. Using any computer that can be purchased in a normal shop, it should be possible for a layperson to download information from a VDR. PHOENIX II was not covered by these rules. In this case it would not have been possible to download the information without someone with the correct technical expertise and equipment.

2.6 National regulations for vessel traffic services (VTS)

As SHK has addressed in previous investigations[21] there are currently no comprehensive national regulations for vessel traffic services (VTS) that, according to the Transport Agency and Maritime Administration's understanding, fulfil international requirements and guidelines for VTS. The national VTS regulations that currently exist (TSFS 2009:56) are targeted primarily at vessels and, in somewhat simplified terms, describe what information can be provided. However, there are no national rules that state what information the VTS is to provide and under what conditions. The lack of clear rules may mean that relevant information is not provided, which was the case in this occurrence when TERNVAG passed the pilot boarding point.

[20] E.g. final reports RS 2016:07, VICTORIA and RS 2016:05 STENA JUTLANDICA/TERNVIND.
[21] Final report RS 2014:01, LIVA GRETA.

During this investigation, it has emerges that the Maritime Administration and Transport Agency will, in the near future, be submitting a request to the Government on this matter, with a proposal for national regulations. Consequently, there are no grounds for SHK to issue any specific recommendation in this regard.

2.7 Risk analyses in the event of collisions involving tankers without inert gas in their tanks.

A natural part of an investigation of an accident is to study the outcome in order to see what can be done to reduce the consequences, if a similar occurrence would take place in the future. When it is an near miss that is in question, it is just as natural to ask what the probably consequences would have been, if an accident had occurred. In recent years, the shipping industry has discussed risks of explosion and collision involving vessels that have installed liquefied natural gas (LNG) as fuel for propulsion. In the event of a collision scenario in which an LNG tank is penetrated, there is a high probability of this resulting in ignition and fire. If a large hole arises in conjunction with the collision, the potential for the pressure release means that there is a lower probability of an explosion occurring.

According to INTERTANKO and SHK’s assessments, the same scenario is likely to arise with a tanker that has a flammable atmosphere in a tank that is penetrated in the event of a collision. This means that a fire would probably start, while it is more uncertain as to whether there would be an explosion as this is dependent on the size of the hole and the potential for pressure release.

3. CONCLUSIONS

3.1 Findings of the investigation

a) PHOENIX II was on a voyage out from Gothenburg with a pilot on board.
b) TERNVAG was on a voyage into Gothenburg and was to take on a pilot.
c) The pilot who piloted PHOENIX II was also to pilot TERNVAG into Gothenburg.
d) Having passed the compulsory pilotage line, PHOENIX II turned to port in order to gain lee for the pilot ladder.
e) The turn was initiated before TERNVAG had passed.
f) The masters of both vessels were alone on their respective bridges in conjunction with the pilot's disembarkation and embarkation, respectively.
g) The intention initially was for the vessels to meet port to port.
h) TERNVAG passed by the pilot boarding position without any action being taken by the VTS.
i) PHOENIX II changed her mind and turned to port instead of turning to starboard as planned following the pilot disembarking.
j) The pilot reacted and questioned PHOENIX II's intentions over VHF from the pilot boat.
k) TERNVAG engaged full astern in order to avoid a collision.
l) PHOENIX II passed just ahead of TERNVAG with a small distance between them.
m) The vessels later met starboard to starboard.
n) In this critical situation, the VTS actively chose not to get involved in the ongoing VHF conversation between the pilot and PHOENIX II.

3.2 Causes of the incident

The incident was caused by shortcomings in the planning of the vessels route when passing each other in conjunction with the debarkation of the pilot, which led to an excessively small margin of safety.

Contributory causes were probably the insufficient manning of the vessels' bridges, combined with the VTS not having informed the tanker about and that she had passed the boarding position.

4. SAFETY RECOMMENDATIONS

In view of the action taken by the Swedish Maritime Administration and Terntank Ship Management AB, SHK finds no reason to make any recommendations to them.

Peter Döhle Group is recommended to:

- Consider developing its ISM manual, primarily with respect to bridge manning during embarkation and disembarkation of pilots. See section 3.3. *(RS 2017:04 R1)*

The Swedish Accident Investigation Authority respectfully requests to receive, by **30 October 2017 at the latest**, information regarding measures taken in response to the recommendations included in this report.

