Bundesstelle für Seeunfalluntersuchung
Federal Bureau of Maritime Casualty Investigation
Bundesoberbehörde im Geschäftsbereich des Bundesministeriums
für Verkehr, Bau- und Wohnungswesen

Investigation Report 181/04

Very serious marine casualty

Fatal accident of diver on CMS CMA CGM VERLAINE on 11 July 2004 in Marsaxlokk (Malta)

1 June 2005

The investigation was conducted in conformity with the law to improve safety of shipping by investigating marine casualties and other incidents (Maritime Safety Investigation Law - SUG) of 24 June 2002.

According to this the sole objective of the investigation is to prevent future accidents and malfunctions. The investigation does not serve to ascertain fault, liability or claims.

The German version shall prevail in the interpretation of the Investigation Report.

issued by:
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Table of Contents

List of Figures

1 Summary of the Marine Casualty

During an intermediate survey to maintain the Building Safety Certificate a Dutch diver sustained fatal injuries on the German Container Vessel CMA CGM VERLAINE at 09.37 h local time on 11 June 2004 in the port of Marsaxlokk on Malta when he became caught in the area of the bow thruster while filming under water. The bow thruster was idling during the diving, although it should have been out of operation. As a result of the suction, the diver became caught in the bow thruster tunnel and was struck by the pitch propeller. It is possible that the diver's supply cable became wound round this too.

2 Scene of the Accident

Nature of the incident:	Very serious marine casualty, CMA CGM VERLAINE
Date/time:	11 July 2004 / 13.37 h
Location:	Marsaxlokk, Malta
Latitude/longitude:	φ 35°51.5‘ N λ 014°32.5‘ E

Section from sea chart connection chart 305, BSH

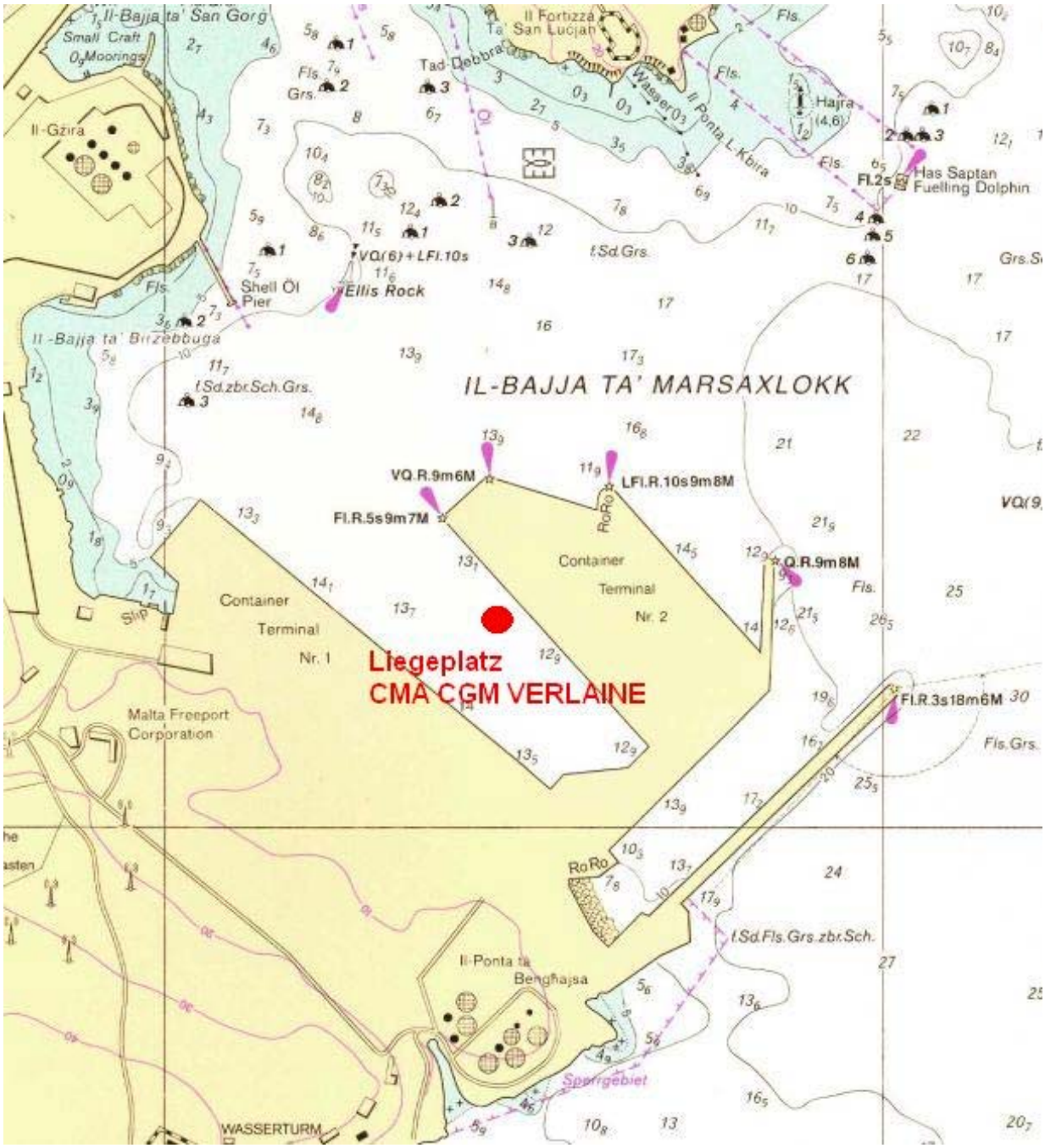

Figure 1: Sea chart

3 Vessel Particulars

3.1 Photo

Figure 2: Photo of vessel

3.2 Particulars

Name of vessel:	CMA CGM VERLAINE
Type of vessel:	Container vessel
Nationality/flag:	Germany
Port of Registry:	Hamburg
IMO number:	9221815
Call sign:	DASO
Operator:	NSB Niederelbe Schiffahrtsgesellschaft mbH & Co. KG
Year built:	2001
Building yard/building number:	Daewoo Shipbuilding & Heavy Machinery Ltd., No. 4070
Classification society:	Germanischer Lloyd
Length overall:	300.00 m
Width overall:	40.00 m
Gross tonnage:	72,760
Deadweight:	79,501
Draft at the time of the accident:	V: 13.20 m H: 13.20 m
Engine rating:	68,520 kW
Main engine:	Hyundai 12 K98 MC-C
Speed:	27 kn
Hull material:	Steel
Hull construction:	Double hull
Number of crew	24

4 Course of the Accident

On 11 July 2004 the container vessel CMA CGM VERLAINE, coming from Port Klang (Malaysia), was in the port of Marsaxlokk, Malta, and made fast at the container terminal at 05.30 h with its starboard side alongside (see Figure 1). In addition to loading and discharge work, the boiler installations and the hull were also to be surveyed. Prior to the surveys, discussions were conducted between the Master, Chief Officer, Chief, GL surveyor and diver. The statements by the witnesses are set out below.

4.1 Master's Report

The Master had been wakened at 03.00 h by the Second Officer in charge of the watch after the vessel had passed the preset position in the chart approx. 25 nm off Marsaxlokk, in order to approach the port. He had been on the bridge since 03.30 h. The "end of sea passage" had been at 03.48 h, in other words the main engine was slowed down from 101 rpm cruising speed to 64 manoeuvring speed and in view of the forthcoming inspections the fuel was switched over from heavy oil to diesel oil.

The Second Officer had checked the command elements and the nautical equipment on the bridge in accordance with the IMO check list. At 04.00 h the Chief Officer took over from the Second Officer as officer in charge of the watch. Half an hour later the vessel had made for the port approach at slow speed and the Master had switched on the bow thruster too.

At 04.36 h two pilots had come on board. The helmsman, the Chief Officer, the Master and the two pilots had now been on the bridge. The nautical officers and the crew had manned the manoeuvre stations. At 04.50 h two tugs had been made fast in order to support the vessel in manoeuvring in the narrow port basin. The vessel had been made fast with its starboard side alongside at container terminal 2 at 05.30 h with four forward and aft lines and two spring lines each. After this the two tugs were dismissed.

