Bundesstelle für Seeunfalluntersuchung
Federal Bureau of Maritime Casualty Investigation
Federal Higher Authority subordinated to the Ministry of Transport,
Building and Urban Affairs

Investigation Report 212/08

Serious Marine Casualty

Accident resulting in severe injuries to 2 people caused by three broken lines while making fast CMS RUILOBA on 18 May 2008 in Bremerhaven

1 September 2009

www.bsu-bund.de

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 16 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 present report should not be used in court proceedings or proceedings of the Maritime Board. Reference is made to art. 19 para. 4 SUG.

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

Issued by:

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Table of contents

Table of figures

1 Summary of the Marine Casualty

On 18 May 2008 the container ship RUILOBA, flying the Spanish flag, was en route from Hamburg to Bremerhaven and headed for Terminal CT 4 on the Stromkaje, with her port side. The westerly wind came from starboard, more from astern than from abeam, with a strength of 3-4 Bft and the ebb tide ran against the vessel at 3 – 3.5 kn. The mooring manoeuvres were controlled from the port bridge wing. In the wing were the Master, Second Officer, a Service-engineer and the Harbour Pilot. The mooring was carried out without any problem. During this, the helm and the engine controls, including the transverse thruster, were operated by the Second Officer according to the recommendations of the Pilot. The RUILOBA should be moored with three bow lines and three stern lines respectively as well as two fore springs and two aft springs. After all the lines were fixed on land, Bremerhaven Port was notified that the RUILOBA had moored at 1810[1]. Afterwards the Second Officer accompanied the Pilot to the aft deck. There the tugboat was still attached with a loose towline to starboard. On the starboard pilot ladder the Pilot noticed an unusual turning of the RUILOBA to port and so he went back to the bridge. There the Master reported that there had been an accident on the aft deck and that an ambulance had to be called. From the port wing no movement of the RUILOBA could be detected anymore. The ship however laid approx. 7 m distance from the pier at the stern. The tugboat was instructed to push the stern of the ship back to the pier again. After this the RUILOBA was about 5-6 m further south than its original position. Through the forward movement and the veering away of the stern, a stern line and one fore and one aft spring each were broken. Because of this, two seamen were gravely injured on the legs.

[1] All times in this report, unless otherwise specified, refer to local time, Central European Summer time = UTC + 2 h

2 SCENE OF THE ACCIDENT

Type of event:	Accident to people during mooring
Date / Time:	18 May 2008, 1812
Location:	Bremerhaven, Stromkaje
Latitude/Longitude:	φ 53°36.0' N λ 008°30.8'E

Section from chart 4, Federal Maritime and Hydrographic Agency

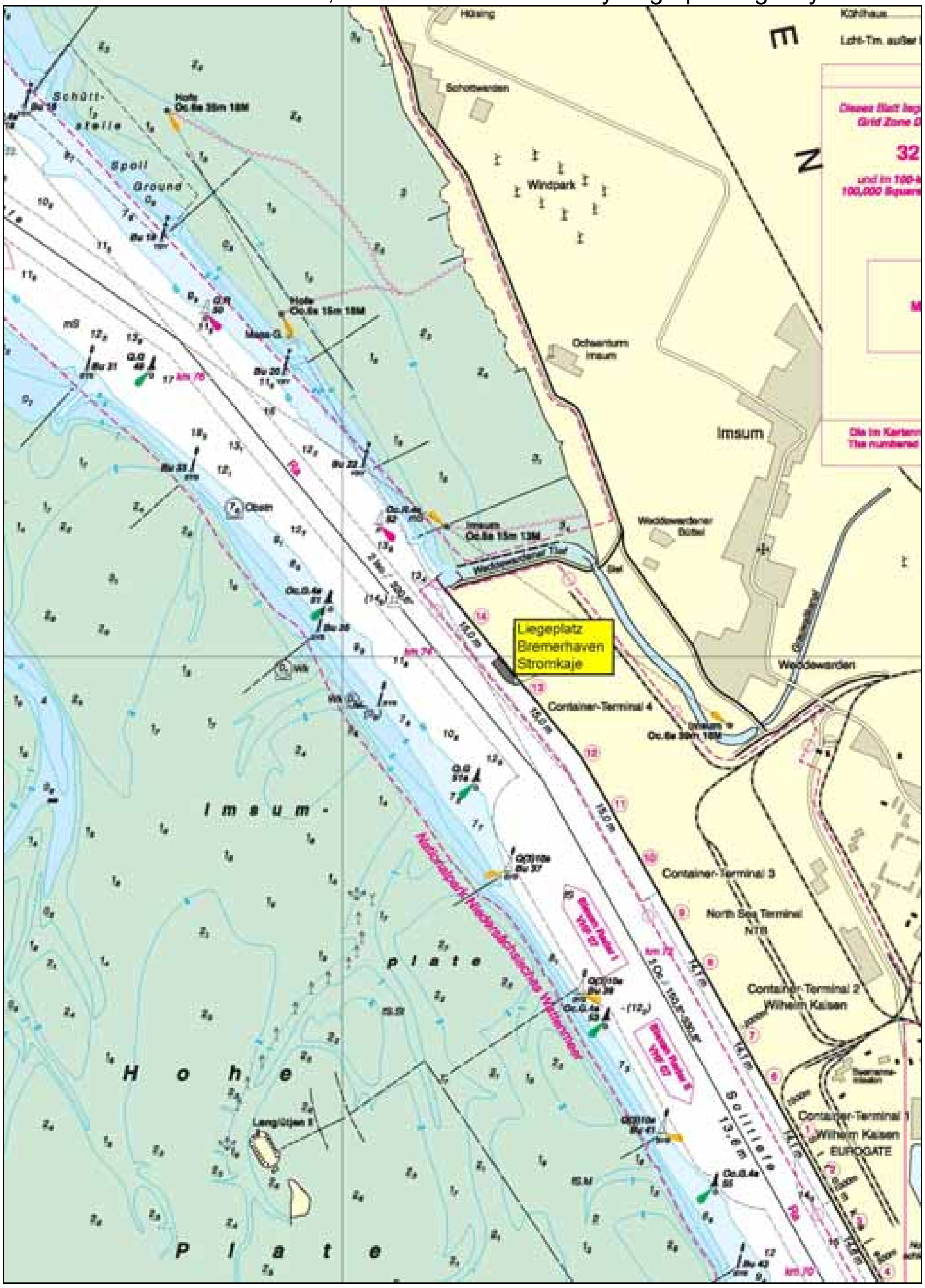


Figure 1:Nautical chart

3 Vessel particulars

3.1 Photograph of the vessel

Figure 2: Photograph of the vessel

3.2 Vessel particulars

Name of vessel:	RUILOBA
Type of vessel:	Container Ship
Nationality/Flag:	Spain
Port of registry:	Santa Cruz de Tenerife
IMO–Number:	9348625
Call sign:	EBWJ
Vessel operator:	Compania Trasatlantica Espanola S.A.
Year built:	2007
Shipyard/Yard number:	Hijos de J. Barrerras S.A., 1651
Classification society:	Lloyds's Register
Length overall:	159.4 m
Breadth overall:	24.8 m
Gross tonnage:	14018
Deadweight:	24496 t
Draught:	9.5 m
Engine rating:	10395 kW
Main engine:	Wärtsilä
Speed:	18 kn
Hull material:	Steel
Number of crew:	15

4 Course of the Accident

On 18 May 2008 the RUILOBA was en route from Hamburg to Bremerhaven and at around 1800 headed to berth 13 at the Stromkaje, with her port side. The westerly wind came from starboard, more from astern than from abeam, at force 3-4 Bft and the ebb tide ran against the vessel at 3–3.5 kn. The harbour pilot was taken on board from the tugboat ANTONIE between buoys 49 and 51. Afterwards the tugboat was made fast aft on the starboard side. At around 1740 and approximately 100 - 150 m northwest of the pier between berths 13 and 14 the main engine stopped through the accidental pushing of the Stop Engine button (Paro Motor) in the engine control room. After vacating the stop command, the RUILOBA was able to continue shortly afterwards under its own power. The mooring manoeuvre was controlled from the port wing. As a result of the investigations of the Waterway Police, it was found that in the wing were the Master, Second Officer, a Service-engineer and the harbour pilot. The mooring was carried out without any problem. During this, the helm and the engine controls, including the transverse thruster, were operated by the Second Officer according to the recommendations of the Pilot.