On behalf of the Swedish Accident Investigation Authority,

Mikael Karanikas Rikard Sahl

REQUIRED BOARDING ARRANGEMENTS FOR PILOT

In accordance with SOLAS Regulation V/23 & IMO Resolution A.1045(27)

INTERNATIONAL MARITIME PILOTS' ASSOCIATION

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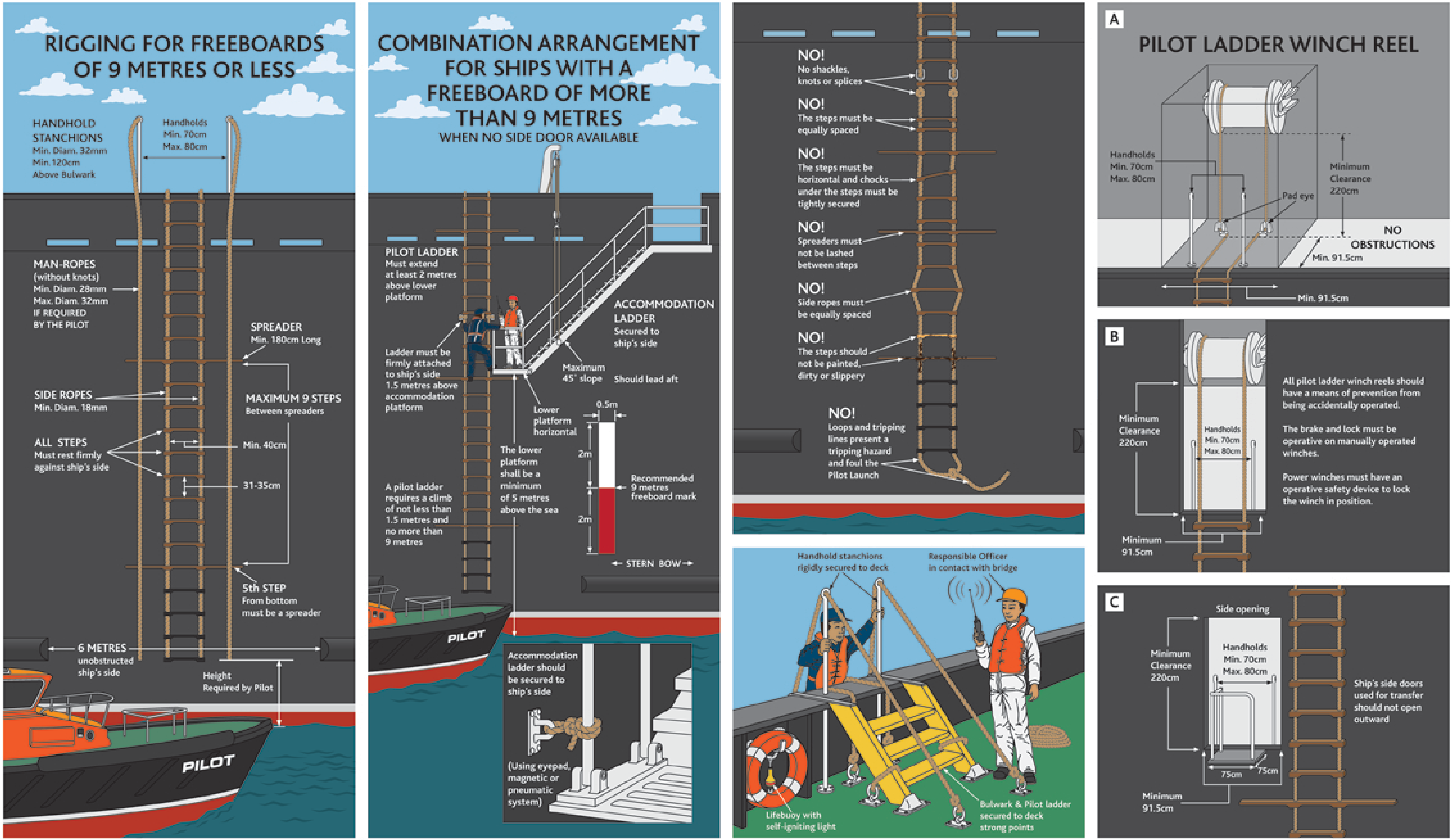

Annex 2

OCIMF

Inert gas systems

The use of inert gas for the carriage of flammable oil cargoes

(First edition 2017)

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The Oil Companies International Marine Forum (OCIMF)
is a voluntary association of oil companies having an interest in the shipment and terminalling of crude oil and oil products. OCIMF is organised to represent its membership before, and consult with, the International Maritime Organization (IMO) and other government bodies on matters relating to the shipment and terminalling of crude oil and oil products, including marine pollution and safety.