During the manoeuvring and mooring the Master had steered the vessel from the starboard wing control position. The Chief Officer had been responsible in the wheelhouse for the bridge control console, the internal communication, and the keeping of the bridge log.

After completion of the mooring operation the vessel had switched over from sea operation to port operation. The remote control of the main engine had then been set from the bridge to the engine control room. After this the Master had signed the tug and pilot papers in the chart room. In the meantime the Chief Officer was reportedly involved in switching off the running elements on the bridge console. These included radar, echo sounder, navigation lights, steering gear, bow thruster, communication facilities, as well as locking the control positions in the bridge wings and the

wheelhouse doors. There was no checklist for this work such as existed for example when leaving port.

At about 05.40 h the Master reportedly left the bridge almost at the same time as the Chief Officer and the two pilots. The Chief Officer had gone to the gangway with the pilots and the Master had gone into his office where the agent and the customs were already waiting to clear the vessel. Shortly after 06.30 h the clearing had been completed. After this the Master had gone to the ship's office on the A-deck in order to participate in the cargo meeting with the Chief Officer and the dock workers. Shortly after 07.00 h the surveyor from the Classification Society Germanischer Lloyd (GL) had joined them in order to discuss the surveys. The vessel operator had ordered the following surveys:

1. Annual Inspection (Insp.) Class Hull and Machinery
2. In-water Survey of Ship‘s Bottom
3. External and Internal Survey on Auxiliary Steam Boiler
4. External and Internal Survey on Exhaust Gas Boiler
5. Annual Insp. Load Line
6. Annual Insp. Safety Equipment
7. Annual Insp. Safety Construction
8. Annual Insp. Radio Safety
9. Annual Insp. International Oil Pollution Prevention Certificate
10. Emergency Generator on Automatic Switch
11. Annual Insp. of Lifting Devices and Cranes.

In view of the short time available the GL surveyor had declared that depending on the course and progress, a little more than 50 % of the surveys could be carried out. The inspection points 6, 7, 8 and 11 had been ruled out from the start. Points 3 and 4 could probably only be carried out partially.

At about 07.40 h the diver had arrived in order to discuss the procedure for the underwater survey and the safety aspects. Now in addition to the Master, the diver, the GL surveyor and the Chief Engineer had been present. The Chief Officer was reportedly in the ship's office at this time in order to coordinate the cargo work. The diver had initially handed over two warning plates lettered "DANGER - DIVER ON WORK" that were to be laid out in the ship's office and in the engine control room. A 220 m long boat line was to be laid out for the diver's boat on the port side of VERLAINE on a level with the water line. After this the diver had handed over a check list he had already signed himself, that was to be signed by the Master, the Chief Officer and the Chief Engineer and contained the following:

1. Hoisting Flag A
2. Rudder Engine to be switched off
3. Bow thruster to be switched off
4. Ballast pumps to be switched off
5. Main Engine to be blocked
6. ICCP, (Electric cathodic protection) to be switched off.

Since the Chief Officer was not present to sign the checklist, the Master had suggested going through the checklist by telephone. The following had been read out and answered:

1. Master: Is flag A hoisted	Chief Officer: Not yet but will be done Master: Not yet but will be done
2. Master: Is rudder engine switched off	Chief Officer: Yes rudder engine switched off Master: Yes rudder engine switched off
3. Master: Bow thruster switched off	Chief Officer: Yes bow thruster switched off Master: Yes bow thruster switched off
4. Master: Are the Ballast pumps off	Chief Officer: Yes the ballast pumps are off Master: OK ballast pumps are off
6. Master: Than I will sign on your behalf	Chief Officer: Yes you can sign on my behalf Master: I will sign on your behalf

After this the Master had signed for the Chief Officer.

After the meeting the diver had left the office in order to clear his equipment and his boat for the diving operation. The Chief Engineer and the GL surveyor had gone into the engine room for the boiler survey.

At about 08.55 h the diver, the GL surveyor, the Chief Officer and the Master had met in the ship's office on the A-deck. The diver had declared that the diving equipment and the motorboat were ready for operation and that there was not much time left for the diving operation since ship's movements were expected in the port at 11.00 h. It had then been confirmed by the ship's side that all measures had been taken and that the diving operation could begin.

At 09.00 h the GL surveyor and the Master had gone onto the diver's boat via the port side pilot gate. Three crew and the diver had been on board. In view of the urgency the motorboat had immediately moved to the diving position approx. 50 m behind the forward stem, the engine had been switched off and the boat had been made fast with the lines already laid out before on the port hand line of the vessel. Hoses had been fastened to the diving suit and were connected with a monitor in the deckhouse of the motorboat. The diver had entered the water at about 09.15 h and swam past the bow thruster to the forward stem.

At this time there had been hardly any wind and the water had been clear and smooth. No ships or boat traffic had been observed in the surroundings.

At about 09.20 h the diving operation had started. The GL surveyor and the Master had sat down on a bench in the deckhouse of the motorboat and observed the monitor. The monitor had showed clear pictures of the bulbous bow and the forward part of the ship's bottom. The diver had reported his observations in a clear voice. The survey had proceeded without any irregularities so far. The condition of the conservation of the ship's bottom had not been particularly good, but reportedly corresponded to expectations. No damage to the steel had been ascertained.

At 09.37 h the monitor image had flickered violently and then disappeared. After this the audio connection was interrupted. Initially it had been presumed that there was a loose cable contact. The boatman came into the deckhouse in order to fasten the cable connection of the monitor that appeared very loose and to call the diver. However, the connection with the diver remained interrupted. After this, through the wheelhouse window the Master had seen bubbles and a few black objects rising in the area of the bow thruster. There had also been a very short, relatively weak but still clearly visible water jet directed to port. After this the water surface had been calm again.

Body parts were seen on the cable hauled in. The Master notified the Chief Officer of the accident via the VHF walkie-talkie and called upon him to set out an emergency call to Valetta Port Control via channel 12.

The Master had been convinced that all safety measures had been carried out and that the bow thruster had been out of operation, especially since the Chief Engineer had confirmed beforehand that due to diesel oil operation only one auxiliary diesel generator had been in operation. That is why the bow thruster could not be switched on or operated. In his experience on previous ships, the main switch of the bow thruster system switched off immediately when the second generator was shut down.

4.2 Chief Engineer's Report

The Second Officer had informed the Chief Engineer at 03.00 h that the "end of the sea passage" would be 03.48 h. At about 03.15 h the Second Engineer and a Motor-man who was on engine watch, arrived in the engine control room. The engine installation had been switched over to "manoeuvre mode", in other words the air compressors had been switched on and the fresh water vaporiser had been switched off.

In addition to the forthcoming class survey in the engine area, repairs were to be carried out on the steam system. For this reason the Chief Engineer had asked the Third Engineer to come to the engine room at about 04.15 h. The electric power had been sufficient for all the loads necessary to approach Malta, such as auxiliary blower, main engine, air compressors, bow thrusters, mooring winches, so that it was possible to work with two diesel generators on the line circuit (generator No. 1 and generator No. 3). The third diesel generator (generator No. 2) had been on standby in "automatic operation".

The bow thruster had reportedly been in the "automatic/bridge operation" position throughout the entire voyage and had been started up from the command bridge at approx. 05.10 h in order to steer for Marsaxlokk.

After mooring, the main engine had been set to "manual / engine control room" at 05.30 h and the engine system had been changed over to port operation, i.e. the main starting air valve had been closed, the indicator valves had been opened and the starting air compressors had been switched to "economy".

The Third Engineer was to drain the boiler water from the exhaust gas boiler in order to make the installation pressure-free.

After this, diesel No. 2 had been idling, i.e. started without generator operation, and all three diesel generators had been changed over from HFO supply to gas oil supply. Since this takes a relatively long time technically, and as there were problems with the fuel pressure, it had taken longer than usual.