The RUILOBA should be moored with three bow lines and three stern lines respectively, as well as two fore springs and two aft springs. This instruction was given by the Pilot via voice radio to the mooring crew. The manoeuvre stations fore and aft were reached via the vessel's own handheld radios. After the mooring lines were passed ashore and the vessel was lying with engine stopped at position 4290, first the Master and Pilot and shortly afterwards the Second Officer went into the wheelhouse. Where the Service-engineer went to could not be determined. On the bridge the pilot papers were filled in and Bremerhaven Port were notified that the RUILOBA had moored at 1810. Afterwards the Second Officer accompanied the Pilot to the aft deck. There the tugboat was still attached with a loose towline to starboard, although the command to release them had previously been given. On the starboard pilot ladder the Pilot noticed an unusual turning of the RUILOBA to port and so he went back to the bridge. The Master reported that there had been an accident on the aft deck and that an ambulance had to be called. From the port wing no movement of the RUILOBA could be detected anymore. The ship however laid approx. 5-7 m distance from the pier at the stern. The tugboat was given the instruction to push on the stern of the ship again, and via voice radio an ambulance was called. Afterwards the RUILOBA was some 5-6 m further south than its original position. The Master went to the stern of the vessel.

4.1 Investigations of the Bremerhaven Waterway Police

For the berthing manoeuvre two mooring crew had been deployed fore and aft respectively to take the lines of the RUILOBA and put them over the bollards. Two further mooring crew later joined them from another deployment. At around 1800 all the bow lines had been set and tightened up partially. The front mooring crew then went to provide support aft. There, two springs and one stern line had already been tightened up, while a second stern line just went into the water and was then heaved onto the land. For the third stern line the heaving line broke. This stern line was then manually pulled on land by five people and made fast. For the mooring crew, the job was now done and they went to the superstructure to help with the pulling out of the gangway. Yet before all the lines were tightened up, the RUILOBA moved forward and black smoke came out of its funnel. In doing this, one of the stern lines broke and immediately afterwards a fore spring line. During this, one person was reported as being on the port wing of the bridge. According to the mooring crew it was around 1804[2]. One seaman astern was injured in the leg. Once headway had been stopped, the vessel moved backwards under engine power and as it did it moved away from the pier at the stern. Because of this, an aft spring broke and injured a second seaman in the leg who stood near the operating station of the winches. Afterwards, one of the mooring crew used a mobile phone to call the emergency medical services with an emergency doctor and organised an escort car for the container terminal so that the RUILOBA could be reached quickly.

Around 1812[3] the Chief was informed by the Master that the engine was no longer needed and control could be switched to the engine control room. In doing this, the Chief allegedly found a propeller pitch of 40-50 %, which was why he could not take over the control. The Master allegedly replied that at his end a 0 % pitch was shown. A few seconds later the Chief then allegedly registered a setting of "Full Astern" and soon afterwards "Stop". When the control of the engines is directed to the bridge, then no changes in revolutions (rpm) or propeller pitch can be made in the engine control room. The manoeuvre log recorder was not in operation. The last recordings were from August 2007. It was 1916 when the engine was finally shut down.

The Master, who had 10 years experience in feeder service, had been on board for 3 months. The RUILOBA serviced Hamburg, Bremerhaven and Gdingen (Poland). On the night of 18 May 2008 the Master was able to rest undisturbed until breakfast the next morning. Afterwards he took over the sea watch and after lunch he could rest for another hour while the ship lay in the roads off Bremerhaven. At 1500 the voyage was continued towards Bremerhaven with a pilot and at 1740 the harbour pilot came on board. The aft tugboat was attached at 1745 and the RUILOBA was supposed to moor on its port side. Before this manoeuvre, there was a complete engine failure. Afterwards the RUILOBA continued the mooring manoeuvre at a narrow angle on the port side. The fore spring line went ashore first. The current was running against the vessel at 3-4 kn. Through the tugboat assistance on the starboard side, it was sufficient to set the propeller pitch temporarily at 5-15 %. The engine control was operated from the conning position of the port wing and the heaving of the mooring line could be observed together with the pilot. When three bow and stern lines respectively as well as two fore and aft springs were fastened on land, the tugboat was relieved and the pilot was accompanied by the Second Officer down below. At 1812 the end of the voyage was noted in the bridge logbook. Afterwards, the Chief was supposed to redirect the engine control to the engine control room. That was not possible although the propeller pitch had been set before by the Master to "Stop". At the same moment the breaking of two mooring lines could be heard and the RUILOBA started to move. With this, the Master rushed to the port wing and set the propeller pitch to "Full Astern" and afterwards to "Stop". The stern of the RUILOBA moved away from the pier and aft spring line broke. It is not confirmed whether all mooring lines had been hauled through at this time. The tugboat pushed

[2] The times which are given by the witnesses may diviate from VDR-data and are not synchronized editorially.
[3] See footnote 2

the vessel back to the pier. Afterwards the Master was informed about the accident by voice radio and initiated emergency measures. He was absolutely sure that he had not set the propeller pitch to 50% especially since when mooring it had been sufficient at 5-15 % pitch. It was reported that the Master had undertaken mooring manoeuvres under comparable conditions more than 10 times at Bremerhaven.

When the pilot came back to the bridge after the accident he was informed by the Master about the events and took over the further coordination of the tugboat and ambulance. He did not pay any more attention to the position of the control levers. The RUILOBA was again motionless at the pier and the broken lines were replaced.

5 Investigation

When the Waterway Police reached the RUILOBA, two emergency doctor vehicles and an ambulance could be seen. The two seamen, with severe injuries to the legs, were tended to and transported to hospital. The main engine was still running and there were a total of three lines broken, the eyes of which lay over the bollards ashore. The broken lines were later replaced (see Fig. 3). On all winches fore and aft mooring lines of steel wire and synthetic fibre were rolled up, which all had long green forerunners.

