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

Investigation Report 01/08

Serious marine casualty

Grounding of the LT CORTESIA on 2 January 2008 on the Varne Bank in the English Channel

1. April 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/Seesicherheits-Untersuchungs-Gesetz, 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.

This report should not be used in court proceedings or proceedings of the Maritime Board. Reference is made to § 19 paragraph 4 of the SUG.

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

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The following report is a joint investigation report with the Marine Accident Investigation Branch (MAIB), UK, and the Federal Bureau of Maritime Casualty Investigation (BSU), Germany.

The MAIB and the BSU have jointly drawn up this report pursuant to the IMO Code for the Investigation of Marine Casualties and Incidents (Resolution A.849(20)).

The Federal Bureau of Maritime Casualty Investigation wished to acknowledge the contribution to this investigation by the UK Marine Accident Investigation Branch, (MAIB), and to thank it for its cooperation and support.

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Federal Bureau of Maritime Casualty Investigation

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1 Summary of the marine casualty

At 04:54[1] on 2 January 2008, the LT CORTESIA ran aground on the Varne Bank sandbank in the English Channel. The ship was on route from Thames Port to the Suez Canal. At the peak of the evening high tide, at 18:58, the grounded vessel was freed with the aid of four tug boats. For investigation purposes, the vessel was ordered to proceed to a sheltered anchorage on the coast approx. 10 nm northeast of Dover. No major damage as a result of the grounding was identified, which meant that the LT CORTESIA upped anchor and was able to continue on its voyage at 18:00 on 3 January 2008.

[1] All times in the report refer to the ship's time = GMT UTC

2 Scene of the accident

Type of event: Serious marine casualty
Date/time: 2. January 2008, 04:54
Location: Varne Bank, English Channel
Latitude/longitude: φ 50°58.38'N λ 001°20.41'E

Section from the chart No. 245, Dover Strait, BSH (Federal Maritime and Hydrographic Agency)

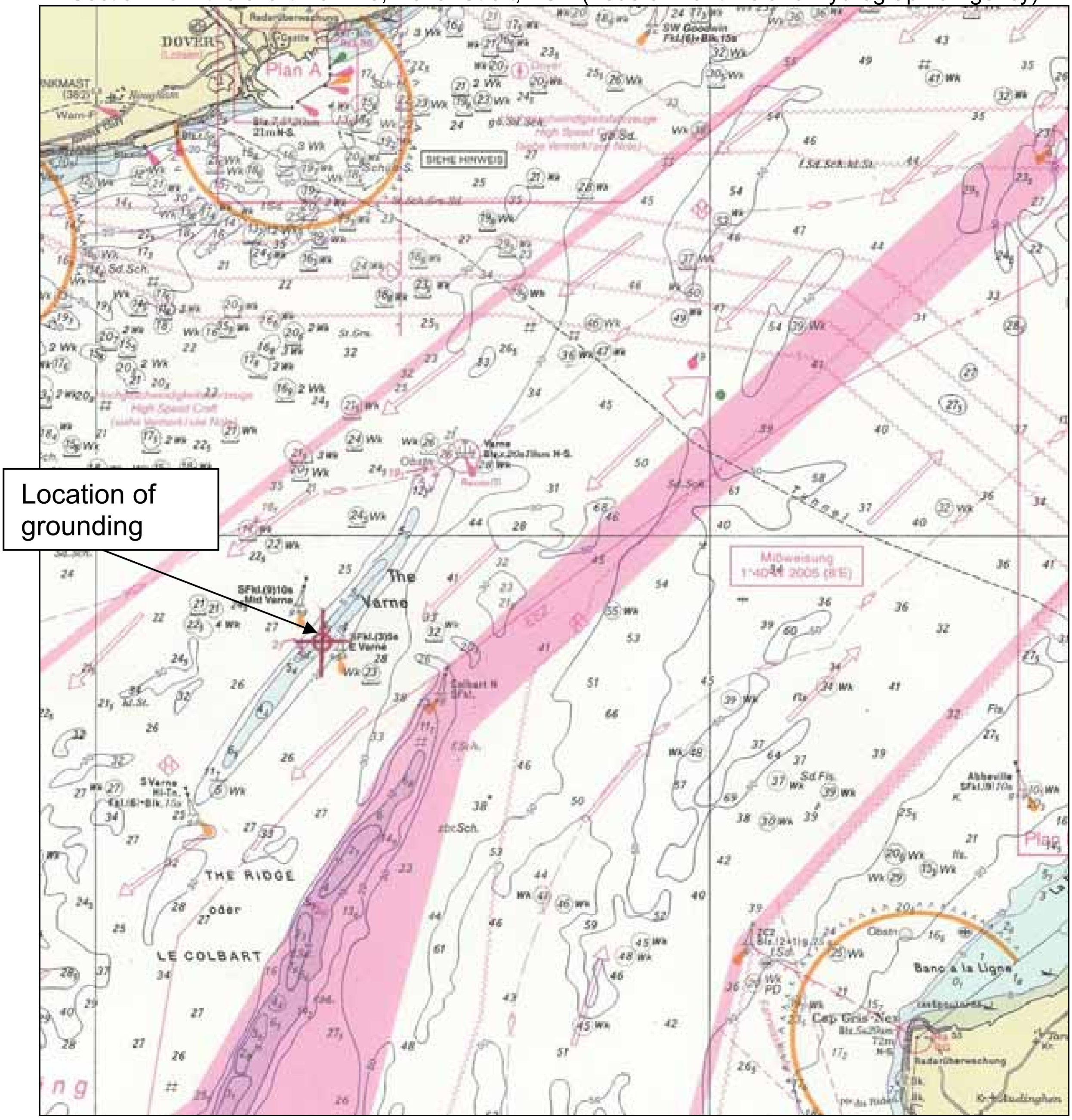


Figure 1: Chart section

3 Vessel Particulars

3.1 Photo

Figure 2: Ship photo (Hasenpusch)

3.2 Particulars

Name of the vessel:	LT CORTESIA
Type of vessel:	Container ship
Nationality/flag:	German
Port of registry:	Hamburg
IMO number:	9293753
Call sign:	DDYY2
Vessel operator:	NSB Niederelbe Schiffahrtsgesellschaft mbH & Co.KG, Buxtehude
Year built:	2005
Shipyard/yard number:	Samsung Heavy Industries, yard no. 1512
Classification society:	Germanischer Lloyd
Length overall:	333.99 m
Breadth overall:	42.80 m
Gross tonnage:	90.449
Deadweight:	10,1007 t
Container capacity:	6,170 TEU
Engine rating:	65,880 kW
Main engine:	Wärtsila NSD 12 RTA 96C
(Service) Speed:	24.5 kn
Draught at time of accident:	aft = 11.75 m , fore = 10.52 m
Number of crew:	22
Number of passengers:	5

4 Course of the accident

The LT CORTESIA was operating a line service on the route China-Europe-Mediterranean (CEM). According to the timetable, the ship sailed from Hamburg to Rotterdam on 29 December 2007. It put out from Rotterdam on 31 December 2007 towards Thames Port, from there putting out on 1 January 2008 towards Port Said.

4.1 Course of voyage from Thames Port

After unloading and loading had been completed, the LT CORTESIA sailed from Thames Port, under pilot guidance, with 27 people on board, at 22:18 on 1 January 2008. The pilot disembarked at the Sunk W1 buoy at 01:36 on 2 January 2008. At 2:15, the captain handed command to the second officer, who was relieved by the chief officer at 04:00. This handover of duty took place in the Dover Strait at the GPS position φ=51°11.00'N and λ 001°41.5'E, approx. 3 nm southwest of the South Falls buoy. The course of 223° being steered at the time of the handover was intended to take the LT CORTESIA to the south of the Varne Bank. Shortly after 04:50, the ship ran aground on the sandbank exactly half way between the west and east Varne Bank shallow-marker buoys. At the time of the incident, the 58-year-old German chief officer was on the bridge, along with a 29-year-old lookout.

With the aid of four tug boats, the LT CORTESIA was freed at 18:58, and proceeded under its own steam to a position approx. 10 nm northeast of Dover, where it was anchored at The Downs for inspection purposes.

There was no evidence of any oil or pollutant leaks or any container losses or personal injury. The damage to the ship was in the form of dents in the mid-ship area.
At 18:00 on 3 January 2008, the LT CORTESIA continued its voyage without any further incidents.

Figure 3: LT CORTESIA on the VARNE BANK (photo AFP)

4.2 Damage arising from the incident

Neither tanks nor the ship's base were damaged when the vessel ran aground. The only identifiable damage in the form of deformation was observed on frame163 on brace struts and frame bulkheads.

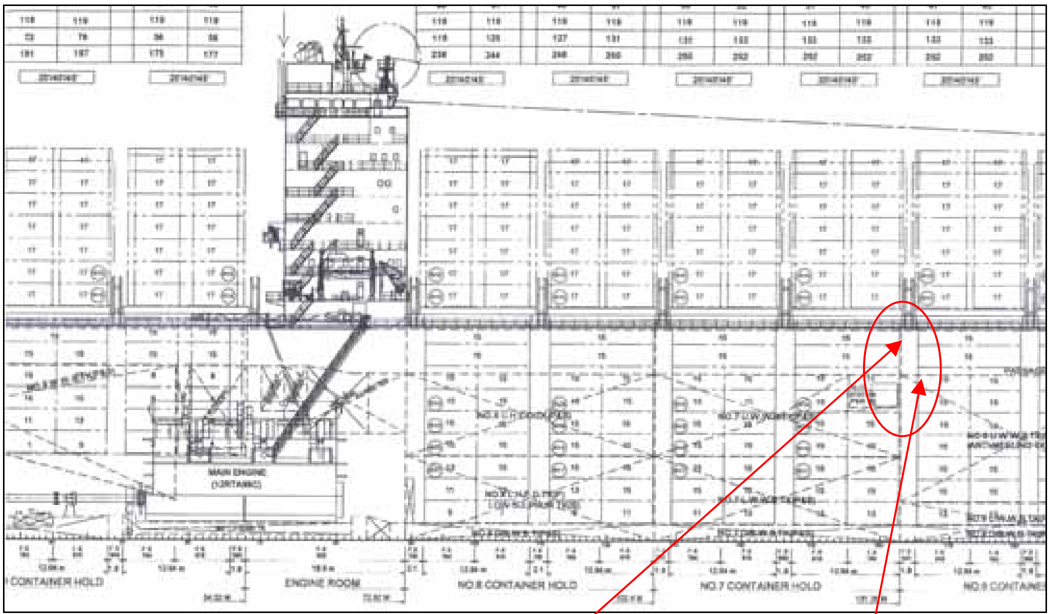


Figure 4: General arrangement plan extract

Figure 5: Damage to the frame bulkhead

5 Investigation

Initial investigations were conducted on board the vessel by the MAIB[2] on 2/3 January 2008. Data from the voyage data recorder (VDR) was saved and all relevant documents and charts were photographed. Further investigations were conducted on board in Hamburg by the BSU on 23 February 2008. AIS data and the recordings from the Dover regional control centre were also available for the investigation.

5.1 Scene of the accident at the Varne Bank

In the Dover Strait, shallows in the fairway due to existing sandbanks and the heavy concentration of shipping traffic result in an increased hazard for shipping navigation. In order to lower the risk of collision, traffic separation zones were established throughout the English Channel, as well as in the Dover Strait. These zones are shipping lanes that are separated from one another as one-way lanes by means of dividing lines or – in the case of the Varne Bank – by means of separation zones. In order to monitor traffic, the British Coastguard runs a Channel Navigation Information Service (CNIS) with the call name Dover Strait. Radar stations in Dungeness and St. Maragaret´s-at-Cliffe record the traffic.

The Varne Bank can be passed on both sides by ships sailing in a southwesterly direction, but ships with larger draught generally circumnavigate the Varne Bank to the south[3]. To the northeast of the Varne Bank, there is the Varne lightship, which is also clearly visible and identifiable as a racon on the radar. There is a further buoy system in place for these 8-nm-long shallows in the form of the east E Varne cardinal buoy on the southeast side, in the form of the west Mid Varne cardinal buoy on the northwest side and in the form of the south S Varne cardinal buoy on the southwest end.

Due to the incorrect interpretation of the radar image, mistaking E Varne and Mid Varne buoys for fishermen, several ships have already run aground on the Varne Bank in the past. Prior to the LT CORTESIA, the most well-known case was the grounding of the LOWLANDS MAINE bulker on 26 April 2006 under similar circumstances.