At about 06.20 h this work had been completed and at 06.28 h generator No. 3 had been taken from the power network. Generator No. 1 had then been running alone on the circuit for the entire period.[1]

At about 07.00 h the engines of generators No. 1 and No. 3 had been switched off and operation had been switched over to "MANUAL" so that it was no longer possible to switch these on automatically again. From 07.00 h to approx. 07.35 h among other work the Chief Engineer had checked the fuel pressure and the fuel temperature of the diesel generator as well as the steam pressure of the exhaust gas boiler.

During the meeting at approx. 07.55 h in the Master's office it had been specified that first of all the inspection of the auxiliary boiler should be carried out, since this was given top priority. It had been agreed with the diver that the underwater inspection should be carried out after this, after completion of all necessary preparations.

The warning signs "DANGER - DIVER ON WORK" had been handed over by the diver and were to be set out visibly in the engine control room and the ship's office. Furthermore, the checklist already signed by the diver regarding switching off and securing of ship's engines had been handed over. The checklist was yet to be signed by the Master, the Chief Officer and the Chief Engineer.

Since the Chief Officer was not present, the Master had telephoned him in the presence of the GL surveyor, the diver and the Chief Engineer and asked him about the measures on the checklist. The Master had repeated the answers to the questions aloud.

The Master had then signed the checklist with the safety requirements in the name of the Chief Officer. The starting system main engine was to be blocked for the engine

[1] This incident was documented the next day by graphic recordings with the computer program of the engine monitor system by the Chief Engineer and the Second Engineer. The recordings had been handed over to the Technical Inspector of the vessel operator NSB to be passed on to the local lawyer.

area by engaging the turning gear and removing the electrical fuses for the electric motor and the electric current for the corrosion protection system (ICCP) was to be switched off. The Chief Engineer had assured this and signed.

After this at about 08.10 h the Chief Engineer had gone to the engine control room with the GL surveyor and fitted the warning plate "DANGER - DIVER ON WORK" at the manoeuvring station of the main engine. The Second Engineer had been charged with securing the main engine in accordance with the regulations and the electrician was to switch off the ICCP installation.

After this work the internal survey of the auxiliary boiler and the safety valves for the boiler had been carried out. At approx. 08.30 h the Chief Engineer had gone up to the main deck in order to welcome his son, his life partner and the two grandchildren at the gangway.[2] The diver had been on the main deck and had asked whether the ICCP installation had already been switched off, which the Chief Engineer and the electrician had confirmed. Only about 15 minutes later the Chief Engineer had been back in the engine room where the GL surveyor was already examining the disoiler together with the Second Engineer.

After this the GL Surveyor had entered the ship's office in order to coordinate the underwater survey. In the meantime the Third Engineer and a Motorman had opened the manhole of the exhaust gas boiler. Since some of the preparatory work for the diving had not yet been completed, the inspection of the exhaust gas boiler had been brought forward. The GL surveyor had then left the engine room at approx. 08.55 h.

During the period from 09.00 h to approx. 10.00 h the Chief Engineer had carried out inspection work in the engine room and issued instructions to close the boiler systems and concerning work to be carried out.

At 10:00 h the Chief Engineer had gone to the ship's office. There the Second Engineer had told him that an announcement had just come through on the command system and that he had been asked to come up to the bridge. There the Master had informed him of the diver's accident.

Furthermore, the Chief Engineer had been fully convinced that all the necessary safety measures had been taken in order to exclude any danger to the diver, in other words:

- main engine blocked against unintentional starting
- ICCP installation switched off
- warning signs set up visibly
- engine crew informed of diving works
- only one auxiliary diesel in the power network
- both reserve diesels switched to "MANUAL" in order to prevent automatic switching on of the diesel engines and thus preventing operation of the bow thruster.

[2] They were to remain on board and travel with the vessel to Hamburg.

With regard to the latter point the Chief Engineer had remarked that on all his previous vessels any bow thruster still in operation would automatically be switched off at the latest when the second generator was switched off from the ship's power supply, since the power switch switched off the main switch panel (see Figure 9).

The Second Engineer had also been of the opinion that the bow thruster was switched off during the accident, which he had also confirmed in the "engine log" per checklist and signature.

Moreover no switching on of a relatively large load had been evident in the electronic records of the engine computer for the entire period from 06.28 h on 11 July 2004 (generator No. 3 switched off from the ship's grid) up to the time of the accident and in the period thereafter. However, this should have been the case if a major load like the bow thruster had been switched on.

4.3 Statements by the Chief Officer of 6 October and 4 November 2004

The Chief Officer had started his sea watch at 04.00 h on the day of the accident. At 04.36 h he had welcomed two pilots and accompanied them to the bridge. He had remained on the bridge until the vessel was moored at Marsaxlokk at 05.30 h. The bow thruster had been in operation during entry. Shortly before berthing he had switched off the two radar sets and the navigation lights. The Master had set the complete "port" operating mode after arrival. Normally the bow thruster was switched off then as well.

At 05.35 h the Chief Officer had escorted the pilots to the pilot ladder on the sea side where they left the vessel. After this he had supervised the bringing out of the gangway and had received the foreman of the dockworkers in the cargo control room (CCR) and had instructed the Third Officer and the bosun regarding the deck watch. At the time of the accident he had been involved with cargo work in the cargo control room. There had been VHF contact with the Master, who had been watching the diver's filming on the boat together with the GL surveyor.

When the Chief Officer had received the radio message from the Master, "What's the matter with the bow thruster?", he had run onto the bridge and had noticed at once that the bow thruster was in operation, whereupon he had switched it off immediately. The pitch had been set at "ZERO". At the same time he had been instructed by the Master to call for medical aid via Valetta Port Control VHF channel 12, since there had been an accident with the diver. It had been generally known that there was to be an underwater inspection in Marsaxlokk.

Prior to the underwater inspection there had been a meeting in the cargo control room office. The Chief Officer had been charged by the Master with ensuring that no ballast operations were carried out during the diving assignment, that the flag "A"[3] was to be hoisted, and that a line was to be laid out along the vessel and the pilot

[3] Signal for: "I have a diver dow; keep well clear at slow speed."

ladder was to be set out on the sea side. In addition the warning sign "DANGER - DIVER ON WORK" was displayed in the cargo control room.

4.3.1 Supplementary Comment by the Chief Officer of 22 April 2005

When he, the Chief Officer, had left the bridge in order to accompany the pilots disembarking via the pilot ladder on the sea side, the Master had still been on the bridge. He had not been able to see that the Master had left the bridge almost at the same time as he had. At any rate the Master had not been directly behind him.

The Master had performed the berthing manoeuvre. When no special instructions were given, it was standing practice in navigation that the last person leaving the bridge was responsible for switching off all the operating elements and their controls. This was how he, the Chief Officer, had acted on board CMA CGM VERLAINE too. That is why he had not checked on leaving the bridge whether all operating elements, especially the bow thruster, had been switched off.

He had had no knowledge that the bow thruster had not been switched off. He had also assumed that the bow thruster had been switched off, so that the function of the bow thruster could not have been switched on at all after changing over to port operation.

There had been no message from the engine room to the bridge that the bow thruster had not been switched off. In his past experience - at any rate on other ships - if it had not already been switched off the engine room had issued a reminder that the bow thruster was to be switched off.

When the Master had telephoned him about the safety list that he, the Chief Officer, was to sign, he had initially not realised that it was the safety list for the diver. Then the Master had suggested reading it out for him and signing for him, the Chief Officer. This had then been done. He, the Chief Officer, had not had the impression that the individual points had been read out in a questioning form requiring an answer, and he had not understood the reading out as if he had to confirm the switched condition of the individual operating elements, such as for example the bow thruster, as if he had checked these himself. At this time he had been in the cargo office. However, he had assumed that the bow thruster had been switched off. He had understood the Master's explanations as if he were ticking off the individual points yet to be carried out and the points that had already been settled. For points 2, 3 and 4 (see page 10) he had understood the Master as if the latter had declared that these points had been settled. He, the Chief Officer, had assumed that the Master had switched off the engines since the latter had left the bridge after him. At the end the Master had asked him whether he could sign for the Chief Officer. He had affirmed this.

4.4 Statement by the GL Surveyor of 13 September 2004

The GL surveyor had been ordered by the owner. He was to carry out the intermediate inspections on behalf of the See-BG (German Marine Insurance and Safety Association).