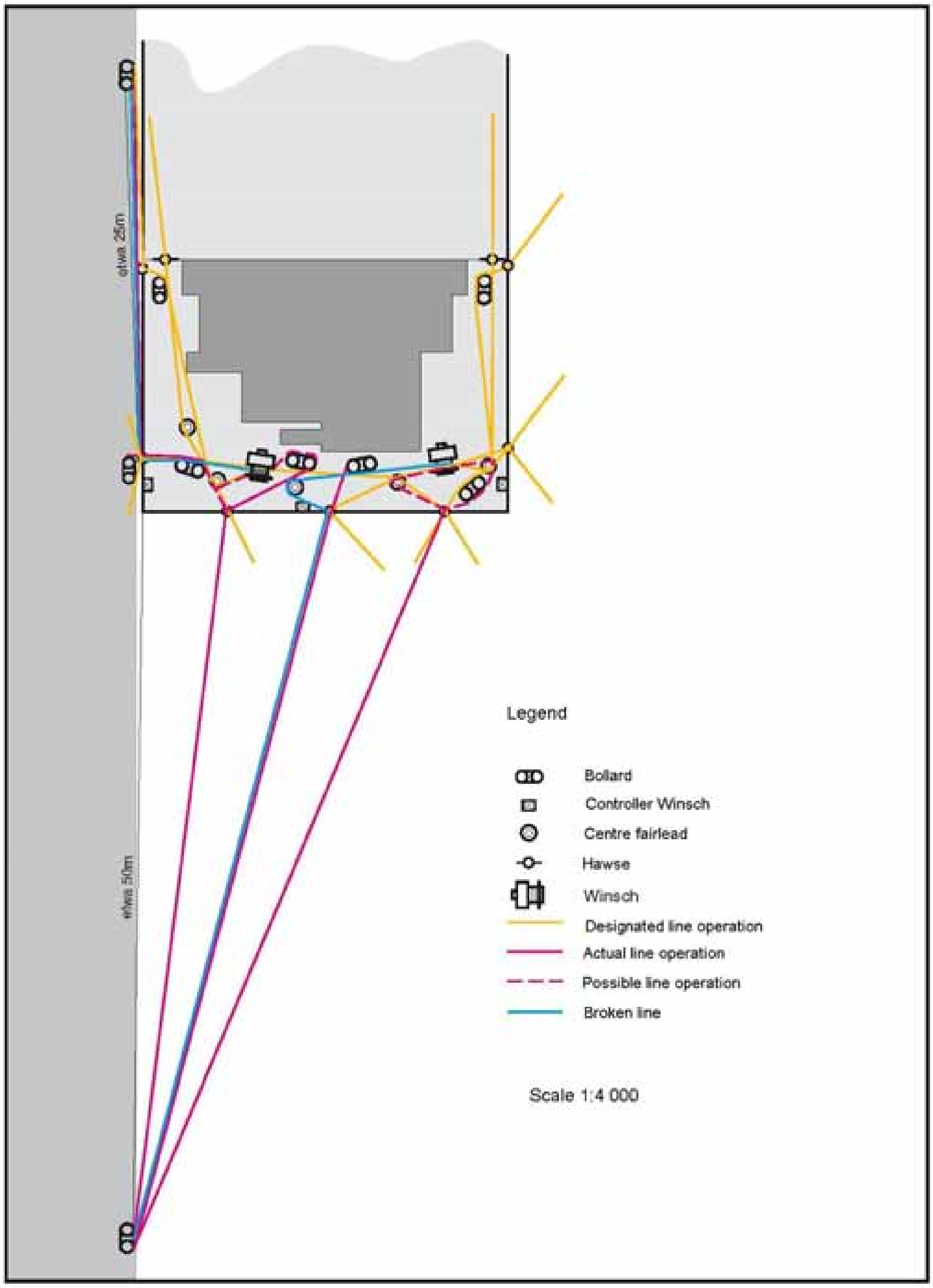


Figure 3: Mooring Plan

Usually at the bow and stern respectively were one spring, one bow line and one stern line with one layer driven on the working drum of the winch, while the rest of the lines remained on the storage part of the winch. The responsible officer at the stern operated the controllers on the winch console (see Figs. 9 and 10), which is situated in the middle of the transom. The broken polypropylene lines were certified and had a breaking strength of 518 kN (50 t, green lines) and respectively 396 kN (40 t, white lines). The broken fore spring was white and the broken stern line and also the aft spring were green (see Figs. 6, 7 and 8). The steel wire rope of the aft spring had, according to analysis of the photos, a diameter of 28 mm, which would correspond to the breaking strength of the green polypropylene rope. The nominal traction force on the stern is specified at the capstan head in 1st gear by the manufacturer Ibercisa as 11 t at a speed of 30 m/min and in 2nd gear as 5.5 t at 60 m/min, as well as in the first layer on the storage drum in 1st gear as 14.0 t and 23 m/min, in 2nd gear as 7.0 t and 46 m/min. After the stern pull came onto the line, the Officer is reported to have warned his second man before the stern line broke, which later had hit the 1st seaman. Afterwards the officer initially standing at the winch, had, according to his own statement, attempted to engage the capstan of the aft spring held by the break in order to provide more slack. Reportedly this did not happen anymore since he himself was hit by the aft spring situated on the storage drum. Engaging would have required to reverse the mechanical lever below the crank handle of the band brake (s. fig. 5 and 8). The investigations of the Waterway Police revealed that, contrary to the mooring sketches displayed above, also lines hauled through were placed on the capstan head and additionally secured on a bollard (s. fig. 4). Hence it is probable that the seaman who was injured first stood in the area of the starboard winch and the injured officer at the port winch in order to be able to work on the capstan heads. The broken stern line and aft spring were lined up in parallel to the capstan heads and were held beyond the breaking strength, respectively, by the mechanical strap brake which is operated with a manual wheel and from the manufacturer is specified for a load of 360 kN (36 t). From viewing the photos, the breaking points were most likely all outside the ship. The impact through overstretching and breaking of the ropes was sufficient to let the long forerunners spring back and hit the seamen on their legs. Depending on the condition of the polypropylene rope the maximum stretching that can be achieved with a length of 50 m is easily 6-9 m, where a total lashing/rigging of approx 18 % and a tolerance of 5 % are assumed. On the working part or storage part of the winch the following rope lengths would fit: green line 37 m, white line 46 m and steel wire 301 m and respectively at half drum occupancy 15 m for the green line, 18 for the white line or 120 m for the steel wire[4].

[4] Source: Drum calculator Drahtseilwerke Bremerhaven with the drum measurements from fig 5

Figure 4: Line guidance after the accident

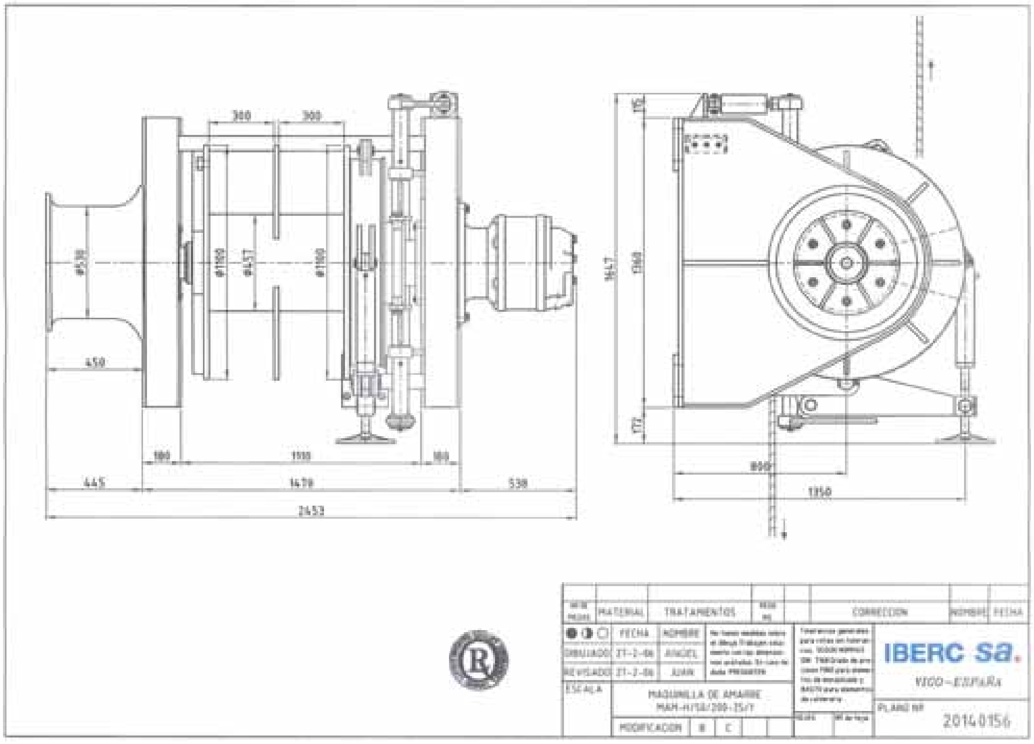


Figure 5: Winch of the manufacturer Ibercisa

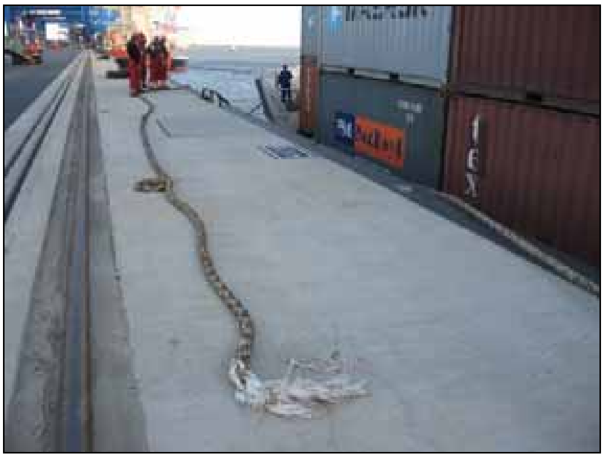
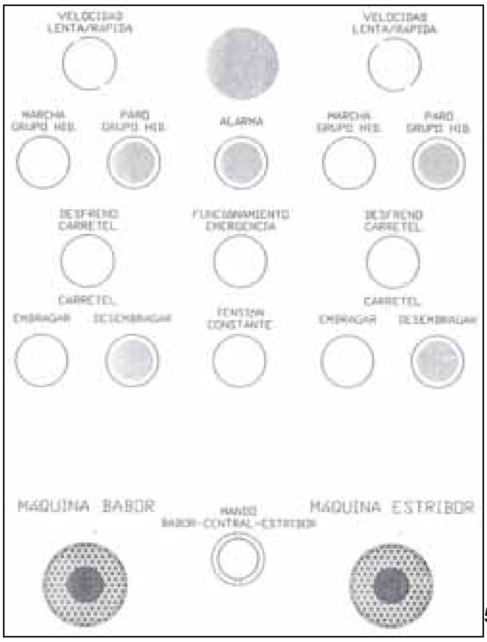