In the separation zone to the south of the Varne Bank lies Colbart Bank, extending approx. 10 nm in a southwesterly direction and marked with north and south cardinal buoys. The distance between the Colbart N and E Varne cardinal buoys is approx. 1.8 nm and the distance between the E Varne and Mid Varne cardinal buoys is approx. 1 nm.

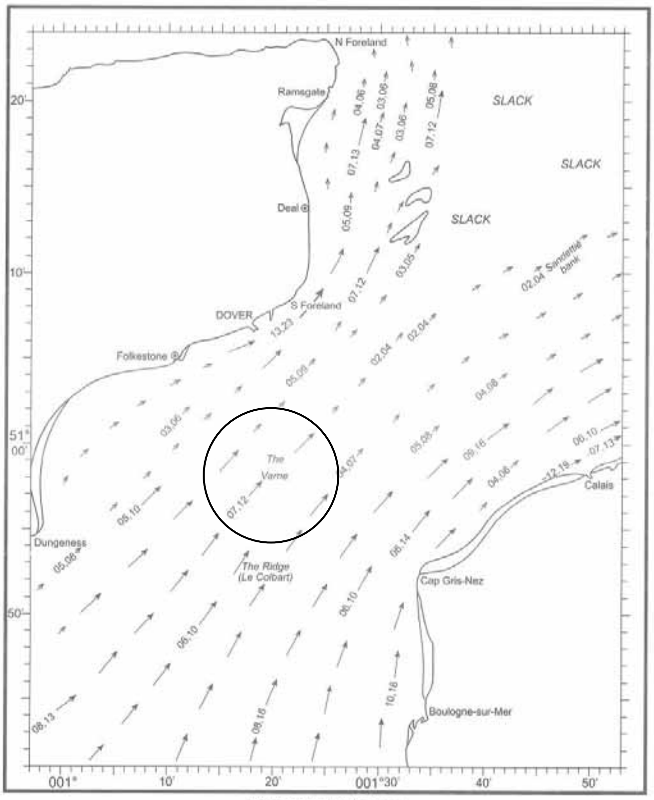
[2] MAIB = Marine Accident Investigation Branch, United Kingdom
[3] However, this is not a recommended deep water route

5.2 Weather report

The German National Meteorological Service (DWD) was commissioned by the BSU to produce an official report on the weather and sea conditions.
The weather conditions in Western Europe were affected by several lows on 2 January 2008. The southwest North Sea and the east mouth of the English Channel were, at the time, experiencing a weak to moderate southeasterly current.
Between 02:00 and 06:00 UTC, the sky was overcast and it was raining and/or drizzling intermittently. The ambient temperature was 5°C, and the water temperature was 10 °C. The moon rose at around 02:20. The waning moon was in the second quarter of its lunar cycle but was not visible due to the dense and low-lying clouds.
Horizontal visibility was between 2 and 4 km. Considering the prevailing temperature differences (air/water), fog patches may have formed in the relevant area of sea locally or even over a more widespread area.
The wind was blowing southwest to east-southeast with an average force of 4 to 5 Bft and gusts of up to 7 Bft. The significant wave heights of the wind sea will have been close to 1.0 m at intervals of around 4 s. There was also a swell with significant wave heights of around 0.5 m from an easterly direction.

5.3 Current

On the date of the incident, there was a neap tide and the time of the incident was approx. 1 hour before high tide at Dover . According to the BSH Channel Manual No. 20171, a northeasterly current of 0.75 to 1.2 kn was to be expected at the Varne Bank.



1 Stunde vor HW Dover
Abb. C 1.1.1 f

Figure 6: Current pattern

5.4 Crew

On the date of the incident, the ship was carrying five passengers and a 22-man crew. According to the Minimum Safe Manning Certificate, at least 18 crew members must be on board.

5.4.1 Captain

The captain was 57 at the time of the incident, had 22 years' shipping experience and had held an STCW II/2 certificate since 1985. He has been employed by the shipping company since 1993.

5.4.2 Chief officer

The 58-year-old chief officer has been employed by the shipping company since 1996. He has been qualified to STCW II/2 since 1976 and has sailed as chief officer since 1987. It was his first voyage on this ship; previously, he had been chartered on a sister ship.
The chief officer came on board in Hamburg on 28 December 2007 and took up his duty at 10:30. The handover to the relief crew member took approx. 5 hours.

5.4.3 Lookout

On the LT CORTESIA, a 29-year-old deckhand was employed as lookout at the time of the incident. According to a statement by the chief officer, he was stood midship with binoculars. The essential tasks of the lookout are to watch the sea-room and report vessels and lights. The chief officer stated that he had not yet properly assessed the lookout, as it was only the second watch on duty together. As a result, the lookout was not given any instructions of what would be expected of him. An assessment of the bridge microphone recordings of the voyage data recorder produced a lack of communication between the chief officer and the lookout during the watch prior to the grounding.

5.5 Ship's course

The following shows the course of the ship from Hamburg up to the grounding on the Varne Bank on the basis of the VDR recordings, the log book, the watch incident book and the statements. Peculiarities and unusual events are highlighted, taking into consideration the 4/8 watch of the chief officer.

29.12.2007 Hamburg- Rotterdam

02:48:00[4]	End of unloading and loading
03:42:00	All lines released, Elbe estuary trading
08:00:00	Passing Elb buoy 44
16:00:00	At position approx. 14 nm west of Texel, start of watch for chief officer until
21:48:00	Moored with starboard side to Rotterdam
24:00:00	Start of unloading and loading

[4] The documented times have been taken from the VDR

30.12.2007 Rotterdam – Thames Port

	Unloading and loading
08:00:00	Tank motor ship TURQUOISE pulls alongside for heavy fuel oil HFO 380 refuelling
11:17:00	Oil spill due to a hose connection coming loose observed on the main deck in the area of the bunker station, immediate start of clean-up work by the crew supervised by the chief officer, all authorities and relevant persons responsible are informed
16:23:00	End of bunkering by the tank motor ship

31.12.2007 Rotterdam - Thames Port

	Unloading and loading
13:30:00	End of unloading and loading
19:00:00	End of clean-up work on deck
20:00:00	Departing Rotterdam

01.01.2008 Rotterdam – Thames Port

04:30:00	Ship moored with starboard side in Thames Port
06:24:00	Start of unloading and loading
21:20:00	Pilot comes on board
22:00:00	End of unloading and loading
22:20:00	Departing Thames Port

02.01.2008 Thames Port – (Port Said) Varne Bank

02:00:00	Pilot disembarks
02:15:00	Captain hands over command to the second officer and leaves the bridge
03:30:00	Captain comes to the bridge
03:50:00	1. officer integrates himself on the bridge
04:00:00	Position φ 51°11.0'N λ 001°41.5'E is entered in the chart and log book by the second officer, second officer leaves the bridge. Next course of events from the view of the chief officer: During the 10-minute watch hand over the second officer showed the position in the paper chart. Dover was passed and no cross traffic in the form of ferries was anticipated The ship was on a course line of 223°[5] and according to the voyage planning of the 3rd officer the route was set south of the Varne Bank. The first officer stated that he had generally sailed north past the Varne

[5] Unless specifically specified otherwise, the headings/course lines are over ground.

Bank on other ships in the past, but that he is fully aware of the southern route.

04:10:00	Change of course to 217° due to traffic situation
04:20:00	Once abeam the MPC buoy, the captain leaves the bridge and from this point on, the chief officer is alone with the lookout on the bridge. Instructions were not issued to the lookout, who stands midship with binoculars
04:25:00	After moving clear of the crossing ferry traffic, the course is set to 225° (back to the old course line)
04:28:00	Subsequently, the lookout reported a light from the Varne lightship and an object crossing into the fairway from port side
04:36:00	Change of course from 225° to 237°; the chief officer plans an evasion manoeuvre towards starboard; this evasion course leads precisely between the east and west cardinal buoys of the Varne Bank; the buoys were interpreted as moving fishing vessels
04:42:00	Varne lightship with racon (T) abeam
04:45:00	While approaching the Varne Bank and subsequently running aground, approx. 15-20 different acoustic signals are issued, these alarms are interpreted by the chief officer as a problem with the engine system
04:47:00	The speed decreases and the bow swings to a course of 230° due to the incipient bank effect to the port side
04:48:00	Autopilot can no longer maintain the set course of 237° and sounds the alarm Switchover to manual steering and the lookout is placed at the helm with the order "Hard starboard"
04:54:00	Ship is aground; it goes unnoticed that there is no longer any speed over ground
04:57:00	The captain is called to the bridge over the on-board telephone and informed that there are engine problems; The captain observes that, although the engine telegraph is set to "Full ahead", the rated speed at this time is extremely low
05:01:00	The captain uses the radar image with the underlaid electronic nautical chart and the clearly visible east and west cardinal buoys to determine that the ship is aground in the middle of the sandbank

5.6 Radio communication with the Vessel Traffic Service of the Dover Coastguard (CNIS)

The area of sea is monitored with radar and AIS by the Vessel Traffic Service of the Dover Coastguard. First, the LT CORTESIA was called at 04:59:02:

04:59:02	Call by Dover Coastguard *Delta, Delta, Yankee, Yankee to the LT CORTESIA, Dover Coastguard....*
04:59:21	Repeated call by Dover Coastguard *Delta, Delta, Yankee, Yankee to the LT CORTESIA, Dover Coastguard....*

04:59:37	LT CORTESIA *Who is calling LT CORTESIA ?*
04:59:40	Dover Coastguard *That is Dover Coastguard*
04:59:43	LT CORTESIA *Yes, Dover Coastguard*
04:59:47	Dover Coastguard *You have come to a stop. You appear to be very close to the Varne Bank* *Are you ok?*
04:59:55	LT CORTESIA *Just a moment, Yes of course*
05:00:05	Dover Coastguard *You have got a draft to 12 meters.* *Are you aground?*
05:00:17	LT CORTESIA *Have I what?* *Yes, we have a radar...a radar damage.*
05:00:30	Dover Coastguard *I can see your radar and you appear to be trying to get off the bank*

The VDR also recorded the conversations on the bridge. Due to background noise and the fact that several people were talking on the bridge, only fragments of conversation can be understood, while the radio conversation between Dover Coastguard and LT CORTESIA can be heard in the background:
hard starboard....rated speed down...Where are we now?....How could that have happened?

No technical fault with the helm, the radar system or any other faults in the electronic navigational equipment were identified by the MAIB or the BSU. At the time of the first VHF call, the LT CORTESIA was already aground on the Varne Bank. The radar image showed at that time considerable wake behind the ship while sailing over ground at just 0.08 kn. The following, somewhat lightened radar image shows the "incoming cross traffic", the reason for the evasion manoeuvre.