The GL surveyor had been on board the vessel at 07.00 h and had met the Master, the Chief Officer and the Chief Engineer in order to discuss and agree on the inspections. The diving firm (Mediterranean Diving Company) had reached the vessel at about 07.40 h. There had been discussions with the diver on the technical and safety-relevant aspects of the inspection. All engine-specific work and ballast water work were to be avoided as these represented dangers for the diver.

The diver had handed the Master a checklist of the works to be avoided and the safety inspections to be carried out. The Master had stamped and signed the checklist.

At about 08.00 h the diver had prepared his equipment for the diving assignment while the GL surveyor started the internal inspection of the auxiliary boiler and after this of the exhaust gas boiler. He had seen a plate indicating that diving work was being carried out on the engine telegraph in the engine control room.

At about 09.00 h the diving firm had notified the GL surveyor that it was now ready for the underwater inspection. Then the Master and the GL surveyor had entered the diver's boat. The port authority had been informed that diving work was being carried out and the "A" flag had been set.

A few minutes after this the diver had entered the water about 50 m from the bow and had swum towards the bulbous bow. He had started examining the ship's bottom at about 09.15 h. At about 09.30 h the video and audio communication had been completely interrupted. A few seconds later parts of the diver's body had reached the surface of the water.

A report about further underwater inspections carried out by a diver of the Maltese investigation authority had revealed that the port grating of the bow thruster tunnel was missing and that there were still parts of the diver's body in the tunnel.

4.5 Investigations by the Maltese Justice Authority

The statements relating to questioning by the court on the day of the accident and further investigations that supply facts not necessarily included in the above statements are set out below.

The Master declared that at the time of the accident the bridge had been locked and not manned. There had been five master keys and one bridge key. The bridge key

had been in the possession of the deck officer on watch, so that he could e.g. set flags or have the deck lighting switched on. The Chief Officer and the Master had each had one master key. It had not been recorded who entered the bridge.

The normal procedure after berthing had been for all bridge systems to be switched off. The Master had not known who switched off the systems after berthing or whether all nautical systems had been switched off.

The bow thruster could only be operated from the bridge by switching on a second generator. No entries had been made in the alarm records of the engine operation between 09.21 h and 11.13 h. The recordings relate exclusively to malfunctions. In normal operation no alarm would be shown when a generator was switched on.

There had been no major grounding known to the Master. He had not known that a sea grating was missing in the bow thruster tunnel. This had been the first underwater inspection for 2 1/2 years.

The diver's boat had been shifted without engine assistance. It had been about 50 m away from the bow and approx. 25 m from the bow thruster. There had been video and audio contact between the diver and the boat. During the accident there had been no water movements or conspicuous noises. The Master had not heard anything when the diver spoke of a loud noise. The boatman had reportedly been in continuous communication contact with the diver.

In port mode only one auxiliary diesel generator had been running at a maximum rating of 2,000 kW[4], whereby there had been a power output of approx. 1,400 kW. The boiler inspections had taken about 45 minutes. During this time it had not been possible to switch on a second auxiliary diesel automatically because the other diesel engines had been switched to "manual operation". It had not been possible to start the bow thruster. It would not have been possible automatically, even if the bow thruster had not been switched off on the bridge after berthing and a second diesel engine had been switched on again. Furthermore, switching on of the second diesel would have been audible.

4.5.1 Findings of the Maltese Experts

The diver had been wearing a wetsuit with lung regulator and a buoyancy control device (BCD). The connected air hose and the video cable led to the boat. He was holding the camera in his hands and this was connected with the monitor on the boat. The supply cables were twisted as usual. The diver initially swam along the surface of the water to the bow of the VERLAINE and also passed the bow thruster tunnel before starting the diving operation. At 09.37 h the Master noticed problems with the video image and the communication was disrupted. The boat was pulled forward with the lines and blood could be seen on the surface of the water.

[4] Note by BSU: the actual nominal rating is 2,960 kW per auxiliary diesel or converted 2,800 kW per generator according to the GL Class Certificate

In the investigation initiated it was ascertained that the grating of the bow thruster tunnel was missing on the port side and that there were still parts of the body and cable on the pitch propeller. Consequently the diver must have been drawn in to the propeller from the port side through the tunnel with a diameter of approx. 2.5 m.

The Master repeated once again that it would be impossible to start the bow thruster with one auxiliary diesel generator running. The Chief Engineer confirmed that only one generator was running throughout the entire port mode. At about 16.00 h experts as well as the Master and the Chief tested the bow thruster system. When the bow thruster was switched on and one generator was running, the power supply was interrupted immediately and the auxiliary diesel generator switched off. After the generator was switched back on again and a second generator was started, the bow thruster worked after pressing the switch for power supply and pressing a second switch for setting the pitch propeller in neutral position. The propeller pitch could then be changed with the operating lever.

According to a Maltese expert opinion, the accident could have occurred as follows:

The diver heard a noise that would be compatible with the starting of the bow thruster. After this the diver was drawn backwards into the bow thruster tunnel by the supply cable winding round the pitch propeller and killed. The starting of the bow thruster is attributable to poor communication of the crew on the VERLAINE.

An attempt was made to clarify in the presence of an expert and the Chief Engineer of VERLAINE whether starting the bow thruster had been caused by technical failure or manual intervention. The vessel has three auxiliary diesel generators that can be operated automatically or manually. In automatic mode the generators are switched on when more electric power is required. In manual mode the generators have to be started from the engine control room. Alarms for the entire engine operation are recorded by a computer system.

The bow thruster is activated by a switch in the engine control room. After this it can be controlled and operated from the bridge. The bow thruster requires at least two auxiliary diesel generators for operation in order to supply sufficient electric power. This was tried out. With just one generator it was not possible to start the bow thruster. This incident was registered in the alarm records. When started properly with two generators, no alarm is shown. At the time of the accident only generator No. 3 was in operation; the other generators were switched to "manual". Accordingly it was not possible to switch on further generators automatically. No alarms had been recorded at the time of the accident. It was therefore presumed that the operation of the bow thruster was only possible by switching on an additional auxiliary diesel generator manually. The Chief Engineer vigorously refuted this thesis.

The audio evaluation of the video tape of the diver's camera for 5 min and 18 s up to the time of the accident revealed that after 2 min and 56 s a roaring sound could be heard in the background, that the diver perceived 26 s later with the words "I hear a lot of noise here above us". About one minute later the words "Eehhh let me check" and "Because there suppose to be the ..." could be heard. The last words were drowned by a strong noise of breaking. A little later the video record broke off. On the

associated photo sequences the supply cables, the attempt to pull on them with a right hand, traces of blood and parts of the corpse could be seen.

At the time of the accident the reserve diver saw parts of the body floating on the surface of the water at the level of the bow thruster and a "great suction" on the port side of the VERLAINE.

5 Investigation

The BSU was notified by the Malta Maritime Authority, Technical Department, on 12 July 2004 of the fatal personal accident that had happened the day before. In response to an enquiry made at the vessel operator the accident was confirmed and the BSU was informed that the Master and the Chief Engineer had been remained in custody. In the letter of 19 July 2004 the Statement of Facts by the Master and Chief Engineer was sent to the BSU via the vessel operator. The further investigations proceeded haltingly since initially no further information about the accident could be obtained. The BSU did not succeed in obtaining the investigation reports confiscated by the Maltese justice authorities via the Malta Maritime Authority. The German Embassy and the lawyers involved were not allowed to inspect the files either. The Embassy drew attention to the fact that the proceedings could last for months and kept the BSU informed via newspaper articles from the Maltese press. The vessel operator was only able to provide the BSU with the investigation results of the Maltese justice authorities on 25. October 2004, pointing out that the charged persons could leave Malta at the end of October 2004 after they had been accommodated in a hotel on bail.

5.1 Survey on Board by the BSU

On 15 September 2004 the BSU carried out an examination on board VERLAINE, after having contacted the vessel operator on 12 July 2004 and after the vessel had run into Hamburg already on 21 July 2004 without the vessel operator notifying the BSU of this. Since the accident all the officers apart from the Third Officer and the Third Engineer had been replaced by their relieving officers.