Figure 6: Broken Fore Spring Line

Figure 7: Broken Stern Line

Figure 8: Port Winch with Broken Spring



[5]

Figure 9: Operation Station for Winches amidships at the transom

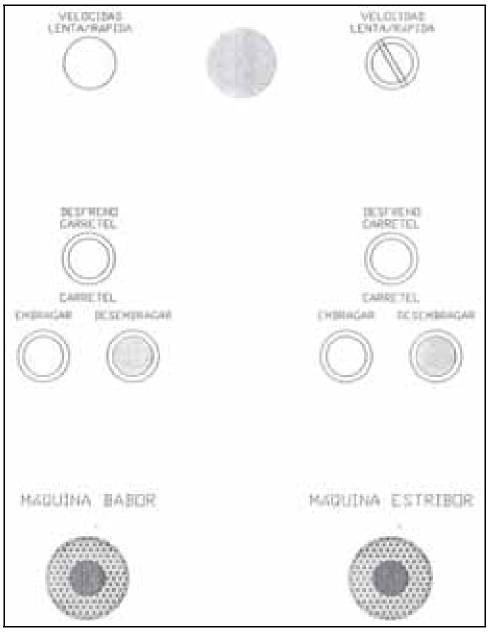


Figure 10: Operation Stations at the transom, port and starboard respectively

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[5] At the control station two speeds (Velocidad Lenta/Rapida) can be selected. Via the switch Grupo Hidraulica the hydraulic pumps are turned on or off. The switch Desfresno Carretel vacates the function of the joystick for starting the driveshaft, which activates the screw brake. The switches Embragar / Desembragar decouple the storage drum so that the capstan head can be worked on. Automated operation with constant load is set via the switch Tension Constante. Further, the switch Funcionamento Emergencia allows for operation of the emergency off function. The Lampe Alarma lights up during malfunction of the winch system, for instance when the hydraulics do not function properly. With the bottom switches, transfer can be made to the lateral operator stations at the stern and the winches can be started up.

5.1 Marine Casualty RUILOBA

In the last 2 years the BSU was notified about 3 accidents which occurred in the Kiel Canal locks and which possibly involved the operation of the control lever during manoeuvring.

On 7 November 2007 at about 1524 CET the RUILOBA, coming from the sea, collided with the inner gate of the Kiel South lock and sustained damage, after the fore and aft spring had broken (Ref 569/07). The lock was no longer operable and the bulbous bow of the RUILOBA was punched in. The damage was estimated at € 200,000. According to investigations by the Waterway Police, the command “Full Astern” to stop the incoming vessel allegedly had been given too late. The helm and control lever had been operated by the 3rd officer acting directly on recommendations of the pilot. The wind came from West Northwest at an average strength of 6 Bft with gusts up to 8 Bft. It was reported that the significant wave height was under 0.5 m with a wave period of around 3 s.

When the RUILOBA had wanted to leave the Brunsbüttler North lock on 5 December 2007 at 1835 CET, the starboard side of the stern touched the lock wall and in the process destroyed the wood fender lying in the water (BSU, Ref. 632/07). During manoeuvring the pilot is reported to have worked with a maximum of 20 % pitch and had reportedly not used either of the two transverse thrusters (2* 650 HP). The wind came from SSE at a strength of 8 Bft.

On 13 December 2007 at 0500 CET at Kiel-Holtenau, the RUILOBA was the second vessel to pass through the South lock towards the sea in windless conditions. On the other side of the lock the MS ILKA lay moored to the pier (BSU, Ref. 640/07). After all the lines had been cast off, the stern drifted towards the middle of the channel and the RUILOBA scraped along the gunwale of the ILKA. It was reported that the transverse thrusters had been employed too late to avoid the touching.

All these events involved pilots. According to statements it was the chain of command through the pilots and the Watch Officer that caused delayed reactions in avoiding the collisions. The shipowning company did not want to make a statement to the BSU about the incidents. The question was especially asked whether there were any indications of a malfunction of the control lever and whether the Voyage Data Recorder (VDR) had been correctly configured since that time. As part of the detention order of 18 May 2008 to 21 May 2008, the faulty VDR had been reported by the BSU to the Marine Insurance and Safety Association.

5.2 Wärtsilä

On 20 January 2009 the BSU visited the Hamburg branch of the Wärtsilä company.

It was explained to the BSU that the engine control is operated with the control lever of type LF 120 of the manufacturer Lilaas. On the bridge of the RUILOBA the control levers are respectively in the bridge wing and at the conning position. They are not electromechanically following. The taking over of the control position must be confirmed with a lighting switch, and when this is done an acoustic signal sounds at the same time. The switchover can only happen when the control levers are in the same positon at each station, for instance, 0, 20, 40, 60, 80 or 100 % pitch (see Figs. 11 and 12).

1. Station transfer is only possible when the levers are in the same position, with the exception of 5.

2. When asked for transfer, i.e. one station wishes to transfer and the CHANGE RESPONSIBILITY (cambio responsabilidad) button has been pressed, on all other stations the transfer demand is shown through an optical signal (blinking of the CHANGE RESPONSIBILITY button) and an acoustic signal. The transfer is complete when the CHANGE RESPONSIBILITY button is pressed on the accepting station and the levers are brought to the same position. At that moment the optical and acoustic signals stop.

3. When a station wants to take over and the CHANGE RESPONSIBILITY button has been pressed, on this and all other stations the transfer demand is shown through an optical signal (blinking of the CHANGE RESPONSIBILITY button) and an acoustic signal. This is unless the levers are in the same positions: then the transfer is immediate. The transfer to the station putting in the request is otherwise when the lever is set in the same position as the lever of the station still responsible. At that moment all optical and acoustic signals stop. This process is not possible between the bridge and the engine room, since these stations are not within visible range. Hence, in this transfer case at both stations the CHANGE RESPONSIBILITY button needs to be pressed in order to actively confirm the transfer. Here, too, the rule applies that the levers (or turning knob in the ECR, see Fig. 12) must be at the same position.

4. If the transfer is not completed within the pre-set time (standard: 20 s) then the transfer process is interrupted and the control remains with the station that had it prior to the initiation of the transfer process.

5. Further, in the ECR there is the button EMERGENCY RESPONSIBILITY CHANGE (cambio responsabilidad emergencia). This allows for control of the engine to be transferred directly to the ECR without the levers being in the same position and without confirmation from the bridge. The transfer is immediate and is displayed for a pre-set time optically (on the bridge the CHANGE RESPONSIBILITY signal blinks and the ECR IN SERVICE lamp (control de paso local) is on and also acoustically.

6. At the controlling station the responsibility is shown through the permanent shining of the CHANGE RESPONSIBILITY button.

