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

Summary
Investigation Report 350/09

Serious Marine Casualty

Collision between MF SCHLESWIG-HOLSTEIN and SY MAHDI on 24 August 2009 3 nm north-east of the Puttgarden ferry port

15 November 2010

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 said act, the sole objective of this investigation is to prevent future accidents and malfunctions. This 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 art. 19 para. 4 SUG.

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

Issued by:
Bundesstelle für Seeunfalluntersuchung - BSU
(Federal Bureau of Maritime Casualty Investigation)
Bernhard-Nocht-Str. 78
20359 Hamburg
Germany

Director: Jörg Kaufmann
Phone: +49 40 31908300 Fax: +49 40 31908340
posteingang-bsu@bsh.de www.bsu-bund.de

Table of Contents

Table of Figures

1 Summary of the marine casualty

At 0400[1] on 24 August 2009, the SCHLESWIG-HOLSTEIN, a ro/ro ferry[2] flying the flag of Germany, which was sailing on a north-easterly course towards Rödby (Denmark), collided with the American yacht MAHDI about 15 minutes after departing from the Puttgarden ferry port. The yacht was proceeding under sail on a westerly course towards Kiel with two people on board. Her skipper observed the departure of the ferry, but saw only her green sidelight up until the very last. Therefore, in spite of the approaching and planned close quarters situation, he was confident that the ferry would observe his right of way and realised they were on a collision course only seconds before the impact. Accordingly, he did not have sufficient time for the usual procedure in critical situations of illuminating his sail with spotlights and calling over VHF. The hazardous approach was only recognised just before the collision, at the moment that the yacht was first identified visually, on the bridge of the ferry as well. In spite of the last-moment action initiated on each vessel, there was not enough time left (approximately 30 seconds) until the collision to avoid the accident.
The fore section on the port side of the MAHDI was hit with considerable force by the bow of the ferry. The yacht heeled very quickly and heavily to starboard, took on a large amount of water in the process, scraped along the starboard side of the ferry and righted herself after parting from the ferry. The skipper, who along with the female co-sailor did not suffer any injuries, managed to start the engine and put the bilge pump into operation.
A general alarm was sounded on the SCHLESWIG-HOLSTEIN and a lifeboat was lowered into the water. Contact between the crew of the lifeboat and the yacht revealed the people on board had survived the accident unhurt and that the yacht was still buoyant in spite of strong deformations on her outer skin. There was no environmental pollution.

A search and rescue vessel, the EMIL ZIMMERMANN, and a Danish tug, the BALTSUND, promptly sailed from Puttgarden to the scene of the accident. The BALTSUND, accompanied by the search and rescue vessel, then towed the yacht to Puttgarden.

[1] All times shown in this report are local = CEST = UTC + 2 hours.
[2] The SCHLESWIG-HOLSTEIN is internationally recognized as a Passenger Ro/Ro Cargo Ship.

2 SHIP PARTICULARS

2.1 Photo of the MF SCHLESWIG-HOLSTEIN

Figure 1: Photo of the MF SCHLESWIG-HOLSTEIN

2.2 Vessel particulars – MF SCHLESWIG-HOLSTEIN

Name of vessel:	SCHLESWIG-HOLSTEIN
Type of vessel:	Passenger Ro/Ro Cargo Ship (railway/car ferry)
Nationality/flag:	Germany
Port of registry:	Puttgarden
IMO number:	9151539
Call sign:	DMLM
Owner:	Scandlines Deutschland GmbH
Year built (keel laying/completion):	1996/1997
Shipyard/yard number:	Van der Giessen-de Noord B.V.-Krimpen/969
Classification society:	Lloyd's Register
Length overall:	142 m
Breadth overall:	25.4 m
Gross tonnage:	15,187
Deadweight:	2,836 t
Draught (max.):	5.8 m
Engine rating:	15,840 kW
Main engine (type/manufacturer):	2 MAK 8M32, 3 MAK 6M32
(Service) speed (max.):	18.5 kts
Hull material:	Steel
Minimum safe manning:	25

2.3 Voyage particulars – MF SCHLESWIG-HOLSTEIN

Port of departure:	Puttgarden (Germany)
Port of call:	Rödby (Denmark)
Type of voyage:	Merchant shipping/international

2.4 Photo of the SY MAHDI

Figure 2: Photo of the SY MAHDI[3]

2.5 Vessel particulars – SY MAHDI

Name of vessel:	MAHDI
Type of vessel:	Sailing yacht
Nationality/flag:	United States
Port of registry:	Clinton, WA
Call sign:	WBU7315
Year built (start of construction/completion):	1992/1995
Shipyard:	Nowlin Construction and Boat Building Company
Length overall:	13.7 m
Breadth overall:	4.0 m
Gross tonnage:	19
Deadweight:	17 t
Draught (max.):	2.0 m
Engine rating:	60 kW
Main engine (type/manufacturer):	Isuzu 90 hp
Hull material:	Steel
Manning:	2

[3] The photo shows the yacht after the accident and therefore without the broken mast.

2.6 Voyage particulars – SY MAHDI

Port of departure:	Simrishamn (Sweden)
Port of call:	Sneek (The Netherlands) via the NOK[4]
Type of voyage:	Other shipping/international

[4] NOK = Kiel Canal.