GL was to carry out an internal boiler survey and the intermediate survey hull due 2 ½ years after a class inspection in Malta on 11 July 2004. The class runs from 1 June 2001 to 31 May 2005, the intermediate survey dates from 1 June 2003 to 31 May 2004 (2 ½ years +/- 6 months). The intermediate surveys were overdue. The GL had intended to carry out a survey of the hull afloat. The necessary diving firm had been commissioned by the vessel operator.

According to the statement by the Third Engineer, the GL surveyor, the Master, the Chief Engineer and the diver met at about 07.50 h to discuss the survey. After this (from approx. 08.00 h) the boiler survey was carried out with the GL surveyor and the Second Engineer.

After completion of the boiler survey the GL surveyor, the officer in charge of the watch and the diver met at about 08.50 h to prepare the lines for shifting the diver's boat. The diver began to prepare his equipment. At about 09.00 h it was reported to the diver that all was clear and the Master and the GL surveyor proceeded via the pilot ladder on to the launch. This was shifted forward approximately up to the level of frame 115 (see Figure 3). At about 09.15 h the diver went into the water there and

started the survey that the GL surveyor and the Master followed from the wheelhouse of the launch. The fatal accident occurred at about 09.35 h.

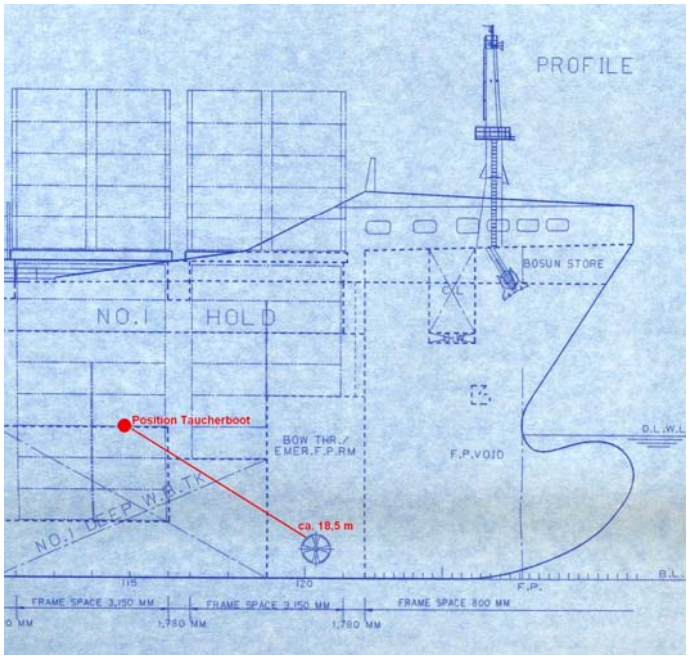

Figure 3: Side elevation foreship

There were no entries in either the ship's log or the engine log concerning the diver's assignment and the accident. There was no copy of the diver's checklist that the diver usually brings on board and which is then worked through jointly by the diver, the Master, the Chief Engineer and the officer in charge of the watch. After the accident the vessel operator devised a checklist and sent this with a circular letter (No. 23) of 13 July 2004 to all vessels of the shipping line as a supplement to the quality management system. Furthermore, an inspector of the shipping line had already flown to Malta on 11 July 2004. It was not possible to submit any inspection report to the BSU.

The bow thruster tunnel was originally secured by sea gratings that served primarily to protect the pitch propeller against flotsam. When the system was switched off, the propeller pitch could be adjusted by the vessel's own movement. The propeller had reportedly sustained damage due to the interfering / disturbing sea grating. That is why the sea grating on the port side facing the propeller had been removed. Photos of the original condition of the sea grating are available on board (see Figures 4, 5). According to the information supplied by the Master, a technical solution has been implemented in the meantime in that the hydraulic motor of the bow thruster switches on automatically when the propeller unintentionally builds up pitch due to the vessel's own movement in a pressure-free condition. This returns the pitch to "ZERO". The sea grating was not remounted.

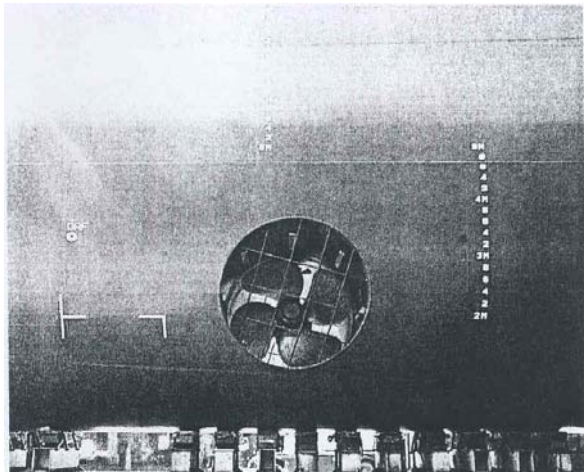

Figure 4: Bow thruster rudder tunnel

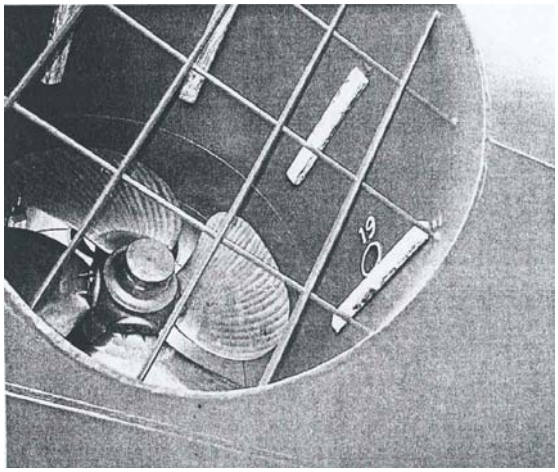

Figure 5: Propeller with grating

Two auxiliary diesels are needed to switch on the bow thruster. In normal operation the system is then switched to the bridge for immediate starting (see Figure 6):

Figure 6: Control console bridge

- Turn the rotary knob "System on/off" to "on". The system checks whether there is sufficient generator power available. If only one auxiliary diesel is running in the port mode (customary mode), the power management system automatically starts a second auxiliary diesel and switched this on in addition. The appropriate lamp on the operating panel only lights up when sufficient generator power is available.

- The hydraulic pump can now be started by push button. A further lamp indicates operation of the pump. In this condition the propeller pitch can already be changed via the hydraulic pump, but the propeller is not yet turning.

- At propeller pitch "ZERO" the propeller engine must be started. Here too a lamp indicates operation. The propeller now rotates without pitch. When the pitch is altered, a bow thruster control effect is achieved.

- If the bow thruster system is not turned off after operation, the propeller continues to rotate with zero pitch. This condition can be maintained in port operation too with just one auxiliary diesel running. If the pitch is now altered, the auxiliary diesel running picks up load and can continue to work up to a pitch of 50% without reaching the capacity limit. At a greater pitch, loads would then be cut off from the power system successively until a "blackout" occurs.

- The bow thruster can also be started from the engine room (see Figure 7). The bow thruster switch panel is located in front of the engine control room. Here it is necessary to turn the rotary switch "Local/Remote" to "Local". This switches operation from the bridge ("remote") to the engine room ("local"). Then the push button "Motor Start" on the bow thruster switch panel is actuated. The propeller now starts to rotate without pitch. It is not possible to change the pitch from the engine room. In port operation, with one auxiliary diesel running, the second auxiliary diesel necessary has to be started manually and switched in. In this case this is not done automatically. If the second auxiliary diesel is lacking, a blackout occurs (see figure. 8).