6.1 Control ECR:

- Lamp in CHANGE RESPONSIBILITY sensor in ECR panel “on”
- Lights in all other CHANGE RESPONSIBILITY sensors “off”
- BRIDGE IN SERVICE (responsibilidad puente) lamp in ECR panel “off”
- ECR IN SERVICE (control de paso local) lamp in bridge panel “on”

6.2 Control Bridge:

- Lamp in CHANGE RESPONSIBILITY sensor in Bridge panel “on”
- Lights in all other CHANGE RESPONSIBILITY sensors “off”
- ECR IN SERVICE (control de paso local) lamp in ECR panel “off”
- BRIDGE IN SERVICE (responsibilidad puente) lamp in ECR panel “on”

6.3 Control Wing Station:

- Lamp in CHANGE RESPONSIBILITY sensor in Wing Station panel “on”
- Lights in all other CHANGE RESPONSIBILITY sensors “off”
- ECR IN SERVICE (control de paso local) lamp in ECR panel “off”
- BRIDGE IN SERVICE (responsibilidad puente) lamp in ECR panel “on”

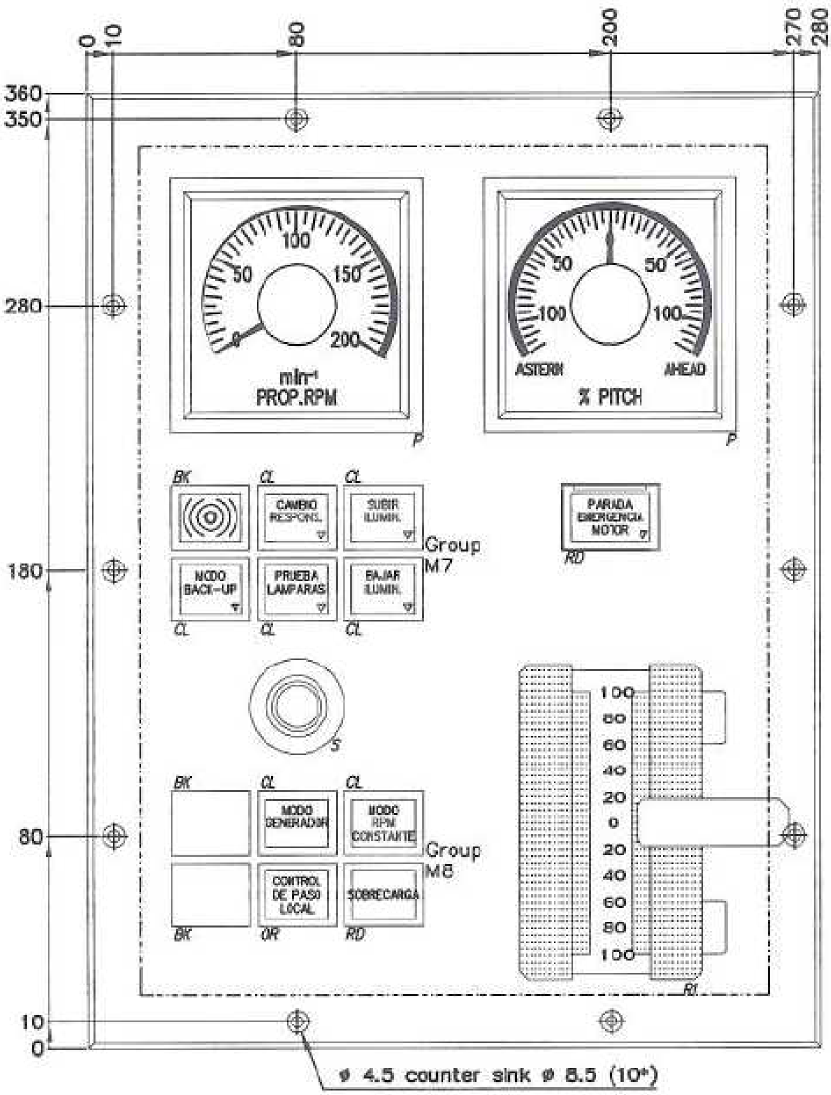

Figure 11: Bridge Control Panel

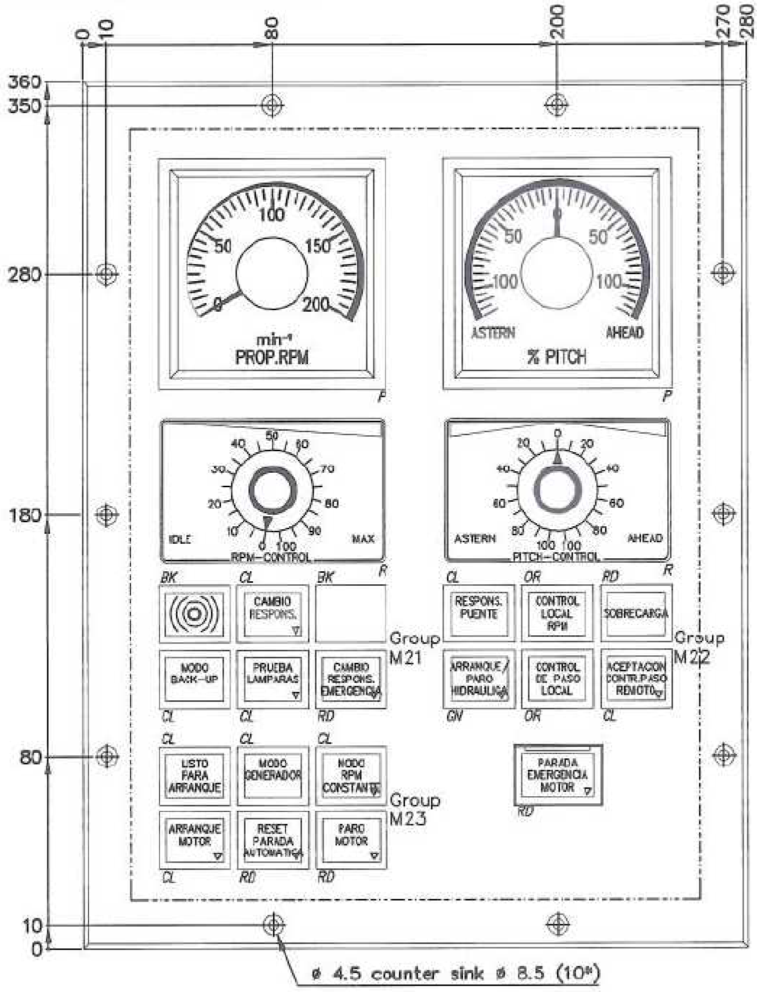

Figure 12: Control Panel, Engine Control Station (ECS)

On the RUILOBA it could have been like this, that the wing station had been left behind by the Master with the control lever in the zero position in order to switch control to the bridge. Once he got there, the Master called the Chief to say that the engine control could be transferred from the bridge to the engine control room. This, according to the statement of the Chief, was reported as not being possible since the control lever was not in the zero position.

In the Lloyd's Register inspection protocol of 20 May 2008 no function shortcomings were described. It was found out that engaging the zero position of the control lever on the RUILOBA is very smooth and easy, and that it would be possible to reach and press the CHANGE RESPONSIBILITY button with the control lever moved slightly from the zero position. The investigations of the Waterway Police confirm the easy operation of all the control levers for the propeller pitch on the bridge and the wing station. The driving levers could be easily moved with one finger and locking in the zero position was barely noticeable.

The brake of the driving lever can be set with an inbus key (1.5. mm). It was demonstrated to the BSU that it would be possible to achieve a very smooth operation.

To better understand the functioning of the LF 120, Wärtsilä let the BSU have a used control lever from the company Lilaas.

5.3 Lilaas

At the BSU the control lever of the type LF 120, from the manufacturer Lilaas, was disassembled and photographed (see Fig. 13 ff). With an inbus key (see Fig. 14), a leaf spring fixed to one side can be moved. The opening in the casing for the inbus key is nondescript at first glance. An instruction manual could not be shown to the BSU. The company Lilaas did not want to make a statement to the BSU. On the leaf spring there is a 90° offset roller, which through the tension of the spring presses against a cogwheel (see Fig. 16). On the cogwheel there is a groove (see Fig. 15), which sets the zero position and locks the lever. The smoothness of running of the cogwheel is set with the leaf spring. The leaf spring can be set with a 1.5 mm inbus key so that the zero position is hardly noticeable. The cogwheel is connected via a toothed belt to a potentiometer, which conducts the current to a regulator (see Fig. 13).