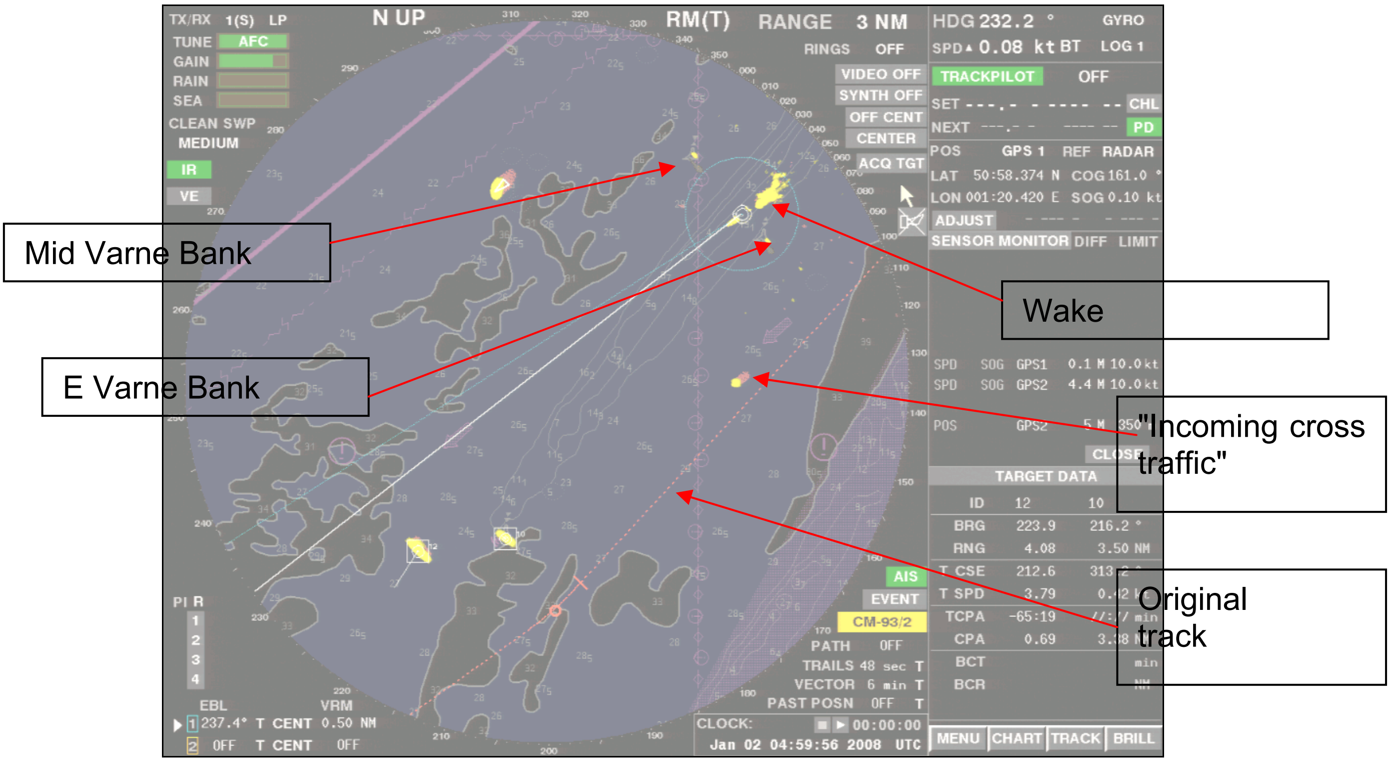


Figure 7: Radar image 04:59:56

5.7 Navigational equipment

According to the equipment list for the Cargo Ship Safety Equipment Certificate, produced by the See-BG (Maritime Employers' Liability Insurance Association), Number 3. "Detailed information about the systems and equipment for navigation", the ship is equipped with official (paper) nautical charts. An electronic chart display and information system (ECDIS) and redundancy devices for ECDIS were, according to the Cargo Ship Safety Equipment Certificate, not approved as an on-board system and equipment for navigation.
The following systems type-tested and approved by the BSH were nevertheless installed on board and approved during the inspection visit by the BSU:

ECDIS :	1 Chartpilot 93xx as planning station 1 Chartpilot 93xx
Radar system	1 Radarpilot 1100 1 Chartradar 1100
Guidance system	NACOS xx-5
Track control system	Trackpilot 1100 NautoPilot NP 1100 (Raytheon Anschütz)

The above system names/company designations from the manufacturer SAM Electronics are explained in more detail in section 5.7.6.1.

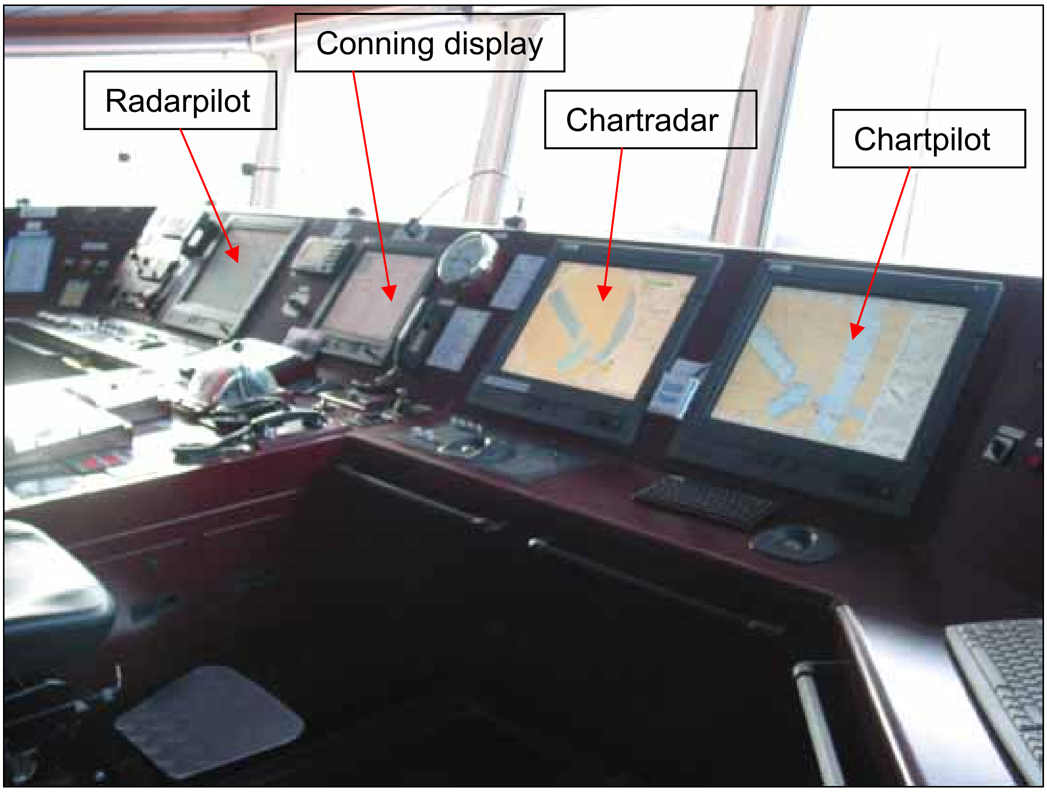


Figure 8: Arrangement of the systems on the LT CORTESIA

With regard to hardware, the ship is equipped, in terms of the systems installed, with an electronic chart display and information system (ECDIS[6]). Since no officially approved chart data was installed in vector format (ENCs[7]), the system only had the status of an electronic chart system (ECS[8]) which does not comply with the carriage requirements under the terms of SOLAS V/19.2.1.4. According to statements given, the electronic chart display was only used as a supplementary system and navigation was essentially carried out on the paper chart.

The voyage plan is generally produced by the third officer. After planning has been carried out on the paper charts, the voyage plan is then transferred on the planning computer (Chartpilot I) at the chart table. The planning data, such as the safety contour (Safety Contour), course monitoring, etc. are transferred to the radar screen or chart screen at the conning position. A waypoint list generated on the computer with courses and distances, as well as the radio sign-in and sign-out data, is printed out and were signed off by the captain.
The planning for passing the Varne Bank by the third officer set out a course of 223°, clearly south of the Varne Bank.

In connection with the grounding of the LT CORTESIA on the Varne Bank, the BSU commissioned an expert's report by Prof. Capt. R. Becker-Heins, MarineServe GmbH Hamburg. This report assesses the use and handling of the electronic navigational

[6] ECDIS Electronic Chart Display and Information System. According to SOLAS Chp.V, Reg. 19.2.1.4, this system may fulfil the carriage requirements with a chart.
[7] ENC = Electronic Navigational Chart = electronic (officially approved) charts
[8] ECS Electronic Chart System.

equipment installed on board. The expert's report was to examine in particular detail the following points:

- Evaluation of the on-board display used; comparing in particular the nautical information taken from an ECS with that from an ECDIS.

- Analysis of the settings carried out on the bridge and overridden alarms based on an evaluation of the VDR.

5.7.1 Data used as a basis for the expert's report

The following data and information was available for this analysis and evaluation of the operation of the chart display system:

- Video recording of the Dover Coastguard (Channel Navigation Information Service CNIS)
  The traffic monitoring radar of the Dover Coastguard provided a live recording of approx. 33 minutes, showing the radar image at the time from 04:31 and therefore covering the time of the grounding incident.

- On board, data was recorded in the voyage data recorder (VDR). The files for the relevant period were read out and made accessible for a PC with replay software.

  - Radar image (with ECS information)
    Activation of the combined radar/ECS display means that screenshots of this video data were generated in a 15-second cycle, which can be examined and analysed as an image file.

  - Noise on the bridge, VHF radio communication
    The audio data was obtained through microphones installed in the bridge deck, and also through recorded radio conversations. In principle, the microphones are also able to record other noise, aside from speech, for example bridge alarms.

  - Sensor, alarm and control element status messages
    Apart from the above information, additional status messages were also logged, for example rudder position, bow thrusters, main alarms, etc.

- Photos of the relevant bridge consoles (3 January 2008 and 23 February 2008)
  The next day following the grounding, the ship, which had since been hauled free and was anchored on the roadstead, was inspected by the MAIB, and numerous photographs were taken of the individual bridge consoles, the bridge arrangement and the ship itself.

5.7.2 Modes of a chart display system

Too often, the distinction between the various operating modes of an electronic chart display system are not clear enough, and the resulting legal consequences are extremely far-reaching. The term "voyage management system (VMS)"[9] is therefore used if no specific operating mode should be set.

In all operating circumstances, a "voyage management system" is used to facilitate the fulfilment of the navigational tasks of the officer on watch on the bridge. This generic term covers types of systems that differ with regard to handling and functionality and the core purpose of which is always essentially to display chart information on a computer screen.

One thing that all systems have in common is that they comprise the following components:

- The "hardware" involving a computer that has the necessary computing power and storage capacity for the large data volumes to be processed.

- The database containing all relevant geographical, hydrographical and administrative information. Depending on the system, these may have a special format and be organised according to particular specifications.

- The application software that encompasses all programs that organise and analyse the database content and convert it into graphical information. They also provide the navigator with the necessary navigational and administrative functions to enable him to use the electronic chart efficiently.

5.7.2.1 System characteristics

In order to be deemed an adequate navigational tool in the context of SOLAS Chp. V, Reg. 34, the voyage management system must fulfil certain prerequisites. Only then will the system be operating in "ECDIS – Electronic Chart Display and Information System" mode. This means that not every chart display system automatically constitutes an ECDIS. However, many bridge officers do not seem to be fully aware of this fact. Errors of judgement relating to the significance of the nautical information displayed may therefore often occur.

If the system is an ECDIS, it is equivalent to navigation using the paper chart, i.e. navigation can take place – where necessary also exclusively – on the computer (SOLAS Chp. V, Reg. 19.2.1.4). According to an IMO resolution, the flag country is ultimately responsible for deciding whether, when a ship is equipped with ECDIS, to dispense completely with the additional use of paper charts for navigation. Any

[9] As explained below, an "ECDIS" is operated in three different modes (ECDIS; ECS; RCDS), which, even where equipment conditions are otherwise the same, is solely dependent on the chart data called up. The term "Voyage Management System (VMS)" is used as a generic term for an "ECDIS" – without any special mode being specified.

applicable supplementary regulations should therefore be clarified with the flag country in each individual case. For the LT CORTESIA, which was sailing under the German flag, an ECDIS could have completely replaced the use of paper charts[10].

For ECDIS operating mode, the IMO minimum requirements for ECDIS (ECDIS Performance Standard) are defined in the IMO Resolutions A.817(19), MSC.64(67) and MSC.86(70) and also apply to vessels sailing under a German flag. Their content covers the following requirements:

- Based on type testing by the Flag State the compliance of the ECDIS system with the aforementioned IMO documents must have been confirmed. In Germany and the other Member States of the European Union this verification is effected pursuant to the requirements of the ship carriage guideline of the council 96/98/EG. This, amongst others, stipulates type testing under the terms of the respective requirements of IEC[11]. Here the combination of appliance software, computer and monitor is being tested and approved. The approval is being effected within the European Union by organizations, which are appointed for the carriage requirement guideline by a Member State of the Union, the so called appointed institutions. In Germany, the Federal Maritime and Hydrographic Agency (BSH) is responsible for type testing. This authority certifies the successful type testing according to module B.

- The database must contain official chart data in vector format, so-called ENCs (Electronic Navigational Charts). Charts are official if they are authorised by a national government authority responsible for hydrographical data collection and processing. For example, the BSH in Germany. ENC data is vector-based data – compared with raster nautical charts produced by simply scanning a paper chart (RNC data). It is only through the use of the vector system that the full functionality of an ECDIS can be realised by linking data. Aside from a loss-free display when enlarging chart sections or filtering the information displayed, one of the greatest advantages is the activation of alarms when certain objects draw near or in the event of other hazards, for example areas of shallow water.

  Appendix 7 of IMO Resolution A.817(19) provides more detailed stipulations relating to the use of official raster nautical charts (RNCs). Where "ECDIS" status is lost, the device is then used as an RCDS (Raster Chart Display System). A reduced set of paper charts must then always be used for navigation in addition to electronic navigation. The use of RNC on chart radar systems is not admissible.

  In contrast, the use of private suppliers' charts that were not drawn up on the instruction of such a hydrographical institute is, in principle, contradictory to the use of the system as an ECDIS. A system operated in ECDIS mode and displaying such data of a private supplier would fall back to the status of an ECD, which is a navigational aid, and on its own not complying with the SOLAS requirements.

[10] IMO SLS.14/Circ.190
[11] International Electrotechnical Commission, IEC 61174

- Ultimately, the ECDIS system must be protected in the event of a possible failure with suitable back-up devices to ensure the safe conclusion of the ship's voyage. In line with the current regulatory situation, possible options are the dual installation of ECDIS systems of the same construction or the additional use of a complete set of amended official paper charts for navigation.