Figure 7: Control console engine control room

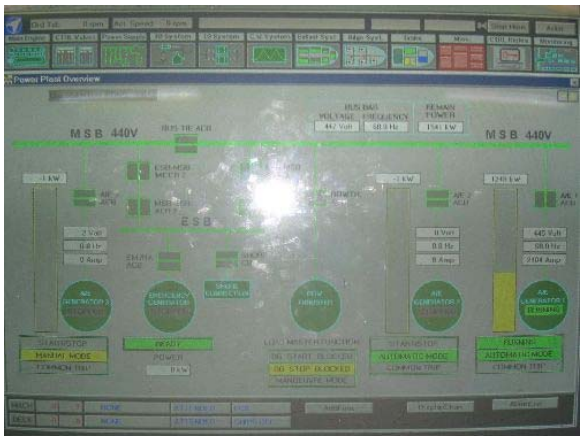

Figure 8: Circuit diagram generators

- The most important safety measure for the diver's assignment would be to interrupt the power supply to the bow thruster on the main switch panel in the engine control room by opening the main switch and mounting an appropriate warning on this main switch. When the main switch is open it is not possible to operate the bow thruster. To close the main switch it is necessary to apply tension to the spring that opens by push button actuation again (see Figure 9). For this it is necessary to actuate the hand lever several times. Only then is it possible to actuate the push button "close". The push buttons for both opening

and closing the main switch are provided with a synthetic cover against unintentional actuation.

Figure 9: Main switch bow thruster

According to the information supplied by the relief Master, there were no service technicians or other external staff on the bridge on 11 July 2004, and apart from the class work no other maintenance, repairs or trials were carried out.

The following information was obtained by questioning the Third Engineer:

- He was simply informed about the fact that diving work would be carried out.
- After he returned from breakfast at 08.00 h he was in the entrance area of the engine room for the assignment of tasks. From here he saw the note regarding diving work on the engine control panel. He could not say anything about a warning sign at the main switch of the bow thruster.
- After the tasks were assigned he was working with two other crew members on the seawater coolers about 6 m away from the auxiliary diesel station. He stated that he had not noticed the diesel generator running with increasing revolutions or the starting of a second diesel generator.

The vessel's command can call up the incidents of the last 48 hours with the computer program of the engine's monitor system. Only service technicians are able to read out 32 days. If a survey had been held on 21 July 2004 when the vessel was in Hamburg, it would presumably have been possible to read out further information from the system.

5.2 Hearing of the Master and the Chief Engineer at the Vessel Operator's

A hearing of the Master and the Chief Engineer at the premises of the vessel operator NSB in Buxtehude was carried out at 14.00 h on 3 November 2004. In addition the legal adviser of the vessel operator, and to start with a lawyer of the vessel operator, were also present. At about 14.30 h the technical inspector of the vessel operator also joined the hearing. He had travelled out to Malta directly after the accident. The Master stated that he had only learned that same day from the vessel operator that a meeting with the BSU had been arranged and asked whether the BSU had received his accident report and the corresponding report by the Chief Engineer. Since this was not the case, copies were made for the BSU.

The Master stated that he had been working as Master for NSB since 1970. He had carried out four duty assignments on a sister vessel. At the time of the accident he had been on the VERLAINE for six weeks.

The Chief Engineer had been sailing in this function since 1983 and has been employed by NSB since 1996. He had been assigned on the VERLAINE since March 2004.

The two gentlemen then described the course of the day of the accident and explained the circumstances of their arrest and accommodation on Malta. The facts that were not known to the BSU at that time are set out below:

- The signed checklist of the diver with the safety requirements for the underwater survey could not be presented. Apparently it could not be found at the time.
- The Master was unable to provide an explanation for the lack of the sea grating at the bow thruster tunnel. The inspector justified this with material fractures and removal as a precautionary measure. It was not possible to determine when and where the sea grating had been removed.
- There was no man on deck to shift the launch. The boat's crew did this themselves with long lines.
- The reserve diver was standing in readiness on the diving boat in swimming trunks and was not expediently equipped for his assignment.
- The Third Officer and two sailors were on deck watch duty.
- The Master had no control over which persons were on the bridge. He complained of the hectic conditions that always prevailed in port operations.
- The vessel was moored fore and aft with four lines and two springs each. There were no problems with the mooring winches. These were designed with sufficient power. The position of the vessel in relation to the pier was never corrected with the aid of the bow thruster.
- The hydraulic pump for the shifting device of the bow thruster was located in the bow thruster chamber. The running hydraulic system and the moving propeller generated a loud noise. On deck the ventilators of the bow thruster could also be heard. The noise development was reportedly substantial here. The Master could not explain why the diver did not come up when he heard a roaring sound.

5.3 Questioning of the Manufacturer of the Bow Thruster System

The bow thruster system of type LIPS CT250H from the manufacturer Wärtsilä Propulsion Netherlands B.V. has a maximum power input of 2,000 kW with a right-hand turning, pitch propeller (see Figure 10). The electric motor turns nominally at a rate of 1,200 rpm with a transmission ratio of 1170:265 between the drive shaft and propeller. The maximum thrust is calculated as 296.3 kN (30.2 t). The propeller pitch is operated from the bridge. The "ZERO" position can be set at +/- 5 % pitch. In this position there is always a current flow. The direction of flow depends on the fine adjustment on starting up. There are no recordings of this. There are no measurements of the engine noises. The sea gratings at the ends of the tunnel are not part of the installation.

According to the operating instructions of the manufacturer, John Crane-Lips, the following procedures are provided for starting and stopping the bow thruster system:

Starting

- Check oil level in tank(s)
- Switch on the remote control system
- Switch on the hydraulic system
- Make complete pitch adjustment on all control stations
- Check whether control handles and pitch indicators are in zero position
- Start the propeller drive motor

Stopping

- Set pitch to zero
- Stop propeller drive motor
- Switch off the hydraulic system
- Switch off the control system

After switching off the control system, no special measures have to be taken. All valves can remain in the position they had during normal service.

The automatic monitoring of bow thruster system operation at the control console on the bridge (see Figure 6) and in the engine control room can be monitored via freely programmable alarms. These include voltage, hydraulic pressure, oil level in the tanks and motor temperature. The status of the system and operation of the aggregates is displayed by lamps. There are further switch panels in the bow thruster chamber and in the bridge wings.

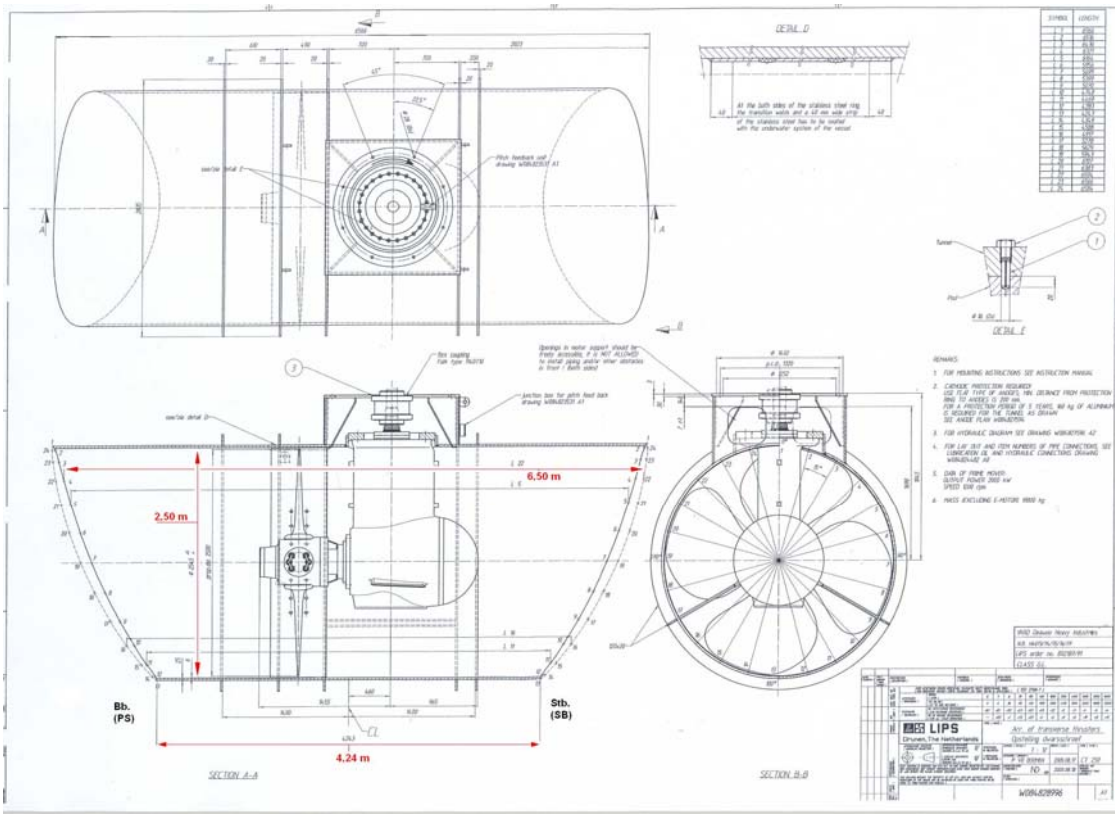

Figure 10: Plan of bow thruster system

5.3.1 Supplementary Statement of 20 April 2005 by the Manufacturer on the Operating Instructions

The manufacturer states that the control console and the electric motor for starting the bow thruster system come from a sub-supplier and are not manufactured by Wärtsilä Propulsion.