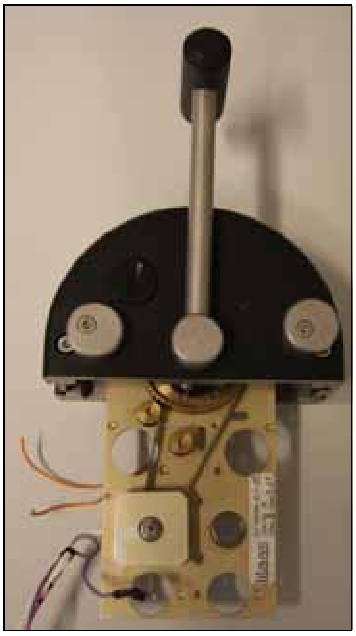

Figure 13: Driving Lever Construction

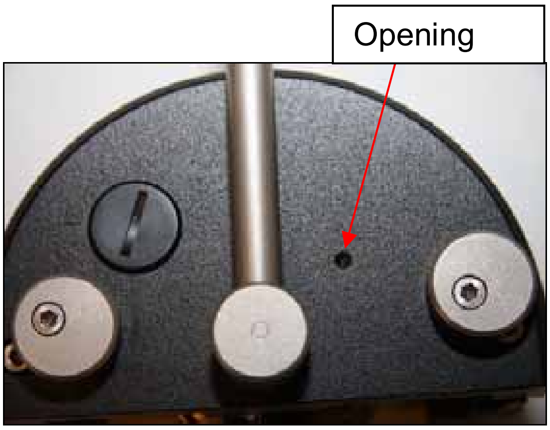

Figure 14: Driving Lever Brake Position

Figure 15: Cog Wheel with groove

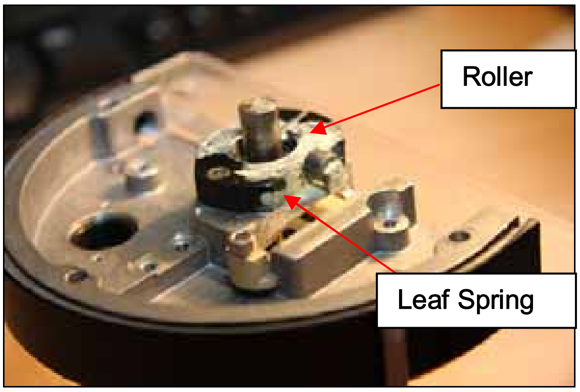

Figure 16: Driving Lever leaf spring brake

The driving lever of the company Lilaas is type-approved. With the certificate A 9880, the classification society Det Norske Veritas certifies amongst other things the vibration inspection according to the standard DIN EN 60068-2-6. For this the expected overall time for which the tested device will be subjected to vibrations in its operating life must be taken into account. The current certificate is valid until 31st December 2009.

5.4 VDR

On 10 March 2009 the VDR data (Voyage Data Recorder) were analyzed with the company Wärtsilä.

Normally the switch “Cambio Response” changes over between the control stations. At the same time a signal sounds which lasts for about 20 seconds without acknowledgement. During this time the transfer must happen so that the command remains valid.

At the time in question the VDR was monitored:

At around 1830 a signal sounded for transfer and/or takeover of the engine control for about 7 s. In this time it was most likely tried at the conning position on the bridge to take over the control from the port wing station and switch it over to the engine control room.

Immediately after acknowledgement of the acoustic signal there was initially a less loud bang and then a louder one. Then the RUILOBA started to move away. The movement was then stopped via a reversing action most likely from the port wing station. How the control lever had previously been set to “ahead”, for instance through vibration or through moving the lever, could not be determined. It would have been possible in a very short time to achieve an increased pitch of the controllable pitch propeller from 0 to approx 50 %.

On account of the faulty VDR configuration, only tendencies are recognisable when interpreting the machine data of the controllable pitch propeller. Normally the rpms of the engine and the propeller shaft remain comparatively constant and, during manoeuvring, one only works with the propeller pitch while the revolution is kept constant by a rpm setpoint signal from the 7000 BASIC control system. The rpm setpoint signal is an input for the governor-system. According to the VDR data, the rpm and propeller pitch values changed considerably. Also, the values for the two transverse thrusters could not be interpreted. The BSU created a movement profile from the remaining VDR data. For this, it needs to be considered that due to the wrongly entered vector receiving point of the GPS antenna in the AIS configuration (see Fig. 17), the ship symbol was never flush with the pier in the AIS configuration. The displayed geographic length in the VDR contains a conversion error in the seconds segment. The situation is correctly displayed geographically however. The traffic situation at the time of the accident was calm (see Fig. 20).

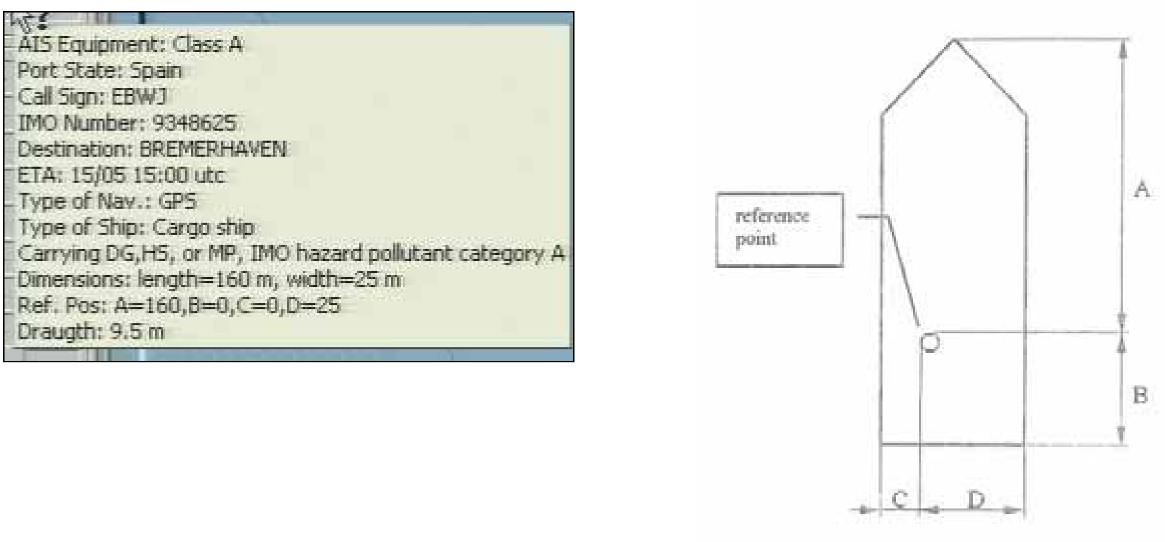

Figure 17: AIS-Configuration RUILOBA

Local-time	Control-lever	Propeller RPM *1)	Propeller Pitch *2)	SOG GPS	SOG AIS	COG (°)	HEADING (°)	ROT (°/min)
18:07:00	Order:	-30	-10	0,0	0,0	144,4	141,5	0,0
	Response:	9	103					
18:09:27	Order:	-24	37	0,0	0,0	144,4	141,5	0,0
	Response:	10	103					
18:10:12	Order:	18	37	0,0	0,1	144,4	141,9	-1,5
	Response:	18	103					
18:10:34	Order:	-6	-70	0,2	0,5	144,4	141,4	-1,3
	Response:	18	103					
18:10:43	Order:	-29	-80	0,2	0,5	144,6	141,2	-1,1
	Response:	15	103					
18:10:55	Order:	11	-83	0,3	0,4	145,6	140,7	-3,8
	Response:	14	57					
18:11:03	Order:	32	-83	0,3	0,2	147,3	140,1	-3,4
	Response:	15	17					
18:11:15	Order:	64	-83	0,3	0,3	153,5	139,2	-4,6
	Response:	18	13					
18:11:42	Order:	-14	10	0,5	0,7	184,5	136,7	-4,7
	Response:	19	90					
18:12:00	Order:	-30	-10	0,6	0,6	199,6	135,3	-3,1
	Response:	20	103					
18:12:30	Order:	-30	-10	0,1	0,2	207,9	134,8	2,4
	Response:	9	103					
18:13:00	Order:	-30	-10	0,2	0,6	207,6	137,9	9,2
	Response:	9	103					
18:13:30	Order:	-30	-10	0,4	0,1	198,5	142,1	-4,2
	Response:	9	103					
18:14:00	Order:	-30	-10	0,0	0,0	198,2	142,0	0,2
	Response:	9	103					