5.7.2.2 Equipment-related legal consequences

If unofficial data that would otherwise fulfil all criteria for an ECDIS is called up on a system, "ECDIS status" may be lost - generally unnoticed by the user. However, the resulting "ECS" mode is not sufficient to fulfil SOLAS requirements that also apply via the Ship Safety Act (SchSG) to ships sailing under a German flag.

If a ship only has an ECS, there is a risk that it is unseaworthy or unfit for voyage from the start. This could affect the liability in the context of maritime law of a shipping company on various points.

The electronic chart display system is part of the equipment of a ship. This means that its task, alongside other items of equipment, is, among other things, to enable the ship's crew to overcome the foreseeable hazards of a sea voyage. As a navigational tool used on the bridge, its functioning is critical to the safety of the ship.

At the same time, as it is not fully automatic, it also has to be operated by the bridge personnel. This requires training in the handling of the chart display system. If, for example, a ship grounds due to incorrect interpretation of the displayed chart image, this is brought about by an inadequately trained or inadvertent user "failing to identify" the navigational situation.

The use of a voyage management system can point to at least two indicators of a ship's seaworthiness. Namely "proper equipment" in the case of blind faith in the information of an ECS or "proper manning", if the system was operated in ECDIS mode but the officer on watch could not safely operate the system.

5.7.3 Errors and risks in electronic chart display systems

The more complex a voyage management system, the more varied the areas in which shortcomings[12] can occur. Adding in the operator as part of the overall system, the field of possible errors and deficiencies is widened to include a substantial component. The resulting risks can be sub-divided into two categories.

The first category includes risks that may arise from system-related shortcomings. This means malfunctioning of the ECDIS or ECS. Technical deficiencies such as a flickering screen light diffuse color contrasts through to complete device malfunction are conceivable.

[12] The term "shortcomings" was chosen here, because its meaning encompasses all unwanted characteristics of a situation. It therefore covers the similar terms "error" and "deficiency", which, however, in this case, describe a shortcoming in the sense of the non-functioning (error) or in the sense of poor functioning or inadequacy (deficiency).

Equally varied are the risks that fall under the second category. These refer to user-related shortcomings. They include application errors, caused by the incorrect usage of electronic chart display systems. Generally, they are based on a lack of understanding or blind faith in the technology. It is precisely these risks that call for closer investigation when looking at a specific case, because they often lead to an escalation of the risk for the ship.

A study commissioned by United Kingdom Hydrographic Organization (UKHO) in cooperation with the Maritime Port Authority Singapore at the end of 2004 examined, among other things, the influence of operator shortcomings when using voyage management systems. The study received international consideration as a "Hailwood report".

One of the most urgent problems borne out by the Hailwood report is the lack of understanding of equipment and usage regulations relating to electronic chart display systems. One of the reasons for this is the fact that the seminars and training courses on ECDIS offered by the shipping companies are rarely taken up. This means that the majority of those asked were unable to distinguish between ECDIS and ECS[13].

When asked whether companies had experience of ECDIS or ECS, the majority intuitively gave the response "ECDIS". When asked follow-up questions, however, it became apparent that the systems actually installed were, in most cases, ECS.

Subsequently, the Hailwood report emphasises the risk that may arise from a user's lack of understanding. The incorrect application of a (possibly also defective) ECS as a navigational tool prior to a grounding must definitely be viewed critically. It is therefore possible to criticise the situation on the ship side, whereby the careful handling requirements demanded have not been sufficiently fulfilled.

5.7.4 Integrated navigational system and NACOS

Generally, on newer ships, the electronic chart display systems are part of an "integrated navigational system", abbreviated to INS[14]. An INS combines the various navigational and ship control elements in one networked system, which can be operated via a central workstation. Usually, navigational equipment such as radar systems, ECDIS or even autopilot are integrated into a INS. Additional sensor data is accumulated and prepared in graphical form before being displayed on a screen. The purpose of this is to support the officer on watch in his navigational duties by providing the user with all data necessary for navigation centrally and in a prepared form.

In "track control" mode, an integrated navigational system can, in conjunction with an autopilot configured for this purpose, enable a previously defined track to be sailed –

[13] This assessment was provided by Dr. Andy Norris (CNI).

[14] The term "Integrated Navigational System INS" refers to systems that comply with the specified performance requirements of the IMO(MSC Circ.) or a national authority

even under the influence of current and wind. In a control process, the INS evaluates the data via the ship position, the adjacent course and the ship's speed, applies this data to a mathematical model of the ship, enabling the ship's behaviour to be predicted, and finally determines the necessary rudder angle. If only the heading is controlled, the autopilot remains in "Heading Control" mode.

An INS would also be able to follow the route planned on the voyage management system at the speeds specified for each section. For this, INS would have to have access to the engine speed - something which, however, is, in practice, rejected by most vessels' commands.

On board the LT CORTESIA, NACOS (Navigation and Command System) from the company SAM Electronics had been installed but does not have approval as a fully adequate INS. It does only have approval as track control system. The NACOS must not implicitly comprise and meet all aspects of an INS. Depending on the requirements, this system offers various configurations within the consoles. They are:

- Radarpilot: constitutes a radar system that, aside from the radar functions, enables the autopilot/trackpilot to be operated and therefore track control.
- Chartpilot: refers to a VMS workstation with type testing for an ECDIS.
- Chartradar: describes a radar system that can, in addition to the functions of the Radarpilot, overlay a VMS layer from a connected Chartpilot on the radar image.
- Conning display: refers to a display for the permanent relaying of Conning information, which can be read out from an available Chartpilot or Multipilot.

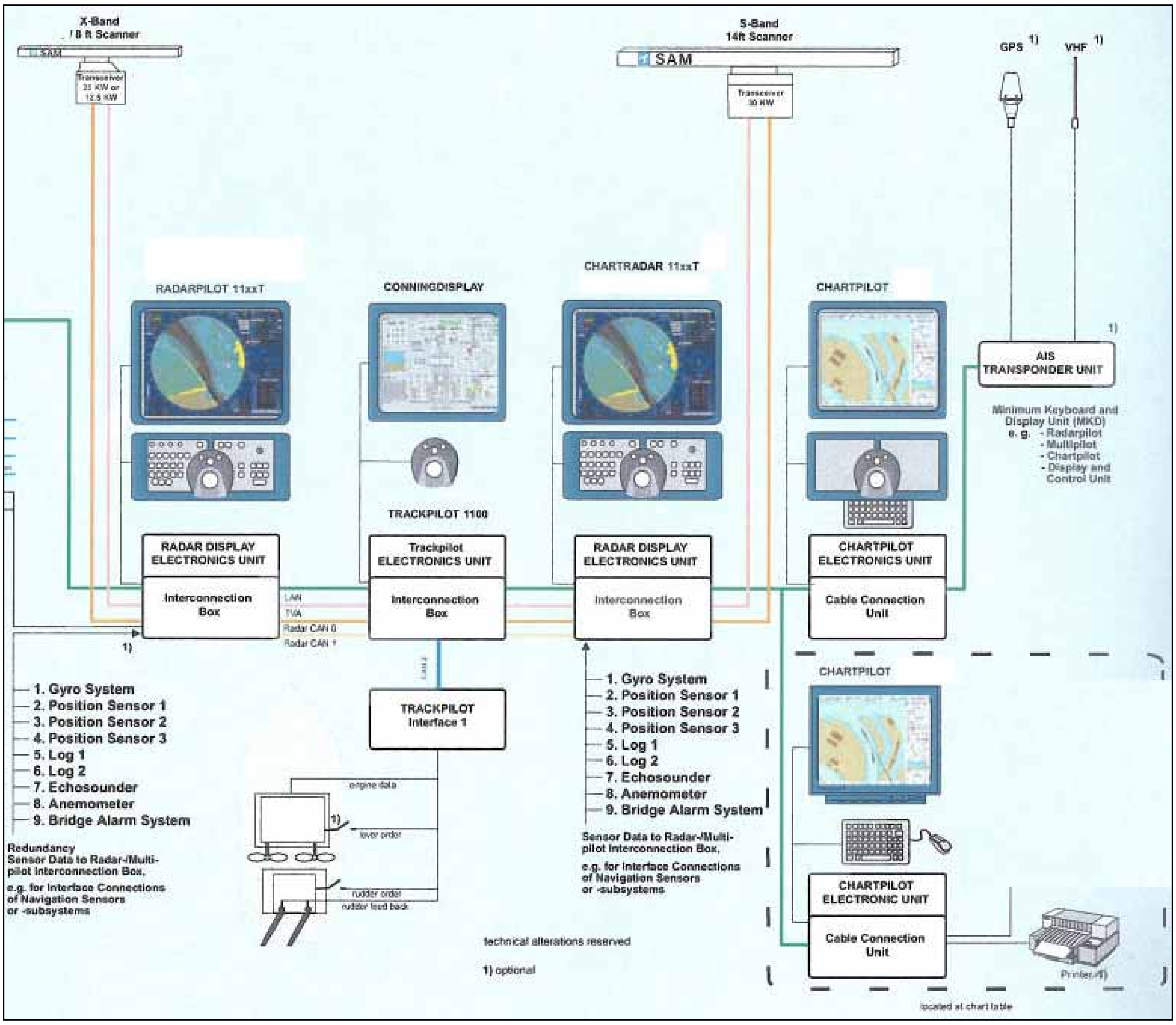


Figure 9: Typical system configuration of the company SAM Electronics
For current bridge arrangement on board the LT CORTESIA, see Fig. 8

5.7.5 Handling a VMS and ECDIS

Safe operation of a complex system like a VMS calls for thorough training of the operating personnel. Usually, a relevant training course should communicate general knowledge about voyage management systems and tackle the special function structure of a system like the one the user will later be using on board.

However, the need for VMS and ECDIS training is not currently set out in a transparent way. Although, up to now, no training requirement has arisen on the basis of the STCW Code, individual flag countries could request at national level that this be one of the conditions for the acceptance of an ECDIS as a substitute for paper charts. For ships sailing under a German flag, no such supplementary requirement is set out. Ultimately, such a demand could only come about from the checking instructions of officers from port state controls[15]. Irrespective of official training requirements, the operators of nautical vessels are obliged in accordance with ISM Code to determine training requirements for their crew and to ensure a

[15] Port State Control Committee Instruction 34/2001/02

relevant training program. The vessel operator NSB runs an own training center with two different simulators in the form of the "NSB academy". Holder of nautical and technical certificates of competence are obliged to regularly participate in seminars and training courses.

In conjunction with voyage planning, as required in accordance with SOLAS, Chp. V Reg. 34 and IMO Resolution A. 893(21)[16] for all ships on all voyages, a VMS provides the option to generate a voyage plan electronically. A significant part of such a voyage plan is the sequence of waypoints, which is also displayed in graphical form on the VMS display. Furthermore, usual navigational aspects should be highlighted, such as are to be expected in the Dover Strait, and especially in proximity to the Varne Bank. Even if a voyage plan has been planned on the VMS, a paper printout must still be produced and hung up on the bridge.

For additional safety, every officially approved ECDIS must have a function[17] available to check for any dangers on the planned route that may arise from sailing close to objects and critical contour lines[18] on the chart. When the "Check" function[19] is activated, the entire length of the route is checked within an adjustable corridor. If the route comes too close to a possible hazard, the operator is notified of this via a warning message.

Generally, all bridge officers record the fact that they have taken note of the voyage plan by signing it. In this respect, the chief officer of the LT CORTESIA must have been informed of the peculiarities of the Varne Bank. A printout of the voyage plan must also be retained after conclusion of the voyage.

If a voyage plan was generated using a VMS, then when later following the waypoints, there are two options for the use of the stored route.

Firstly, the voyage plan can only be loaded (Loaded Track). In this case, the tracking of the waypoints and the sections between them is displayed graphically on the electronic chart, but, aside from the display, VMS does not carry out any other functions or checks with regard to a track control. The VMS also does not issue any alarm signals, e.g. if the ship moves more than a specified tolerance away from the planned track.

One of the loaded voyage plans can then be activated (System Track). The planned route is still displayed on the screen but now, the VMS can execute additional functions. If the ship's autopilot has a track control mode (this would be the Trackpilot in the NACOS), the VMS can send the track control module the necessary information to sail via the waypoints and the ship would automatically follow the specified route. As a further option, if the track was activated, the VMS would be able

[16] IMO Resolution A 893(21) - Guidelines for Voyage Planning
[17] IMO Res. A 817(19) Performance Standards
[18] Can be set via the "Safety Contour" menu option, which is otherwise used for colour differentiation of the contour zones on the chart.