The text on the operating console refers to manufacturing data subsequently submitted by Messrs. Wärtsilä.

Following actions have to be taken to give a start signal to the bow thruster starter box:

1. Switch S1 must manually be set to on.
2. Generator power must be available. Main switch board must close a contact to withdraw the interlock of the "GEN power available".
3. Power pack must be manually started to withdraw the interlock "hydraulic pressure available"".
4. Pitch must be in the „zero area“. Will be automatically adjusted to zero when power pack is switched on.
5. Start button on wheelhouse or engine room panel has to be activated manually.

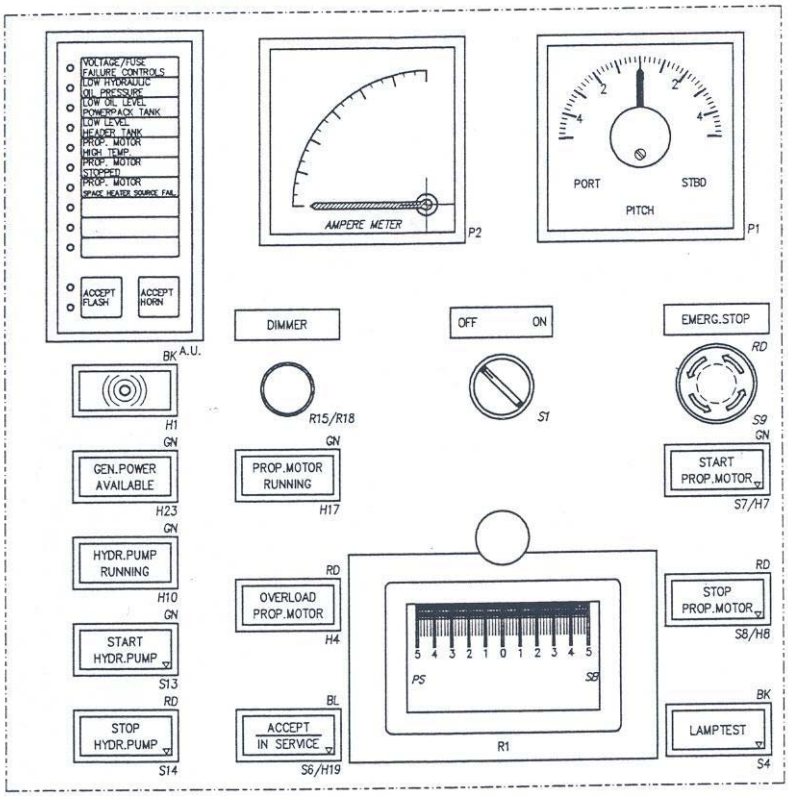

Figure 11: Control console bow thruster system Messrs. John Crane-Lips

START LOOP BOW THRUSTER

1. Switch S1 at wheelhouse panel

Switch S1 is situated on the main wheelhouse panel. When this switch is in the off position, the power supply to the control transfer is switched off. (power supply B)
Further there is **no** request, to the main switch board, for generator power.
The start loop is open, independent from any other actions.

When switch S1 is set to on. Power will be available and only action that is taken is a request for generator power to the main switch board.

2. Generator power available

This is an external input from the main switch board. This input is for the LIPS system an allowance from the main switch board that sufficient power is available to start the bow thruster.
Only action is that green light at the panel "GEN POWER AVAILABLE" (H23) is lit.
Start loop can not be closed when "gen power" is not available.

3. Hydraulic pressure available

A pressure switch is situated at the power pack. This indicates when sufficient pressure is available to operate the power pack. This means that hydraulic pump must be running. This pump has to be started manually from the wheel house panel (S 13) or local at the starter box in the bow thruster room.
Only action is that green light at the panel "hydr.pump running" (H10) is lit.
Start loop can not be closed when hydraulic pressure is not available.

4. Zero pitch

The pitch indication module provides a closed contact when pitch is in zero (this is a small area around zero pitch).
Start loop cannot be closed when pitch is not in the "zero-area".

5. Start button

Two start buttons are supplied in the LIPS control system. One is situated at the wheelhouse panel (S7) and other at the panel in the ECR (S7).
Start loop can not be closed when no start button is manually activated (pulse).

5.4 Questioning of the Divers on Board the Wreck Search and Surveying Vessel ATAIR

For professional divers the diving equipment normally consists of a helmet (see Figure 12), a wetsuit or dry suit, a buoyancy jacket or harness with additional air cylinder for approx 15 minutes of working air and weights. The cables/"umbilical cord" (e.g. for video, lighting, communication and compressed air) are twisted together and coloured differently. In addition the diver always carries a knife or pair of scissors in a chest holder (see Figure 13) or fastened to his leg. The video camera is carried freely or mounted on the helmet.

Figure 12: Diver's helmet

Figure 13: Harness jacket

A diving group consists of at least three persons (diver, reserve diver, signal man). The work is regulated in BG Regulation C23 See-BG (German Marine Insurance and Safety Association). The reserve diver stands on deck with diving equipment, but without a helmet. The signal man guides the umbilical cord of the diver. No additional safety line is needed. Agreed signals can be exchanged with the diver by pulling on the umbilical cord. The signal man also checks the communication and the compressed air station. The compressed air is reduced to 12 bar from a pressure cylinder with 200 bar on the tender and passed via the air cable (blue, see Figure 13) to the diver with the umbilical cord. The additional air cylinder can be activated manually via a three-way valve on the helmet.

Breathing is controlled via a lung automat in the helmet. A microphone, loudspeaker and lamp are also fitted on the helmet. Thanks to the good sound transmission in the water (approx. 1,600 m/s) the diver hears nearly all noises below water, including the auxiliary diesel and the outflow of service water. At diving depths of around 15 m the diver can remain in the water for approx. 18 minutes without stopping times when he comes up. The total decompression time according to Table 1 is then at least 15 seconds. Ideally, rising should not be faster than 10 m/min. A repeat diving operation would be possible.

On the ATAIR the Chief Engineer and the bridge crew are notified that diving will take place prior to a diving operation. The main engines and the water jet drive for manoeuvring cannot be started then. An appropriate warning plate is mounted on the bridge. Noises can only be allocated roughly to sources. The only possibility would be to remain in the diving position immediately when noises are perceived and to enquire via the radio connection where these noises come from. From a flow of about 0.5 kn the diver no longer has any chance of maintaining his position. The capping of the umbilical cord, probably consisting of three cables, using a knife would then not be possible at short notice. There was no possibility of allocating noises when the diver swam above water to the bulbous bow at the front either.

6 Analysis

The nautical and technical officers were basically informed that there would be surveys to renew the class. These included the boiler surveys in the engine room and the hull survey below water. There were detailed discussions on the procedure between the Master, Chief Officer, Chief Engineer, diver and the GL surveyor. The discussions were partly carried out separately and by telephone. According to the discussions the bow thruster system should have been switched off via the operating console on the bridge. No checklist for the work to be avoided and the safety checks to be carried out on the VERLAINE could be presented to the BSU.