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Abbreviations and glossary

The following are agreed definitions for terms used within this paper:

CDI

Chemical Distribution Institute

Deadweight (DWT)

The carrying capacity of a ship, including cargo, bunkers and stores, expressed in metric tonnes. It can be given for any draught, but here is used to indicate summer deadweight at summer draught.

Guidance

Provision of advice or information by OCIMF.

IMO

International Maritime Organization

Inert condition

A condition in which the oxygen content throughout the atmosphere of a tank has been reduced to 8% or less by volume by the addition of inert gas.

Inert gas

A gas or a mixture of gases, such as flue gas, containing insufficient oxygen to support the combustion of hydrocarbons.

Inert gas plant

All equipment fitted to supply, cool, clean, pressurise, monitor and control the delivery of inert gas to the cargo tank systems.

Inert Gas System (IGS)

An inert gas plant and inert gas distribution system together with means for preventing backflow of cargo gases to the machinery spaces, fixed and portable measuring instruments and control devices.

SOLAS

International Convention for the Safety of Life at Sea

Bibliography

CDI

CDI Best Practice Recommendations Regarding the use of Nitrogen

The publication provides recommended procedures for the safe handling of nitrogen on chemical tankers.

ICS

Tanker Safety Guide (Chemicals)

Chapter 5 contains useful information on the requirements for inert gas and options for sourcing including Nitrogen generators.

IMO

International Convention for the Safety of Life at Sea 1974, as amended (SOLAS)

Chapter II-2, Part B Prevention of Fire and Explosion contains carriage and operational requirements for inert gas systems.

International Code for Fire Safety Systems (FSS Code)

Chapter 15 *Inert Gas Systems* details the specifications for inert gas systems as required by SOLAS Chapter II-2.

Inert Gas Systems

Comprehensive guidelines containing details of the design and operation of inert gas systems together with legislative requirements.

Study on incidents of explosions on chemical and product tankers (IMO MSC 81/8/1)

This document summarises the activities and conclusions of the inter-industry working group formed to investigate fires and explosions on chemical and product tankers.

OCIMF/ICS/IAPH

The International Safety Guide for Oil Tankers and Terminals (ISGOTT)

Contains comprehensive guidance on inert gas systems and operational procedures.

1 Introduction

Hydrocarbon gas normally carried in petroleum tankers cannot burn in an atmosphere containing less than approximately 11% oxygen by volume. Accordingly, one way to provide protection against fires or explosions in the vapour space of cargo tanks is to keep the oxygen level below that figure. This is usually achieved by using a fixed piping arrangement to blow inert gas into each cargo tank in order to reduce the oxygen content and render the tank atmosphere non-flammable.

The International Convention for the Safety of Life at Sea (SOLAS 1974), as amended, requires that inert gas systems be capable of delivering inert gas with an oxygen content in the inert gas main of not more than 5% by volume. By maintaining a positive pressure in the cargo tanks at all times, with an atmosphere not having an oxygen content greater than 8% by volume, the tank atmosphere is rendered non-flammable.

This document provides guidance on the use of inert gas for the carriage of flammable oil cargoes on oil tankers of all sizes. For the purposes of this paper, and in accordance with SOLAS Chapter II-2, Regulation 1-6.1, flammable oil cargoes are defined as crude oil or petroleum products that have both:

- A flashpoint of less than 60°C in a closed cup test using approved flashpoint apparatus.
- A Reid vapour pressure below the atmospheric pressure or other liquid products that have a similar fire hazard.

This paper is based on historical incidents involving fires and explosions in the cargo areas on tankers carrying flammable cargoes. The guidance establishes the safety benefits of using inert gas as an effective barrier to prevent cargo tank fires and explosions, regardless of vessel size.