Figure 18: Interpretation of Sensor Data

*1) Zero position RPM Order = -30 and RPM Response = 9
*2) Propeller-Pitch in %

RPM: Revolutions per minute
SOG: Speed over ground from GPS and AIS
COG: Course over ground
ROT: Rate of turn
Heading: Steering course

Startposition 18:07:00 53° 35,9830'N 008° 30,7780'E
Endposition 18:14:00 53° 35,9810'N 008° 30,7800'E

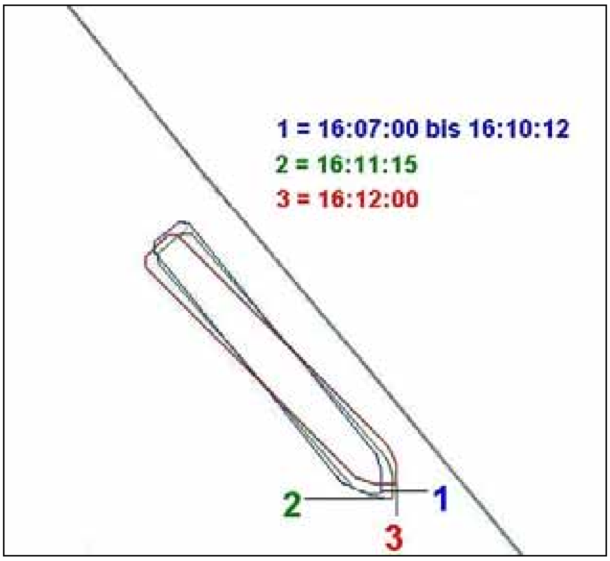

Figure 19: Movement Profile for various times UTC

At 1807 the RUILOBA lay quietly in position parallel to the pier and the propeller pitch was "zero" (see Fig. 18). At around 1809 the propeller rotations changed and the propeller pitch too. From 1810 the RUILOBA started to move causing a stern line and a foreward spring to break. At around 1812 it reached its maximum forward speed. In the process the stern moved away from the pier and the aft spring broke. At 1810:34 the propeller pitch altered with a change of direction. It is likely that the Master had tried to stop the RUILOBA with an astern manoeuvre. In doing so the spring line aft had broken. At 1814 the RUILOBA lay again parallel to the pier. The deviation of approx. 5-6 m south from the original position, originally declared by the Pilot, could be explained and was confirmed by trend. According to the VDR data a forward movement and rotation towards port could be determined.

Figure 20: Traffic Situation at 1810

The traffic situation was quiet around 1810. Therefore no swell was generated which could have caused the RUILOBA to move during the mooring procedure.

The audio recordings of the VDR were only able to be interpreted in a limited manner. Only fragments could be analysed. The Spanish investigation authority has translated for the BSU the most important passages. Shortly after it was heard that the transfer/takeover signal of the engine control sounded, the propeller pitch was at 50 %. Afterwards there was the first bang at 1810:14 and the second one at 1810:16. The second bang could be heard significantly louder. A telephone receiver was put down and steps could be heard as well as the words "give to the starboard side" and the question how the situation was with the fore spring. These recordings confirm that Master and Chief had been on the phone together and that the engine control was not able to be redirected to the engine control room[6]. The sounds possibly signified that initially the stern line (low sound) and then the fore spring (loud sound) and lastly the aft spring had broken. The final sound could not be identified.

It stood out that only one hour after the accident at 1916 the engine control had been transferred from the bridge to the engine control room and only then had the engine been turned off.

[6] According to performance standards for ship‘s data recorders there is no duty to record which control station is in charge

5.5 Analysis

At the stern two seamen were severely injured on the legs when, following the mooring manoeuvres that were executed from the port wing control station, a stern line, fore spring line and aft spring line broke and the RUILOBA set itself in motion. For this the position of an control lever must have been changed. The control levers are located in the bridge wing stations, the conning station in the wheel house and the engine control room (ECR). On the bridge were the Master, Second Officer, the Pilot and an Service-engineer. The engine control room was manned at least with the Chief. At the time of the accident the control station on the port bridge wing was in operation (see Fig. 21) because from here the Master had allegedly tried to return the vessel back to position.

Figure 21: Bridge Wing - Port side

According to the statements and VDR data, shortly before the breaking of the lines the Master was standing at the conning station in the wheelhouse and was on the telephone with the Chief in order to transfer the engine controls to the engine control room. This would have only been possible from there without exceptional interference of the Chief into the steering process, if he had previously been wanting to transfer from the port wing station and the turning knob in the ECR shows the same pitch as in the port wing as well as if the CHANGE RESPONSIBILITY button would have also been pressed in the ECR. Overall, at that time, only a corresponding acoustic signal could be heard in the audio recordings. This could have been the prompting signal for transfer from the port wing station to the conning station or another station. The signal sounded for 7s. Proper transfer was not possible since, according to the display in the ECR, one control lever had been set to 50 % pitch. The proper transfer was not possible because an control lever in the ECR had, according to the display in the ECR, been set to 50 %. Immediately afterwards initially a soft and then a load bang could be heard. After this the captain put down the phone receiver and hurried to the port wing station. There, he stopped the forward motion of the RUILOBA through an astern manoeuvre, which means that the engine control had not yet been transferred to another station. Changing the pitch from „ahead“ to „astern“ is associated with delays. Until reaching of the zero position, the ship moved further to „astern“. The maximum engine performance and performance capacity of the controllable pitch propeller – in moored condition (bollard pull) – already occurs with a pitch that is less than 100 %. By comparison of different combiner diagrams, maximum engine output can be achieved already at 60 % pitch and constant rpm.[7] A combined operation between pitch and engine rpm can be selected from the bridge. Most often, however, manoeuvring is executed with constant rpm because the transverse thrusters are supplied directly by the shaft generator. Only around 1916, further signals for changing the engine lever controls could be heard. The long time interval until the turning off of the engine can be explained with the initiated emergency measures, once it had been reported that two persons had been severely injured on the aft deck and the RUILOBA needed to be properly moored again.

There are no indications and no plausible (apparent) reason for the driving lever having been changed by anyone on purpose once the RUILOBA lay in position and the mooring process had bee completed aside from the pulling out of the gangway. Possibly, the driving lever had been moved forward through inattention, for instance through unnoticed touching, by a motion of the body or in connection with pressing the transfer button, or through vibration in the port wing while the zero position was not locked in place. Both scenarios are possible. With a situation of four people in a tight space and then leaving the port wing, the driving lever on the right lower side of the control stand was easily accessible. Through the smooth operation of the driving lever it could also be possible that it had initially not been properly locked in zero position and had shifted by itself on account of the vibration that is noticeable especially in the wings.

In the directive 96/98/EG and its continuations, the driving lever is not listed as ship equipment. Therefore there are no uniform type approval specifications regarding style and inspection criteria. The rules for construction of the largest classification societies stipulate that driving levers must be type-approved. The inbuilt driving lever of the manufacturer Lilaas of type LF 120 had a type certificate issued by Det Norske Veritas and had also been tested for vibration. Despite this, during the accident investigations, the ease of movement and the barely noticeable zero position had been evident. During the initial inspection and test run this fault would have most likely become noticed and would have been removed. It is therefore probable that the ease of movement had resulted on its own over the course of the one year ship operation through vibration. Resetting the lever movement would have been swift and easy with a 1.5 mm inbus key. Obviously this function was not known to those on board and an operating manual was not available. Also the suppliers Lilaas and Wärtsilä, like other manufacturers, could not show the BSU an operating manual[6]. The adjusting screw on the other hand is rather nondescript and not easily recognizable as such on the casing (see Fig. 14).

[7] The BSU does not have the combiner diagram of the RUILOBA.
[6] The manufacturer Wärtsilä intends to publish the technical contexts in a Technical Bulletin.