After the vessel had run into port the unfavourable customary general hectic conditions on board prevailed. The bridge and the engine had to be made clear for port operation, loading and discharge operations and the surveys had to be organised. The GL surveyor pointed out already in advance that it would not be possible to carry out all the planned surveys. He also had a subsequent order for another vessel. The diver's checklist had to be worked through. The diver had a timeframe of approx. two hours for the diving operation, since ship operations in the port basin were expected after this. This supposed pressure of time might have contributed to the safety requirements for the diving operation not being carried out conscientiously on board. However, it should be noted here that according to the crew list the VERLAINE was manned with an additional 4th Nautical Officer. Accordingly it would have been possible to organise responsible tasks better with consideration given to the general workload in order to relieve other officers.

After the vessel had entered port there was no specified procedure for clearing the bridge (e.g. switching off nautical systems and the bow thruster). The Master and the Chief Engineer were of the opinion that as on previous vessels of the vessel operator, it was not possible for the bow thruster system to run with only one diesel generator running. However, instead of the erroneously assumed nominal rating of the auxiliary diesel of 2,000 kW, the actual performance according to the class certificate of GL is 2,960 kW per auxiliary diesel, or 2,800 kW per generator. This faulty assessment might have contributed to the assumption that the bow thruster must have been out of operation in any case due to switching off manually or automatically.

The operation of the bow thruster system is only described inadequately in the manufacturer's operating instructions. In particular there is a lack of any information on automatic switching off by insufficient power uptake and the fine adjustment during first commissioning of the system and the associated effects in idling operation. As a result the crew has no further opportunity of gathering information about risks in connection with the system.

On the day of the accident the diesel generator running for port operation had a load of approx. 1,400 kW with a remaining power reserve of approx. 1,600 kW. The maximum power input of the bow thruster system is 2,000 kW. Consequently continuous operation is basically possible with one diesel generator running. Even the pitch of the propeller could be increased by up to 50 % before overloading takes

place and the loads are withdrawn from the power in manual operation successively without power management until a blackout is reached. The most important measure for preventing operation of the bow thruster system would be to interrupt the power supply at the main switch in the engine control room.

The bow thruster tunnel was originally secured at the ends by sea gratings. The sea grating on the port side is missing. It was removed by way of precaution since damage to the bow thruster system was feared as a result of wear. This measure was not known to the Master, the Chief Engineer and the surveyor. No records of the removal of the sea grating have been submitted to the BSU. The sea grating might have been able to prevent possible winding of the diver's supply cables round the propeller of the bow thruster and have prevented the diver from coming into the propeller area. The actual purpose of the sea grating is to protect the bow thruster system against flotsam, however.

Sounds can be heard well under water. However, it is difficult to allocate the source of noise precisely in terms of distance and location, since noises coming from far away are perceived too. Even when the diver swam to the bow and passed the level of the bow thruster, he was unable to allocate noises during ongoing loading and discharge operations. The only safe opportunity for the diver would have been to ask the signal man on the diver boat where the noises were coming from, and if possible not to leave his present situation. Directly before the accident the signal man on the diver boat registered roaring sounds, but the boat's crew interpreted these as an electrical disturbance in the cable connection. At this time possible operation of the bow thruster or some other fault were not considered. The reserve diver / signal man was standing ready on the diver's boat in swimming trunks and was not suitably equipped for his assignment. It is questionable whether he was guiding the supply cables (umbilical cord) of the diver properly so that he could give or conversely receive signals by pulling on the umbilical cord. During the diving operation the diver no longer had any chance of maintaining his position, since even at a current force of approx. 0.5 kn he would necessarily drift with the current. It was not clarified whether the knife was used for cutting the supply cables.

According to the statement by the Chief Officer, directly after the accident the bow thruster system was idling and the pitch was set at "ZERO". The Chief Officer ran to the bridge immediately after the accident to check the status of the system and switched it off. According to the observations on the diver's boat, parts floating upwards and a water eddy were sighted. It is therefore to be assumed that the system was at least idling during the accident and that the turning pitch propeller was in operation.

Even when the variable propeller is idling there is always a pitch of up to 5 % for technical reasons and a current flow is generated. The pitch depends on the fine adjustment of the system on installation. There are no records of this. When idling the propeller turns at 265 rpm.

6.1 Cause of the Accident

As a result of the bow thruster system being switched on sufficient current flow was generated to suck the diver into the pitch propeller. It is possible that the supply cables of the diver became wound round the pitch propeller too and intensified the forces acting on the diver. The accident was further promoted by the lack of a sea grating on the bow thruster tunnel, which was not known to anyone on board, and the incorrect assumption that the bow thruster was switched off. The accident is therefore attributable to inefficient communication in the vessel's operation and to a lack of documentation of structural changes to the bow thruster tunnel.

Although there was a checklist handed over by the diver to be worked through by the ship's command, and agreements were made between the ship's command, the diver and the surveyor, the safety measures to protect the diver's life were not carried out reliably. These would have included switching off the bow thruster from the bridge and interrupting the power supply at the main switch in the engine control room. Then the bow thruster system would no longer have been able to run.

That the safety measures were not carried out reliably is attributable to the hectic conditions on entering port due to pressure of time, to the lack of procedures for "clearing the bridge" after running into port and for diving works, and to negligence due to an incorrectly assumed hypothesis that the bow thruster can only work with two auxiliary diesel engines running.

The diver only had a slight chance of freeing himself, e.g. by cutting the supply cables, and of allocating the noises he perceived under water in order to be able to initiate counter measures in good time. He had to assume and rely on the fact that all the necessary safety measures had been carried out on CMA CGM VERLAINE.

7 Safety Recommendation(s)

The BSU recommends owners, operators and crews of vessels to which the International Safety Management Code (ISM Code) applies to ensure that important operational procedures on board are described adequately as regards safety of the vessel and that the tasks arising are concretely allocated to the relevant enabled staff. In all cases these include measures for plant and engine operation on the bridge and in the engine room that are necessary when changing over from sea to port operation or vice versa. The work on the vessel carried out by external firms with their additional safety requirements are to be realised efficiently as co-valid documents, i.e. the tasks resulting from these are to be allocated to staff members on board responsible from case to case.

The owner must observe his obligation of reporting structural changes in the authorised structural condition of the vessel to the supervisory institutions.

The manufacturers of bow thruster systems must ensure that the maintenance and operating instructions of the equipment they bring into circulation include the necessary detail and provide easily understandable information about starting up and switching off. This also includes clear indications of the automatic switching off, the fine adjustment and the unintentional and uncontrollable build-up of pitch of the variable propeller when idling and of special dangers and risks in the pressure-free condition and during maintenance work or underwater surveys of the system.

8 Sources

- Investigations
  - Water Police Malta
  - Maltese Justice Authority
  - On-board survey of CMA CGM VERLAINE and questioning at the vessel operator's offices, Federal Bureau of Maritime Casualty Investigation (BSU)

- Written statements/comments
  - Vessel's command CMA CGM VERLAINE
  - Vessel operator NSB Niederelbe Schiffahrtsgesellschaft mbH & Co. KG
  - Classification Society Germanischer Lloyd (GL)
  - Wärtsilä Propulsion Netherlands B.V.
  - Embassy of the Federal Republic of Germany in Valletta
  - Records of the proceedings of the Maltese Justice Authorities

- Statements by witnesses
  - Crew of CMA CGM VERLAINE
  - Crew of the diver's boat
  - GL surveyor

- Expert opinions/technical article/information supplied orally
  - Divers of the wreck searching and research vessel ATAIR of the Federal Maritime and Hydrographic Agency (BSH)
  - Maltese expert opinion of the course of the accident with analysis of the audio records of the diver
  - Germanischer Lloyd

- Sea charts and vessel particulars
  - Federal Maritime and Hydrographic Agency (BSH)

- Documents
  - BG Regulation C 23 See-Berufsgenossenschaft (See-BG) (German Marine Insurance and Safety Association)
  - Accident Prevention Regulations Sea (UVV-See) of the See-BG (German Marine Insurance and Safety Association)
  - BSH ship's files
  - Diving equipment Pommec BV, Netherlands, Beuchat USA
  - Classification and Building Regulations of GL
  - International Safety Management Code (ISM Code)