This paper does not offer guidance for chemical tankers carrying chemical cargoes. OCIMF supports the guidance issued by CDI, in *CDI Best Practice Recommendations Regarding the use of Nitrogen*. The CDI recommends that all cargo and tank cleaning operations involving flammable chemical cargoes are carried out whilst the relevant cargo tanks are inerted by nitrogen.

2 Legislation

The SOLAS requirements for tankers to be fitted with an inert gas system were developed by the IMO and had initially entered into force in 1980 for tankers 100,000 DWT and upwards. The SOLAS amendments, that entered into force 1981, reduced the threshold to 20,000 DWT.

The SOLAS amendments, that entered into force on 1 January 2016, reduced the threshold further and require new build tankers 8,000 DWT and over, constructed on or after this date, to be fitted with an inert gas system when carrying flammable cargoes.

OCIMF welcomes these changes; however, the principle of basing inert gas requirements on vessel DWT does not adequately recognise the risks posed by flammable oil cargoes or the proven safety benefits of carrying such cargoes under inert conditions.

3 Review of incidents

3.1 Historical incident review

In 2006, an inter-industry working group, formed to investigate fires and explosions in cargo areas on oil and chemical tankers, presented its findings to the IMO Maritime Safety Committee (MSC 81/8/1 and MSC 81-INF.8). The group examined 35 incidents that had occurred over the previous 25 years and the report noted that:

- In the majority of cases the ship was tank cleaning, venting or gas freeing when the incidents occurred.
- Failure to follow established procedures was observed in a significant number of incidents.
- In several cases, the tank atmosphere for non-inerted tanks had apparently not been evaluated or was not being monitored.
- In most cases ignition occurred within a cargo tank.
- None of the incidents occurred during the use or operation of inert gas.

The inter-industry working group report was considered by IMO delegates and influenced the debate that resulted in the adoption of the 2014 SOLAS amendments and the consequent reduction in the oil tanker DWT requirements for fitting inert gas systems from 20,000 DWT to 8,000 DWT for tankers constructed on or after 1 January 2016 when carrying flammable cargoes.

3.2 OCIMF analysis of incidents 2004–2015

OCIMF has undertaken a further study of incidents involving fires and explosions in the cargo area on tankers during the period 2004–2015 where maintaining the cargo tank in an inert condition is likely to have prevented the incident. For consistency with the IMO study oil and chemical cargoes have been included.

The data, which was collected from public and member incident databases, indicated that a total of 15 incidents involving fires and explosions occurred in the cargo area over the 12-year time frame. From the data reviewed by OCIMF, these events resulted in 20 fatalities and a further 30 people missing, presumed dead.

Vessel	8,000 DWT or less	8,000-20,000 DWT	20,000+ DWT	Oil cargo	Chemical cargo	Activity
1	X			X		Tank cleaning
2	X			X		Gas freeing
3	X				X	Loading
4		X		X		Tank cleaning
5			X		X	Gas freeing
6		X			X	Discharging
7			X		X	Tank cleaning
8			X	X		Tank cleaning
9			X		X	Loading
10	X			X		Tank cleaning
11	X			X		Ballast condition
12		X		X		Tank cleaning
13			X	X		Decanting slop tank
14	X			X		Deck maintenance
15	X				X	Tank cleaning

Table 3.1: *Number of fires and explosions on oil and chemical tankers 2004–2015*