According to their technical specifications, the winches of the manufacturer, IBERCISA, are suitable for handling mooring lines of steel wire and chemical fibre. Noticeable were the long forerunners of the wires, each approx 50 m. This combination is unusual and does not correspond to the recommendations of the OCIMF (Oil Companies International Marine Forum). According to this a forerunner should be a maximum of 11 m (6 fathoms) long and have a 35 % higher breaking strength than the wire, because synthetic fibers wear out faster than wire. Further, the rope ends should be connected with a fairlead shackle (see Figs. 22 and 23). For this, the eye of the synthetic rope should be covered, for example with a leather protection. Due to the different expansion characteristics of the materials, steel wires with forerunners are recommended as springs and brest ropes, while fore and aft lines should be from synthetic fiber. The mixing together of the different materials in both spring lines and fore and aft lines should be avoided so that the load is evenly distributed.

The Marine Insurance and Safety Association recommends in its bulletins F5 and G3, on the basis of good experiences with polyamide, to use this as the material for forerunner. In addition for the winch operation there should always be one person available. Locking the winch lever is prohibited. The so-called slippage[7] on the capstan heads is to be avoided and the cables are not to be left constantly on the capstan heads. They are to be put on bollards and secured. Instead of slippage on the capstan head, the winch is to be used for slackening the line. For synthetic fibre ropes there is the danger of sticking and uncontrolled sweating. Through this the surface becomes smooth so that there is the danger of accidents because of sudden slipping. Any chafing is to be avoided which means the ropes must not be led over/across sharp edges/corners, in order to avoid abrasion and breakage. When knotting lines a breaking strength loss of 50 % must be reckoned with. A person should never be situated beneath a cable under load. When heaving in, the loose part must immediately be rolled up or stored away behind the person at the capstan head to reduce the danger of stumbling.

From storage drums the cables must only be stretched out over the working part and if possible only one layer. This avoids tension loss and abrasion as well as the overspilling of ropes.

On the RUILOBA several acknowledged procedures for reducing the risk of accidents during mooring were violated. Making fast properly at the stern, taking into account known behaviour regulations, would have had to be done with at least 3 seamen so that the above rules could have been adhered to. Permanent manning was lacking by one winch controller and of one observation post, which could have watched the rope guidance. The officer later injured was himself busy with mooring and could not properly handle his actual tasks of communicating with the bridge and supervising the works on deck. When the ropes were tight enough to break, at least with sufficient manning and careful observation the possibility of losing time to avoid a breakage would have been there. Too little manning by necessity led to both seamen having to be in the danger zone and safety distances not being able to be met. The precise locations of the seamen during their accidents could not be

[7] Slippage means slackening the rope fixed on the capstan head without moving the winch. This results in high friction.

determined. As can be seen in Fig. 24, the distances and spaces at the stern between fairlead, bollards, centre roller and winch are comparatively narrow to find protection spaces. This makes it more difficult to take avoiding action during danger situations.

With its recommendations for tanker shipping, the OCIMF goes beyond administrative stipulations. Especially when working with wires, its recommendations should be adhered to for other areas of the shipping industry also. With proper application of the stern line, fore spring line and aft spring line maybe would not have broken. Nonetheless the cause for the two accidents involving people was the surprising movement of the RUILOBA, which came unexpected to everyone involved, after it was basically already in position and moored.

Figure 22: Connection Forerunner Line

	No.90M	No.120M
Forerunner	7" - 9"	9" - 11"
Breaking Load	90m/Tonnes	120m/Tonnes
Proof Load	55m/Tonnes	70m/Tonnes
Safe Workload	30m/Tonnes	40m/Tonnes
Weight	7.8 Kilos (17.2 lbs)	13, 3 Kilos (29 lbs)

Figure 23: Fairlead Shackle Mandel

Figure 24: Stern of the Vessel

The records of the Voyage Date Recorder (VDR) were only usable to a limited extent. The faulty operation of the VDR, probably already since the start up of the operation of the vessel, led to an erroneous reproduction[8]. The geographic situation, owing to an improper configuration of the automatic ship identification system (AIS) was wrongly displayed and the data for the engine control was not plausible. The audio logs were unclear and could only be interpreted in a fragmentary manner. The faulty VDR and the faulty AIS should have come to attention during the initial inspection prior to start-up of operation of the vessel and/or during subsequent inspections. According to SOLAS Chapter 1 Rule 7 the inspection was to guarantee that the workmanship for all parts and components of the ship and its equipment was satisfactory in every aspect. The flag state is responsible for adherence to the rules and it can transfer the inspection to an approved authority. The BSU does not know whether the errors have in the meantime been rectified.

The shipping company has not made statements to the BSU as to what measures had been taken after the 3 accidents in the locks of the Kiel canal in 2007 and after this accident. Therefore it remains unclear whether the events have been dealt with in the safety management of the shipping company.

[8] The VDR of the type MER was installed and put in operation by Radio Maritima International S.A. (RMI), Madrid. The manufacturer Interschalt has sold the VDR to RMI and provided support for the projection. On 18.12.2007 and 18.05.2008 the service of the manufacturer ordered to back up the VDR data detected deficiencies concerning the installation of the system while backing up the data.

6 Safety Recommendations

The following safety recommendations do not constitute any assumption regarding fault or liability, neither in kind, number or succession.

6.1 Operator

The BSU recommends to the shipping company Compania Trasatlantica Espanola S.A. to make sure that any errors and faults detected during inspections in ship equipment are dealt with reliably and within the set deadlines. If there are doubts regarding the executed repair works and/or type or configuration, the faults should be sufficiently documented and if needed be reported to the supervising authorities so that measures for quality control and market watch can be undertaken. In this context the BSU points to its investigation reports where in particular faulty installation relating to the Voyage Data Recorder (VDR) and the automatic ship identification system (AIS) has been proven.

6.2 Ship’s Command

The BSU recommends to Masters and responsible Officers to take care that they make available sufficient staff to allow for safe working on the manoeuvring stations in connection with the rope operations and that working safety regulations can be adhered to. Care must be taken that officers supervise the workings of a safe ship operation and are not employed themselves, e.g. through giving a hand so that they themselves would then need supervising. Ropes immediately running next to each other should be designed in a manner that stretch and breaking strength are the same. During accidents, the accident location must be secured and machinery not required promptly turned off. These processes are to be documented in the safety management system.

6.3 Flag States / Classification Societies

The BSU recommends to classification societies, especially during initial survey before vessels are put into operation, to thoroughly check the vessel’s equipment, especially for the arrangement, configuration and adjustment of electronic devices so that errors in installation can be recognized in time and if need be already be dealt with during the sea trial.

6.4 Manufacturer

The BSU recommends to the Norwegian company Lilaas, manufacturer of control levers for engine control, to make available operating and maintenance manuals. The manufacturers of main engines are recommended at handover to check all manuals for their completeness. This also includes documents of the suppliers.

7 Sources

- Investigations of the Waterway Police (WSP) Bremerhaven

- Written declarations/statements
  - RUILOBA crew
  - Lloyd‘s Register Classification Society
  - VDR manufacturer - Interschalt maritime systems AG

- Witness Statements
  - Crew
  - Mooring personnel

- Expert Reports/Technical Papers
  - Drahtseilwerke Bremerhaven, Drum calculator
  - Ibercisa winch manufacturer
  - Ministerio de Fomento, Direccion General de la Marina Mercante, Madrid
  - RUILOBA accident notifications, BSU 569/07, 632/07, 640/07
  - Wärtsilä engine manufacturer, Branch Hamburg

- Nautical charts and Vessel particulars, Federal Maritime and Hydrographic Agency (BSH)

- Documents
  - OCIMF Oil Companies International Forum, Effective Mooring, Guidelines on the use of high modulus synthetic fibre ropes as mooring lines on large tankers
  - Marine Insurance and Safety Association, accident prevention stipulations, G3 Guidelines for mooring and hauling equipment, F5 Memorandum concerning selection, use and care of synthetic fibre ropes
  - RUILOBA ship files
  - Manuals Ibercisa winch manufacturer
  - Classification stipulations Lloyd’s Register, Det Norske Veritas, Germanischer Lloyd
  - Vibration testing DIN EN 60068-2-6
  - Lilaas, Technical description control lever

- Radar Logs, Vessel Traffic Service Bremerhaven

- Images
  - Photograph of the Vessel, Hasenpusch
  - Accident Photos, Waterway Police Bremerhaven
  - Drawing Mooringplan Graphische Technik BSH