[19] "Check" is a term used by the manufacturer SAM Electronics; other manufacturers, for example, may call the function "Validation".

– if the regulatory prerequisites on board are in place – to also control the engine speed so that a specified speed profile is adhered to (Speedpilot).

In the case of an on-board system from the manufacturer SAM Electronics, it is possible – even without going through the safety checks mentioned for the intended route – to store or load voyage plans, or even declare them to the system track, whereby in the latter case, a warning message would appear.

Irrespective of the existence of waypoint planning, when the ship sails, a defined safety zone around the ship is always monitored in terms of chart information[20]. The length of this foreseeable sector can be set by the operator but is at least 1 nautical mile[21] when the track is activated. An alarm is triggered if chart objects such as buoys enter the monitoring sector or a minimum selectable depth is breached by water depths on the chart. Before running aground in shallows, the VMS would issue alarm signals accordingly. However, in the Chartpilot from the manufacturer SAM Electronics, this alarm function can be deactivated by the operator.

5.7.6 Evaluation of the data

On the voyage from Thames Port to the Suez Canal, the LT CORTESIA container ship ran aground at around 04:50 on 2 January 2008. There are recordings from the voyage data recorder (VDR) for the period prior to and during the grounding. However, only screenshots of the Chartradar were recorded and not the Chartpilot, which displays the actual VMS.

[20] In view of the data structure, this monitoring function only works on the basis of vector charts.
[21] Pursuant to the product specification of the manufacturer SAM Electronics

5.7.6.1 NACOS configuration

Generally, the pictures of the bridge on the LT CORTESIA indicate the following arrangement of the NACOS consoles:

Figure 10: Arrangement of the bridge consoles on the LT CORTESIA

- In the centre at the height of the central console is a Conning display, which permanently displays the navigation data of a connected Chartpilot or Multipilot but does not demonstrate any further functionality.

- To the right of this, at the workstation of the officer on watch, a Chartradar is installed in line with the centre. Although this system works primarily as a radar, a VMS layer can also be displayed. However, the hydrographical data records are not stored on the Chartradar itself, but rather on the connected Chartpilot, which means that the radar has to read in the chart data externally from this "chart server".

  Only limited operating functions are available on the Chartradar for the selection and display of chart information. The Chartradar operator can choose what hydrographical data is imported, i.e. ENC or CM-93/2. RNC data, for example, cannot be displayed on the chartradar. A number of presentation parameters can also be defined, for example to enlarge the chart section or set the density and type of chart symbols. However, based on this Chartradar query, the Chartpilot only delivers a "chart picture" bit map.

  But chart-specific monitoring and alarm functions can no longer be influenced at the Chartradar workstation, e.g. the parameters for the safety sector (alarm warning relating to objects on the chart, breach of safety depth, etc.). These values must be transferred from the settings on the Chartpilot, even if other charts are currently displayed there (if necessary, also in another format). The test standard for the chartradar according to IEC 60936-3 does not prescribe alarm functions. However, they are partly displaced on the chartradar.

Ultimately, an operator may have selected completely different chart displays on the Chartpilot and on the Chartradar without necessarily having been aware of the effects on monitoring functions. It is also not possible to draw conclusions from the chart content currently mapped on the Chartradar about the simultaneous Chartpilot chart display. For example, an ARCS[22] may be loaded on the Chartpilot, whereby the device is operated in RCDS[23] mode, but the Chartradar displays the "chart picture" of an ENC. The example given would be particularly unwise, given that the Chartpilot in RCDS status cannot provide any monitoring function (as would be the case with vector data) and the Chartradar is, in principle, unable to do so on the basis of its functionality[24].

On ships with a gross tonnage greater than 3.000, with keel laying after the 01.07.2002, it is necessary to install two radar systems. Pursuant to SOLAS V/19 one of these has to be an X band and the other an S band, whereby the allocation of the radar screens to the display and operating consoles - in this case the Chartradars – is being left up to the operator. The Chartradar described here was allocated to the S band.

The recordings of the VDR come from this screen according to the determinations. The direct device settings, as made on the Chartpilot, can therefore only be simulated to a limited extent. However, if a VMS is actually run as an ECDIS, i.e. as the primary navigational tool, storing this data in the VDR would also be useful in order to later ensure that information about the navigational settings and the chart work carried out (which cannot be simulated here) can be received in the fullest extent possible by the officer on watch.

- The device next on the right, i.e. with the screen on the far right, is a Chartpilot. As previously explained, the Chartpilot would fulfil all system-related requirements to enable a voyage management system to be operated in ECDIS status. Although a large number of the settings carried out here have an effect on the behaviour of the VMS and therefore also on the chart display on the Chartradar, this data has not been stored in the VDR. An operator can therefore, for example, only deactivate the alarms on the Chartpilot in the case of the automatic monitoring of the safety sector around the ship, but no obstacle or shallow water alarms would be output on the Chartradar.

[22] ARCS Admirality Raster Chart Service
[23] RCDS Raster Chart Display System
[24] In view of this deficiency in functionality, a Chartradar can never achieve the status of an actual ECDIS, and chart transfer will always remain an ECS layer (ECS Electronic Chart System - navigational tool that does, however, not fulfil the carriage requirements in accordance with SOLAS Chp.V, Reg.19

- On the left next to the central console is the second radar[25]. The same applies correspondingly to this radar, as to the Chartradar at the officer on watch workstation. As a radar display, however, the screen of the X band radar was probably displayed here.

- To achieve the required duplication of the ECDIS, so that the VMS constellation could replace the use of paper charts as an actual ECDIS, as shown in the photo below, a second Chartpilot has been set up as a so-called planning station in the rear section of the bridge at the chart table.

Figure 11: Second Chartpilot as a planning station at the chart table

5.7.6.2 Presentation parameters on the Chartradar

As the recordings of the VDR probably affect the Chartradar at the workstation of the officer on watch, the following statements apply exclusively to this device. As described in detail in the previously paragraph, the display values of the other consoles may sometimes have been configured completely differently.

Below, only selected display elements are to be examined in further detail. If settings have been changed compared with the previous settings, this can never occur automatically, but rather always calls for the intervention of the officer on watch. The settings would remain unchanged throughout the entire voyage as long as the officer on watch does not modify them. Even when the Chartradar is restarted, many of the "old" settings would be reloaded again[26].

[25] According to the carriage catalogue the LT CORTESIA is equipped with a chartradar and a radarpilot
[26] With the exception of the screen presentation, which is set to "Standard"

N Up	The screen orientation North Up is definitely suitable for this application case and corresponds to the familiar orientation on a paper chart.
RM(T)	As a movement reference, Relative Motion means that a standard setting has been made. The "T" in brackets indicates that the display was connected with true vectors.
CLEAN SWP	This screen clearing process has been set to MEDIUM. This correlation function did not necessarily have to be activated. However, no radar targets appear to have been lost.
IR	Activation of Interference Rejection as a further screen clearing process would also only have been required if ships in the surrounding area had generated an extraneous radar sound. If so, although this would only have been the case with certain time limitations, then IR would not have to have been activated over the entire period. However, small radar targets do not appear to have been lost.
VRM	A circle with a radius 0.5 nm around the ship was set using the Variable Range Marker. This may also be used to mark the close range.
RANGE / OFF CENT	In addition to the range of 6 nm, the centre of the radar screen was shifted towards the direction of the heading. This resulted in a recording range in the direction ahead of the ship of some 9 nm, which was adapted to the traffic situation along the one-way lane.
BUZZER OFF	The line through the loudspeaker indicates that the BUZZER OFF function was activated. In most cases, this suppresses the acoustic alarm output.
AIS	When AIS information is connected to the display, the Chartradar overwrites the ARPA symbol with the triangular AIS symbol if AIS data is received for a contact. However, the relevant vectors are missing in the display in question (see VECTORS), since the targets have not been activated . In principle, AIS vectors provide additional information (e.g. ROT[27] of a contact) and should be considered helpful.
CM-93/2	Irrespective of the fact that, as described above, a Chartradar can never take on the status of an ECDIS, with the CM-93/2 data, unofficial chart information is displayed. This must not be used for navigation.

[27] ROT = Rate of Turn

However, as previously explained, no conclusions can be derived from the fact that this Chartradar worked with CM-93/2 data about the chart displayed at the connected Chartpilot. In any event, the chief officer should, in the present case, not have sailed solely based on the information of the Chartradar, but instead, should have verified the navigational data using an approved navigational tool. If an ENC were loaded, either a paper chart or the Chartpilot would be a possible option for this.

VECTOR

Activated targets are displayed with associated vectors. When displaying the vectors of acquired targets, the user has a choice between relative and true vectors. Although true vectors were selected here, for the purposes of preventing a collision, the intermittent display of relative vectors would also have been advisable, as close range breaches are then apparent. When the chief officer plotted the course through the two E Varne and Mid Varne buoys, however, any possible exceedance of maximum close range was, in any event, not the cause of the grounding.

DEPTH CONTOURS

Settings here derived from the chart image.
Parameters cannot be set on the Chartradar, but are transferred from the Chartpilot.
In the case of the depth contour display, a 4-colour differentiation was set. The Shallow Contour was at 20 m and the Safety Contour was at 30 m[28]. The (unknown) value for the Deep Contour was of no consequence due to the low water depths.
In fact, the setting options for the Depth Contours can be confusing at first glance. Generally, the collective term Depth Contours covers the menu options for Shallow Contour, Safety Contour and Deep Contour. The colour differentiation is used in areas shallower or deeper than a settable Safety Contour to distinguish between navigable and non-navigable areas of sea, taking into consideration the relevant draught of the ship.

On activation of the 4 color mode non-navigable areas are shown in blue shades (light or dark blue), while navigable areas are in white shades (grey or white). If the Shallow Contour is set, a further distinction is made in terms of the non-navigable areas between absolutely critical depths (dark blue) and depths to be avoided (light blue). Accordingly, the Shallow Contour can take on as a maximum the value of the Safety Contour. In turn, the Deep Contour makes a

[28] According to the specification for Chart Content and Display Aspects of ECDIS (S52) a value of 30 m is automatically set for the Safety Contour, if the user dos not set another value

distinction between waters with limited navigability[29] (grey) and waters where navigability is unrestricted (white).

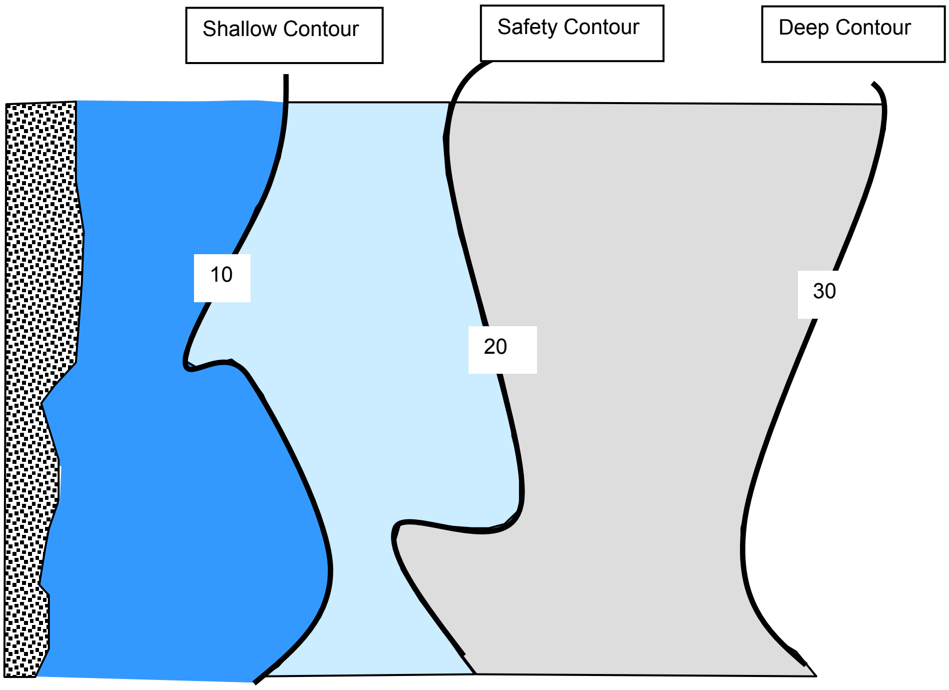


Figure 12: Colour 4-color differentiation[30] according to depth contours

Nevertheless, the system generally cannot make a precise colour distinction for the relevant contour value entered. This means that only a contour line available in the database can be used for delineation purposes. As a rule, these are only input by cartographers for special values, for example along the depths 5 m, 10 m, 20 m, 30 m or 50 m. When a different value is entered for a contour, the system therefore searches for the next bigger contour line available (i.e. with a not existent depth contour line of 12 m a value of 20 m is assumed). But the operator is not separately shown which contour line.