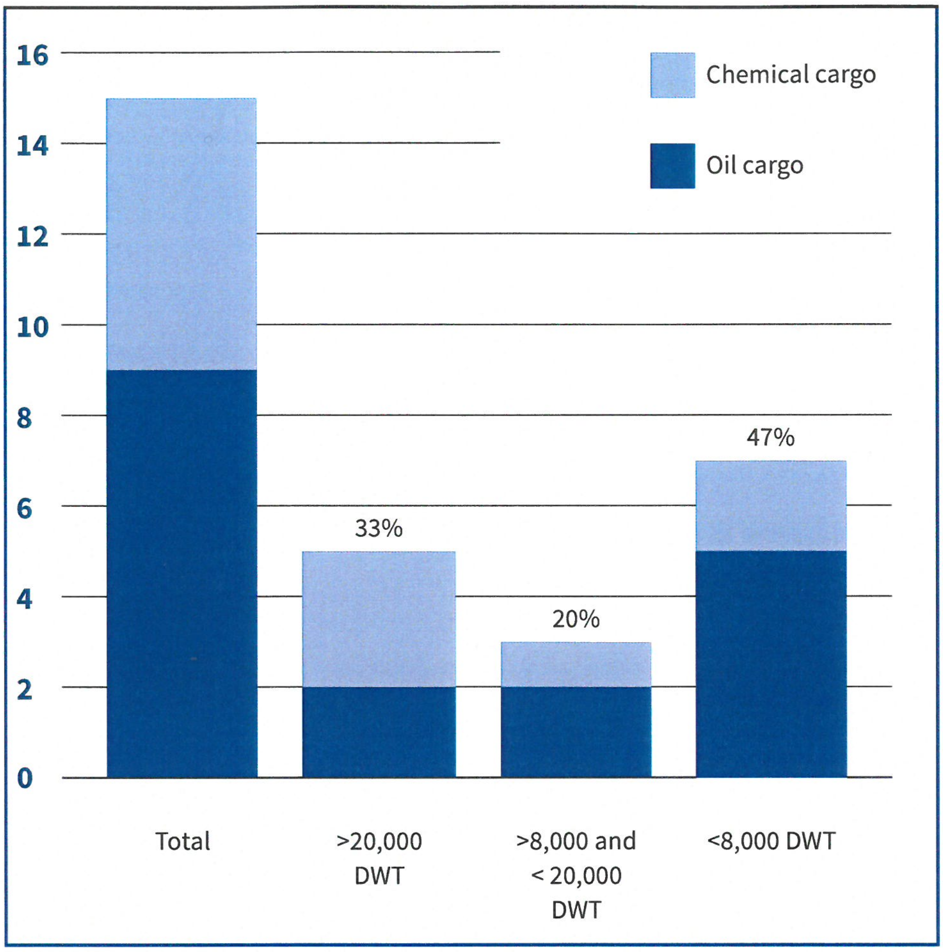

Figure 3.1: *Number of fires and explosions with oil cargoes and chemical cargoes 2004–2015*

The data indicated that a majority of the incidents involving fires and explosions occurred on vessels less than 20,000 DWT. The two incidents involving fires and explosions on oil tankers greater than 20,000 DWT occurred on vessels with inert gas systems installed; however, the tank was not being maintained in an inert condition at the time of the incident.

The study supports that the provision of inert gas on vessels over 20,000 DWT carrying oil cargoes is preventing incidents involving fires and explosions. There continues to be incidents involving fires and explosions on vessels less than 20,000 DWT carrying oil cargoes resulting in fatalities.

4 Guidance for the use of inert gas systems on oil tankers

The IMO inter-industry working group report and the OCIMF study found that flammable oil cargoes are carried more safely on oil tankers that have installed, and are effectively using, an inert gas system to maintain the cargo vapour space in an inert condition.

The enhanced safety associated with the use of inert gas systems outweighs concerns such as increased port turn-around time and issues associated with cargo segregation and product quality.

The safety benefits of inert gas in cargo tanks are well recognised throughout the tanker industry. Over the years many lives have been lost, or serious injuries sustained, due to incidents involving fires and explosions on non-inerted tankers transporting flammable oil cargoes. The installation of an inert gas system on oil tankers of all sizes that carry flammable oil cargoes is both technically and operationally feasible. The effective use of the system, allied with training and the application of correct procedures, prevents incidents involving fires and explosions in cargo tanks and will result in a significant safety performance improvement when carrying flammable oil cargoes on oil tankers.

In summary, OCIMF has concluded that oil tankers that carry flammable oil cargoes should be designed and fitted with a SOLAS compliant inert gas system.

- Operators of existing oil tankers not already covered by the SOLAS inert gas requirements should consider installing a SOLAS compliant inert gas system on those vessels during the vessel's next special survey/major refit.
- Existing oil tankers less than 20,000 DWT fitted with an inert gas system that is not fully compliant with SOLAS requirements should be operated in such a manner that cargo tanks are maintained in an inert condition.
- New oil tankers that are to carry flammable oil cargoes should install a SOLAS compliant inert gas system when the vessel is being built.

All vessels fitted with an inert gas system should maintain it fully functional, use it in accordance with ISGOTT guidance, and maintain cargo tanks in an inert condition at all times, except when it is necessary to be gas-free for tank entry.

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