This means that readings of 11 m, 15 m, 19 m or 20 m may then all be given the same colour distinction along the 20 m line, if between the 10 m and the 20 m depth contour line are no further depth contour line in the database. With the "DAY" display type, buoy symbols can be seen clearly. The Varne Bank stands out faint.

[29] E.g. based on hydrodynamic phenomena, such as squat

[30] Possible is also a 2 colour distinction with the subdivision into blue=not navigable critical areas and white= unrestrictable navigable

Figure 13: "Day" display type. Varne Bank shows up as dark blue

However, with the brightness configuration “NIGHT” selected at the time of the accident the buoy symbols are almost not visible and the display of the depth contours is low in contrast to such an extent that no differentiation can be identified between the shallower or deeper areas of the Shallow Contour.

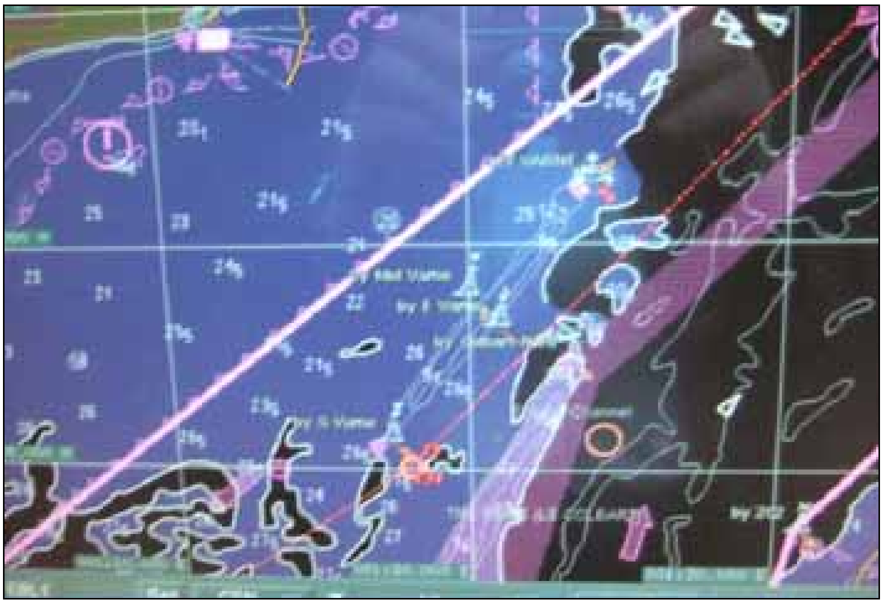


Figure 14: "Night" display type. No contrast against the surrounding area

As the colours are allocated in accordance with the IHO Standard S-52[31], it is necessary to check whether this is a general shortcoming.

[31] Meanwhile issue 4.2

By setting the Safety Contour to 30 m, virtually the entire one-way lane in this case was highlighted as "non-navigable". It is questionable whether this setting was made intentionally by the chief officer or whether these value was retained from the last change, which may have been some time ago, respectively was the automatic value of 30 m according to the standard S-52 set by the system.

SAFETY DEPTH

The Safety Depth determines the depth which is used to mark rocks, wrecks and shipping obstructions as danger potentials, whose chart depth is listed with a value corresponding to the Depth Contour or lower as the Depth Contour. On the ECDIS shipping obstructions are displayed by means of a magenta colored circle with toppled cross.
Wrecks are marked by darker or lighter colors selected, depending on the day or night representation selected.

SYMBOLS

Settings here derived from the chart image.
Parameters cannot be set on the Chartradar, but are transferred from the Chartpilot.
Under the S-52 symbol, when also used with the Chartpilot to display CM-93/2 charts, the operator can choose from two categories: Paper Chart Symbols or the Simplified Symbols. Here, Paper Chart Symbols were selected. In connection with the colour allocation problems described under DEPTH CONTOURS in NIGHT mode, the Paper Chart Symbols can barely be detected on the screen. While the echoes of the targets on the radar are extremely brightly illuminated, buoy symbols, for example, disappear almost completely beside them.
It would have been better to select Simplified Symbols, which would have been clearer to see with their colour markings.

5.7.6.3 Handling conclusions

As the screenshots of the VDR provide information about which settings on the Chartradar were made by the chief officer, statements can be derived to a limited extent as to whether relevant use was made of the radar system and the chief officer exercised due diligence.

On examing the screenshots, it is apparent that, during the entire recorded time, no trial manoeuvre was attempted. With a trial manoeuvre, an officer on watch can plan which course and/or heading change would enable him to avoid coming into close range of oncoming traffic[32]. However, leaving the track and changing course to starboard at 04.36 due to a suspected close range situation with another vessel were, in fact, the catalyst events that led to the ship running aground.

In connection with the mentioned manoeuvre to avoid close range, it is also questionable whether there was even any need at all for action on the part of the LT CORTESIA from the start. The initial situation appears to be such that there was initially no overtake situation in relation to the incoming vessel as per Reg. 13 KVR[33], because a close range situation would not have arisen in view of the passing distance[34]. However, even if we were to assume an overtake situation, the TCPA[35] would be so late that the vessel being overtaken would, in all probability, already have made the navigational course change level with the E Varne buoy in a southerly direction. The delay function of a trial manoeuvre would have provided a concrete conclusion.

However, most relevant radar targets were acquired by the chief officer, including the Varne shallow buoys as targets 9 and 11, which were later indicated as Dangerous Targets on the target display. The acoustic alarms that sounded were suppressed by the "BUZZER OFF" setting.

If safety alarms had been generated on the connected Chartpilot, which is the only place where the safety zone is monitored through critical chart data, they would also have been forwarded through to the Chartradar. However, the VDR recording shows that, in the period in question, no such hazard warnings were issued on the Chartradar. Approaching the Varne Bank marked with buoys would have been cause for such alarms in any case.

Firstly, when a chart object, like the buoys for example, are recorded by the monitoring sector (where the set maximum range ahead could not be reconstructed) or areas with too low depths compared with the Safety Contour, and secondly, when the ship moves directly into the danger area.

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[32] According to regulation 8 of the International Regulations for Preventing Collisioss at Sea from 1972 „Manoeuvres to avoid collisions“ such a manoeuvre planning is rquired in terms of section d

[33] Although the own course amounted to 228° at this time, the course of the incomer to 247°, the course difference amounted to 19°

[34] Presupposing close range of 0.5 nm

[35] Time of Closest Point of Approach= Time up to the closest approach

The fact that no such alarm could be recorded on the Chartradar can only be caused, ultimately, by two factors, taking into consideration the fact that the Chartradar itself cannot trigger such alarms but rather "only" takes on the alarms of the Chartpilot. Either the Chart Alarms in the relevant Chartpilot menu were deactivated by the operator or raster data was being run on the Chartpilot. In view of the data structure, no such monitoring can generally be linked with raster data.

Figure 15: Menu for Chart Alarms on the Chartpilot (later simulation)

The following examines the actions of the officer on watch on the Chartradar in chronological order. The times are from VDR information.

03:51:00 The right-hand side of the screen maps the important Conning, voyage plan and radar target data in the context of voyage monitoring. Level with the centre is normally the alarm window, where the incoming alarms are listed.
However, the operator can position a sensor display over this window. Incoming alarms would then be displayed by hiding the sensor display until the alarm is stopped.
Until 03:51, an echograph display was placed over the alarm window, which, in this case, would have been extremely

useful to avoid running aground. After 03:51, the second officer replaced this display with wind information, thus missing the depth information. (Compare the two figures below)

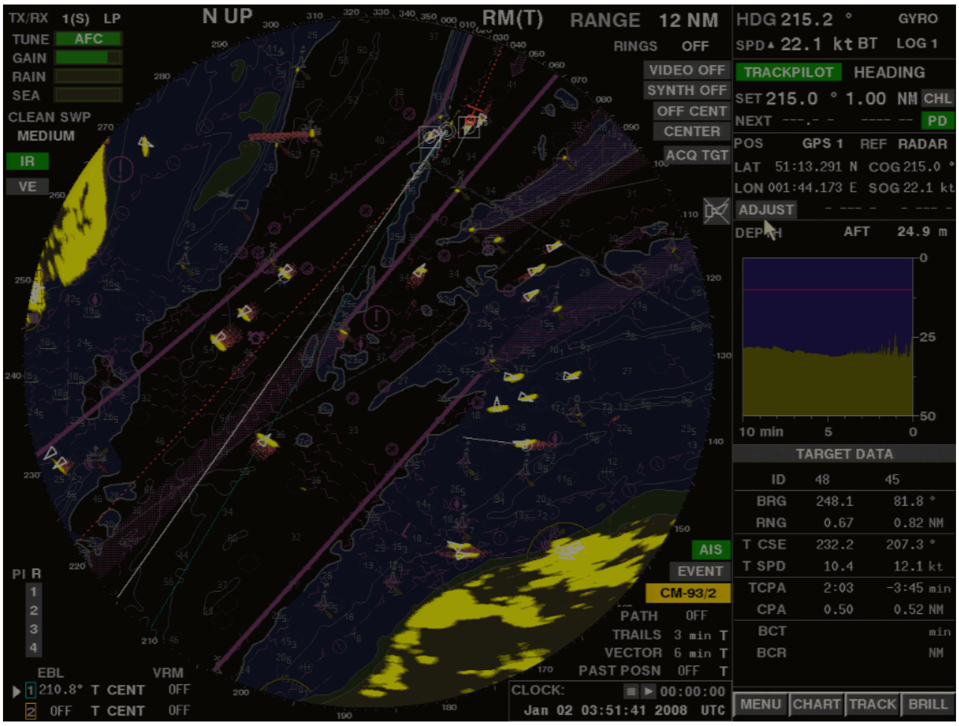

Figure 16: Chartpilot of the LT CORTESIA up to 03:51:41 on 2 January 2008

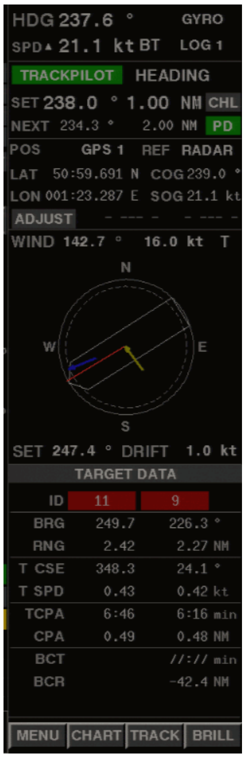

Figure 17: Display bar of the LT CORTESIA at 04:44 on 2 Januar 2008

As the Chartpilot in the standard display does not show the echo sounder depth, the water depth was probably only shown on the echo sounder itself and the Conningpilot. However, the digital display of the echo sounder is located on port side of the central console and therefore outside the field of vision of an officer on watch.

04:19:00

Up to this time, the Trackpilot was set to "Track", which means that the ship was held in Track Control mode on the displayed system track. As of 04:19, the course controller was switched to Heading Control, so that the chief officer had to monitor and, if necessary, correct the course himself. From the information available, there does not seem to be any obvious reason for this step. Ultimately, the ship would probably not have run aground if the ship had continued to be run in Track Control.

04:32:00

On the Chartradar, a vessel can be identified pulling into the one-way lane from the separation zone. The situation is shown below on the AIS/radar screen of the Vessel Traffic Service.

Figure 18: AIS/radar screen of the Vessel Traffic Service CNIS

04:32:00 The incoming vessel is plotted on the LT CORTESIA and interpreted as a Dangerous Target.

04:34:00 With the aid of the EBL[36], the officer on watch plots the course through the two E Varne and Mid Varne shallow buoys. As already mentioned, in view of the inverse colour allocation in NIGHT mode and the activation of Paper Chart Symbols, the buoy symbols are difficult to identify as such, but on closer inspection, the markings should have been recognised as buoys at least by this point. The buoy echoes also do not have any kind of sailing vector, as "True" vectors were set. Confusing the objects with fishing vessels would therefore have been avoidable if the necessary care and attention had been taken. (See Fig. 19)

04:44:00 At a distance of some 2.5 nm, the two shallow buoys E Varne and Mid Varne are acquired on the radar. As their relative motion moves into close range[37], the buoys are displayed as Dangerous Targets with the numbers 9 and 11 in the target data window. The True Speed of both buoys is given as 0.4 kn (see Fig. 17). Even if the LT CORTESIA were sailing at a speed over ground of 21 kn, the grounding incident could still have been avoided by changing course to port. As the figure below shows, the buoy symbols are definitely weak but can still be identified.

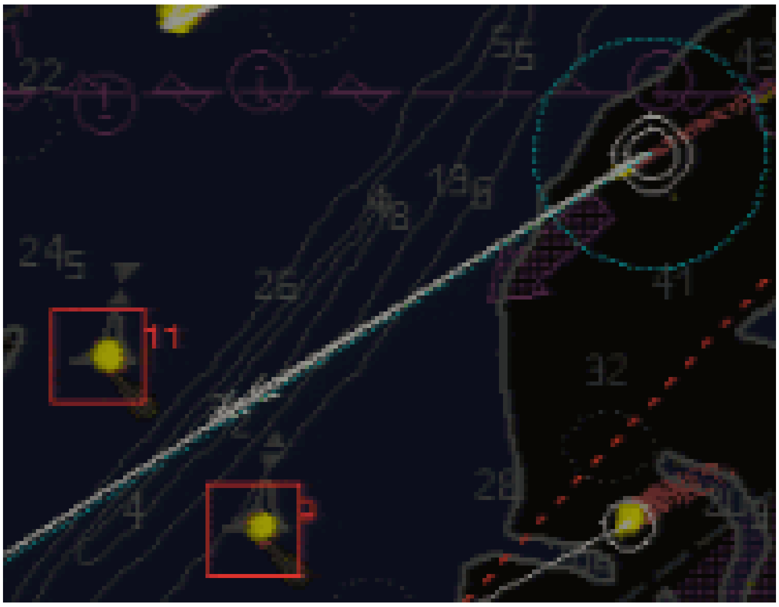

Figure 19: Cardinal buoys E Varne and Mid Varne at 04:44

[36] EBL Electronic Bearing Line

[37] In view of the size of the VRM, close range is assumed at 0.5 nm. This value could then also have been entered as a CPA limit value on the ARPA

What is astounding, however, is that neither the chief officer nor the lookout spotted and identified the buoys. According to information available, there was extremely good visibility of 8 nm at this time. Given the nominal range of the buoy lights, it would have been possible to clearly make out the rapid flashing in groups of 3 or 9. This would exclude any mix-up with fishing vessels (in accordance with the KVR), also because they would have carried clearly different masthead lights.

04:49:00 The recordings show that the Trackpilot was completely switched off (i.e. also no longer any Heading Control). It can therefore be concluded that the crew had switched to manual steering or to the second autopilot system (Raytheon-Anschütz).

5.7.7 Replication on the simulator

With the support of subject group S33 of the BSH, the route sailed by the LT CORTESIA was replicated on a Chartpilot located in the laboratory for navigational systems. For this, the Chartpilot received the necessary input data from a simulation computer. The chart material available included both ENCs for the Varne Bank area and a version of the C-Map CM-93/2 data, as used on board the LT CORTESIA.
Initially, it was necessary to check whether, when using official ENCs instead of proprietary CM-93/2 data, the system would have behaved differently, in particular whether there would have been changes in the monitoring alarms. Checks were also carried out to determine what warnings and/or alarms could generally have been expected.
As already illustrated, the Chartpilot in the NACOS of the LT CORTESIA may, at the time in question, have loaded different chart material to that displayed on the Chartradar. In the worst-case scenario, if raster charts were used on the Chartpilot, no safety breaches would have been registered even if monitoring alarms were activated on the Chartpilot because of the data structure of raster data, and therefore no alarms could have been forwarded to the Chartradar.
According to information from the shipping company, it should be assumed for the purpose of further explanations that CM-93/2 data from C-Map was used on the Chartpilot. On the basis of this assumption, the results of the test runs on the simulator can be summarised as follows:

- Of the relevant data, in relation to the surrounding the Varne Bank area, the unofficial CM-93/2 information is no more enlightening than the ENC data records. It appears that both data records contain the same important hydrographical information. In this case then, the use of official ENCs instead of private CM-93/2 data would not have resulted in additional or better hazard warnings on the VMS/ECDIS. Although officially, reading in CM-93/2 data would mean that the system becomes a non-SOLAS-compliant ECS and navigation according to this information would have been "in contravention of the regulations", this can, nevertheless, NOT be deemed the cause of the grounding.

- Monitoring of the safety zone around the ship and the ship's position itself is also possible with CM-93/2 charts. As already mentioned, a hazard warning is even triggered twice; firstly when the safety sector encounters a chart object or a depth area that is too shallow, and secondly when the ship's position moves into a danger area. Only if the Chart Alarm is deactivated are NO such alarms generated. In this respect, it can be assumed that these chart alarms had actually been switched off. Although, according to information from the crew, the Depth Alarm was set to 10 m at the time of the incident, the value for this Under Keel Clearance in a simulator run was set to 5 m or, in the second run, to 12 m.

Various methods can be applied in order to determine a safety depth for the depth alarm. Ultimately the safety depth is specified by the master. It would for example be conceivable to take the draft of the ship plus 2 m safety depth. In this precise case with a draft of 12 m this would lead to a safety depth of 14 m.

The setting of the depth alarm of 10 m stated by the crew would result in a similar critical water depth. As can be learned from the manual of the chartpilot the depth alarm refers to the water depth measured under the keel by echo sounder, the Under Keel Clearance. If the stated 10 m for the depth alarm are added to the draft of 12 m astern this well lead to a critical water depth of 22 m.

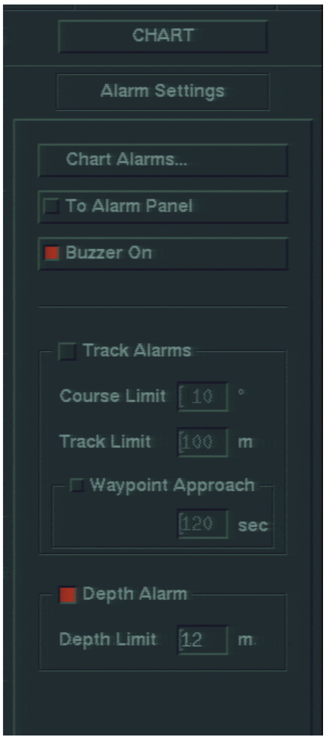

Figure 20: Menu for alarm settings on the Chartpilot

When the clearance fell below the set Safety Depth (Under Keel Clearance), a corresponding alarm was triggered in the simulator operation[38]. Generally, the Depth Alarm is displayed on all devices on the bridge that show the water depth and also has to be stopped on each device individually. However, the acoustic alarm is suppressed when Buzzer Off is activated.
The fact that, during the grounding, the Depth Alarm did not show up on the Chartradar leads to the conclusion that this function had already be deactivated on the Chartpilot. This means that setting the Depth Alarm to the 10 m specified by the crew would have been meaningless.

The different colour display was tested when changing the Depth Contours and the Safety Depth:

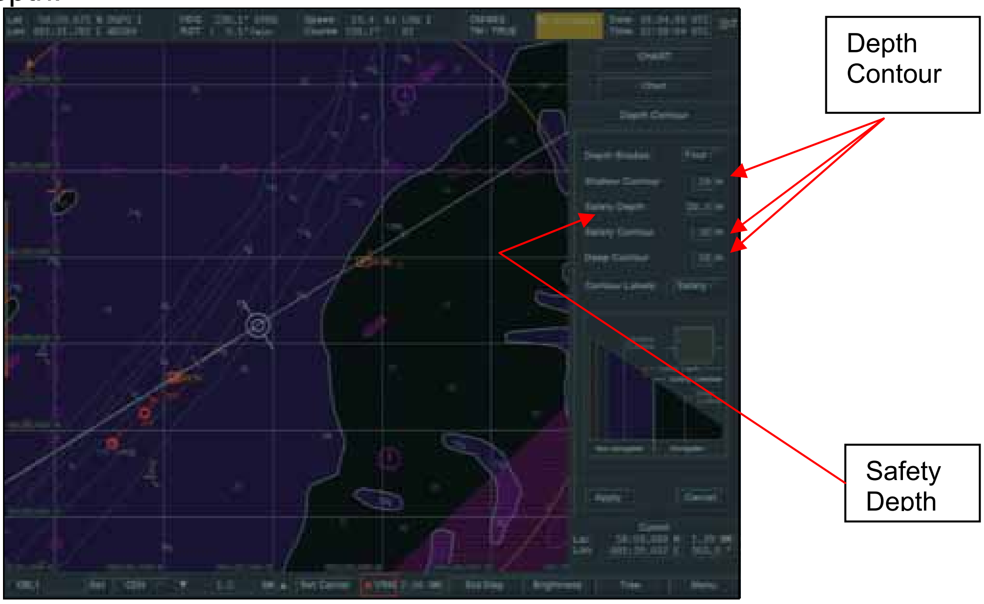

Figure 21: Night mode safety depth 30 m

In the case of the above "NIGHT" setting, the Varne Bank, as well as the buoy symbols, does not stand out, since they are in the unsafe area, where according to the definition no maritime shipping should take place and which should therefore be avoided
When set to day mode, as below, the Varne Bank is identifiable as dark blue, but it is still behind the Safety Contour:

[38] The simulation computer cannot show the actual depth profile for the simulation. More often, simplified profiles are used for calculation

Figure 22: Day mode (Settings as figure 21, night-mode)

With this display the Varne Bank as well as the buoy symbols in the light blue and grey area stand out. Wrecks and shipping obstructions are highlighted.
The display grows even more clear with the setting of the Safety Depth and the Safety Contour on 20 m. The one way waterway is displayed as largely navigable water area. The passage between both sand banks is visible and more shipping obstructions and less wrecks are displayed:

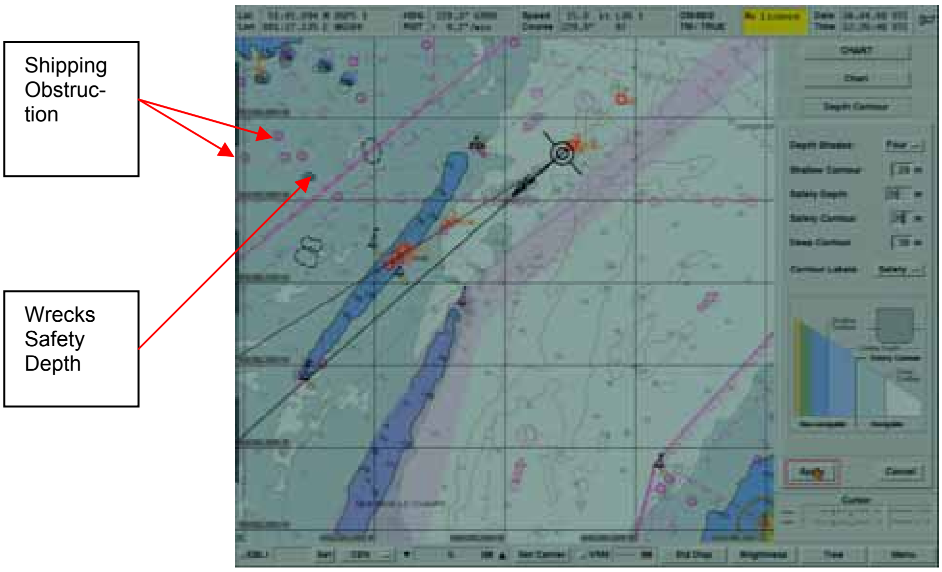

Figure 23: Setting for Safety Depth 20 m

5.8 Work times

Together with an expert from the Occupational Safety and Health Administration (AfA) Hamburg, the work times of the crew members assigned to watchkeeping on the bridge on this voyage were evaluated. The sea watchmen are generally assigned according to a three-watch plan. For the chief officer, the watch plan sets out a 4-8 watchkeeping on the bridge, together with an able-bodied seaman as lookout.

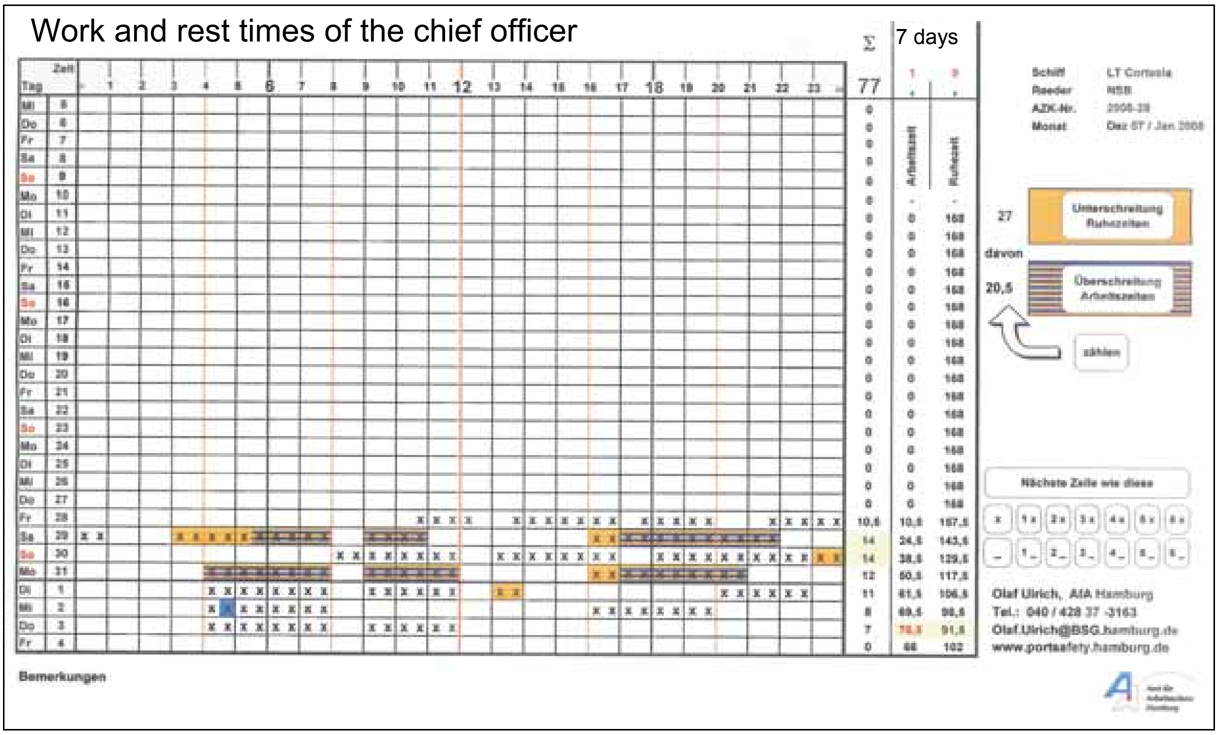

Figure 24: Work times of chief officer

The work times of the chief officer significantly exceed the maximum work times in accordance with the Seamen's Law. The work times on 29 December and 31 December 2007 are given as up to 18 hours in a 24-hour period.
In the 30 hours prior to the incident, the documented work and rest times are in order from a legal viewpoint. From experience the expert of the AfA Hamburg commissioned by the BSU supposed that it seems likely that, during the stay in port in Thames Port on 1 January 2008 between 14:00 and 20:00, there was no opportunity for the Chief Officer to catch up on sufficient sleep.
The count of weekly work times, at 76.5 hours, is high. This value is only kept down by the recordings on 2 and 3 January 2008 (after the incident). It is not possible to assess whether, during normal navigation at sea, these excessive work times would have been offset, for example, by relief from duty.
The investigated work time sheets did not point to any manipulation or "embellishment" of the work times.

6 Analysis

The serious marine casualty is due to misconduct on the part of the chief officer. The traffic situation was not correctly assessed and, as a result of a number of wrong decisions, the LT CORTESIA ran aground on the Varne Bank.

6.1 Port stays, persons involved, fatigue

Estuary and coastal trading is a huge load for the crew, in particular for the chief officer, who is traditionally responsible for load and stability. A sleep deficit due to loading and unloading operations and other disruptions is almost inevitably a given when it comes to such voyages. The term rest time is often defined in different ways. If the officers, for example, during their leisure time, particularly during the stay in port, spend time in the mess or quarters, they are still bothered with questions, calls, visitors or appraisers during the break period. Such "work" may amount to several hours a day during the stay in port, but is often perceived and documented very differently by those affected. This is compounded by the fact that, irrespective of the recorded overtime, the crew receives flat-rate pay, which inevitably means that the care does not tend to be taken when it comes to completing work time sheets.

After a holiday phase of several weeks, the chief officer signed on in Hamburg on 28 December 2007 in a well-rested state. He was not experiencing any health or personal problems. However, there are legitimate indications that, on the day of the incident, after just six days on board, the chief officer was overtired and/or limited in his actions. The response to the calls from the Dover Vessel Traffic Service and the failure to recognise that the ship had run aground would, for example, only be explained by overtiredness. It can be assumed that, as a result of the unforeseen oil spill in Rotterdam and additional activities associated with this, a large portion of the scheduled/necessary rest times could not be observed and therefore full productivity and attentiveness were not possible.

6.2 Lookout and bridge team

The LT CORTESIA was manned with a qualified lookout in accordance with Reg. 5 of the Regulations for Preventing Collisions at Sea (KVR) and the STCW Code. Clear and unambiguous duties were not assigned to the lookout by the chief officer and there was no sufficient communication between the watchkeeping crew members on the bridge prior to the incident. In addition to visual observation, all other available means should also be used to obtain a full overview of the situation. This also includes regular observation of the ship control and alarm systems. It can be assumed that the lookout was not sufficiently integrated in the responsibility and not optimally employed in order to fulfil the tasks most effectively. According to the VDR recordings, effective joint bridge team management was not carried out during the watch.

6.3 Use of the available electronic navigational equipment

No conclusive verdict on the relevant use of the voyage management system could be reached in this report alone, as only VDR recordings of the Chartradar were available. The Chartradar could never be the primary navigational tool, but rather, this would have been in addition the Chartpilot if formal prerequisites (e.g. tested and approved ENC) were fulfilled at all. However, there are no recordings from the Chartpilot. Furthermore, it is not clear from the Chartradar recordings what chart material was loaded on it; only the use of CM-93/2 data was assumed.

If the Chartpilot had been run with such CM-93/2 charts, the nautical chart display system would have already switched, as a result, to the non-official status of an ECS. Navigating with this type system instead of the use of paper charts would have represented a breach of the equipment regulations in accordance with SOLAS Chp. V, Reg. 19.2.1.4 and the German Ship Safety Act and would therefore have been in contravention of the regulations. However, in the laboratory trial, the alarm behaviour of the ENC and the CM-93/2 charts shows no difference. The use of the Chartpilot and/or the Chartradar in ECS status was, in this respect, not a decisive factor for the grounding. With good seamanship, the navigational situation would also have been correctly identifiable on an ECS (i.e. also based on CM-93/2 data).

Ultimately, from a navigational viewpoint, the ship ran aground as a result of two main factors:

- The crew's inadequate voyage management system skills and the resulting incorrect settings, particularly in relation to the Depth Contours, the Chart Alarms and the Depth Alarm settings.

- The resulting errors of judgement being made, which were caused by the chief officer and/or the bridge team disregarding conventional navigation.

6.4 Avoidance of such incidents

According to the information supplied by the vessel operator the Chief officer attended a Bridge Management Training at the University Wismar, Shipping Department, Nautical College Warnemünde in October 2004. The errors made by the chief officer in the handling of the VMS and the interpretation of the chart display could have been avoided with navigational due diligence. If the chief officer had selected a better night display or had chosen a 2-color-display in conjunction with a better setting of the Safety Contour he would have – even in the night - noticed the absolutely non-navigable critical depth representation of the Varne Bank. With the correct settings alarms would have already been noticed by the 3rd officer carrying over the route planning on the system and their examination. Only after the aforementioned improved settings the planned route would have been navigable without alarms.

Applying the otherwise usual navigational caution would also have avoided the incident. GPS positions are to be checked by conventional navigational procedures (bearings, distance measurements). The extent to which this was carried out by the chief officer cannot be verified on the basis of the VDR Chartradar images. However, if these observed positions had been plotted on the paper chart, which would have been necessary with ECS status, the danger posed by the Varne Bank would have definitely caught the attention of the chief officer.

Just as incomprehensible is the obvious lack of object verification by the relevant lookout. Given the environmental conditions, the Varne lightship with the racon signal and both Varne cardinal buoys with their characteristic markings must have been visible and identifiable from the bridge in good time prior to running aground.

During the marine casualty investigation, it was not possible to determine whether navigation was actually carried out using the paper charts available on board. There are also contradictory statements as to whether the handover of watch duty took place at the chart table or at the Chartpilot. In this respect, it can be assumed that, during his bridge watch, the chief officer relied too much on the (supposed) "ECDIS" displays and navigated solely "according to the computer". A chief officer with such extensive professional experience must have been able to foresee that such action entails extreme risks.

6.5 International endeavours

In the context of the 54th meeting of the IMO Safety of Navigation sub-committee – NAV54, a resolution was made in mid July 2008 to make it mandatory in future for certain ships to be equipped with ECDIS. To this end, a corresponding carriage requirement is to be set out provisionally by means of an addition to SOLAS Chp. V Reg. 19.2.1.4. In the meantime, however, it seems to be imperative that the operators of nautical vessels check and clarify which on-board systems and electronic charts currently fulfil ECDIS status and whether these systems have been accepted by the relevant administrative bodies of the flag country as fulfilment of the regulations relating to equipment. This must be documented accordingly in the equipment list for the Cargo Ship Safety Equipment Certificate, including the available redundancy devices. Finally, crews must be instructed unequivocally on how the on-board navigational systems and equipment should be used.

Unambiguous information concerning the system status as regards the carriage requirements are to be strived for, so that the watch officer is able to notice how the system can be used regarding navigation.

Training of the crews in the available, installed voyage management systems, which is currently not internationally regulated, should be intensified and particular attention should be given to preparing, implementing and monitoring the voyage. In addition the setting of the Depth Contours with regard to the existing Depth Contour lines in the database should be observed.

More Depth Contour Lines in the areas 10-20 m and 20-30 m would be desirable.

Furthermore, the varying significance of VMS status as an ECDIS, ECS or RCDS for the ship's voyage-worthiness is to be clarified.

7 Action taken

The vessel operator of the LT CORTESIA has evaluated this serious accident. The nautical officers were in informed about the course of the accident in written form.
During the training in the in-house simulator this accident is being simulated in order to prevent this kind of accident or similar accidents in future. In particular it is dealt with risks associated with unfavorable settings of the systems.

8 Safety recommendations

The following safety recommendations do not pose a presumption of guilt or liability either in respect of type, number or sequence of recommendations.

8.1 Shipping companies and navigation schools

The Federal Bureau of Maritime Casualty Investigation recommends that shipping companies and navigation schools now train senior nautical personnel in the different voyage management systems. Particular reference is to be made to the varying device parameters and settings. A further area of focus should be the different system-status information such as RCDS, ECS or ECDIS, and the relevant legal stipulations connected with them.

The Federal Bureau of Maritime Casualty Investigation also recommends reminding the responsible ship's officers emphatically of the importance of a lookout and the relevant employment and assignment of such on the bridge team when carrying out and monitoring a voyage.

8.2 Vessels' commands

The Federal Bureau of Maritime Casualty Investigation recommends that all vessels' commands always follow the radar image attentively during watchkeeping on the bridge in line with the stipulations of the STCW Code. An adequate overview in the case of a ship not equipped with ECDIS involves the use of the paper chart.

8.3 Operators of vessels sailing under a German flag, vessels' commands

The Federal Bureau of Maritime Casualty Investigation recommends that all operators of vessels sailing under the German flag observe the legally stipulated work and rest times for ship crews. If necessary, arrangements are to be made to relieve the chief officer by another work organisation, particularly in the case of coastal trading.

8.4 Federal Ministry of Transport, Building and Urban Affairs

The Federal Bureau of Maritime Casualty Investigation recommends that the Federal Ministry of Transport, Building and Urban Affairs, in the context of current endeavours relating to ECDIS carriage requirements, emphasises to the relevant committees of the International Maritime Organisation IMO that the training aspects directly connected with the carriage requirements, particularly for planning, carrying out and monitoring a voyage on ECDIS, are to be regulated in a similarly compulsory way.

9 Sources

- Determinations of the MAIB

- Written statements
  - Vessel's command
  - Shipping company/owner
  - Classification society

- Witness accounts

- Evaluation of the work time sheets of sections of the crew of the LT CORTESIA by the Occupational Safety and Health Administration (Port Supervision/Shipping), Hamburg

- Expert's report on ECS/ECDIS by Prof. Capt. R. Becker-Heins, MarineServe GmbH

- Nautical charts and vessel data as well as providing simulation technic of the Federal Maritime and Hydrographic Agency/Bundesamt für Seeschifffahrt und Hydrographie (BSH)

- Official weather report by the German National Meteorological Service (DWD)

- On-board VDR recordings

- Radar plots by Vessel Traffic Services (VTS)/Vessel Traffic Centres

- The Nautical Institute, Bridge Team Management- A Practical Guide, ISBN 1 870077 66 0