2.7 Marine casualty information

Type of accident:	Serious marine casualty, collision
Date/time:	24/08/2009/0400
Location:	3 nm north-east of Puttgarden
Latitude/Longitude:	φ 54°32.8'N λ 011°16.2'E
Ship operation and voyage segment:	15 minutes after the ferry cast off
Consequences:	Yacht sustained heavy material damage

Excerpt from nautical chart 31 (INT 1357), BSH[5]

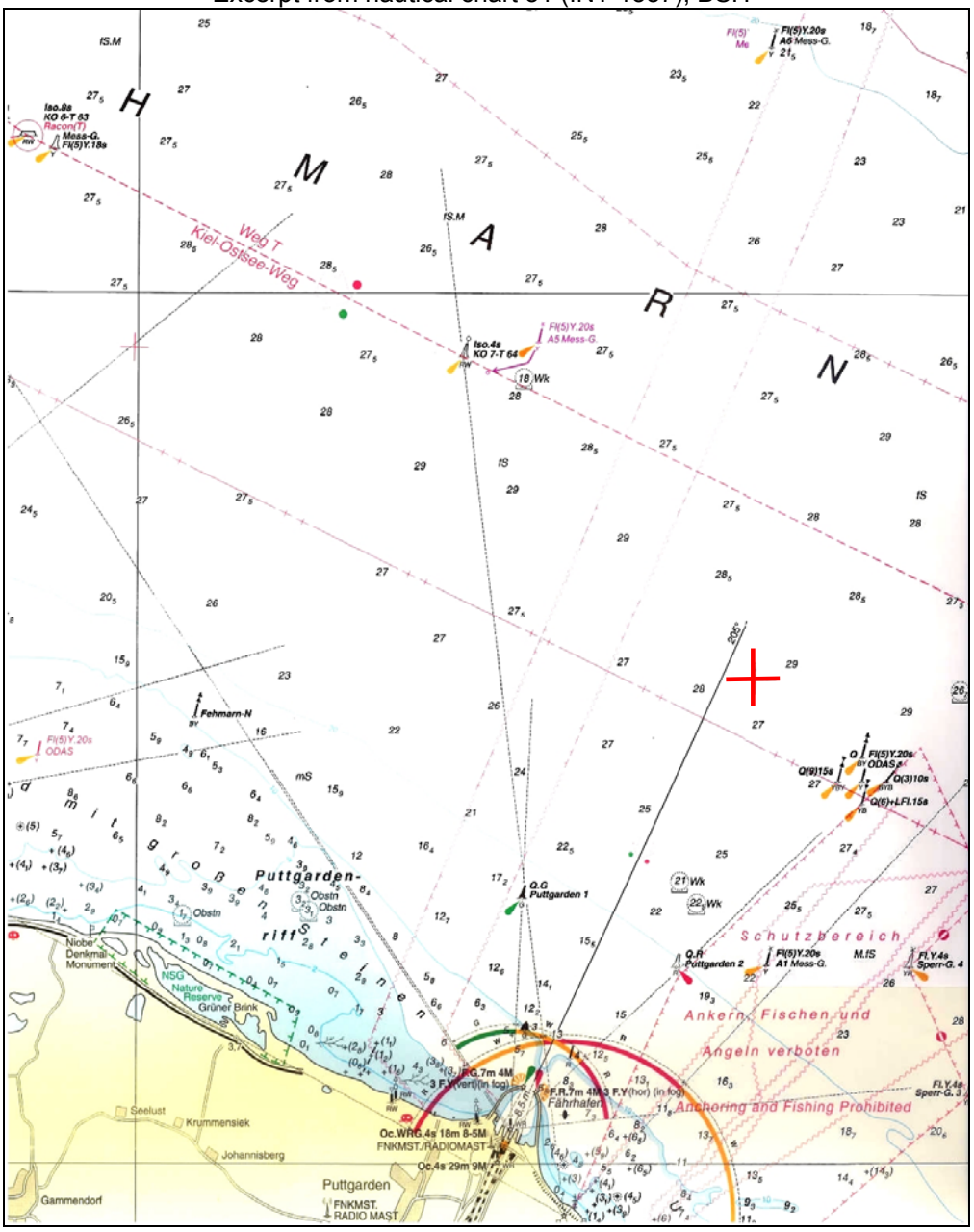


Figure 3: Scene of the accident

[5] BSH = Federal Maritime and Hydrographic Agency

2.8 Shore authority involvement and emergency response

Agencies involved:	MRCC Bremen, German Maritime Search and Rescue Service (DGzRS), WSP Schleswig-Holstein, Federal Police
Resources used:	Federal police patrol vessel 23 Search and rescue vessel EMIL ZIMMERMANN Tug BALTSUND
Actions taken:	MAHDI towed to Puttgarden
Results achieved:	No personal injury or environmental damage Damaged yacht towed safely to the berth

3 COURSE OF THE ACCIDENT AND INVESTIGATION

3.1 Course of the accident

The SCHLESWIG-HOLSTEIN, a double-ended ferry which operates on the ferry route between Puttgarden and Rödby, sailed out of the Puttgarden ferry port at 0345 on the day of the accident in accordance with her schedule. The night was dark, visibility was not restricted by rainfall or fog and the sea was calm. The bridge was manned by the master (port radar), the chief officer (starboard radar) and a lookout (starboard side of the bridge).

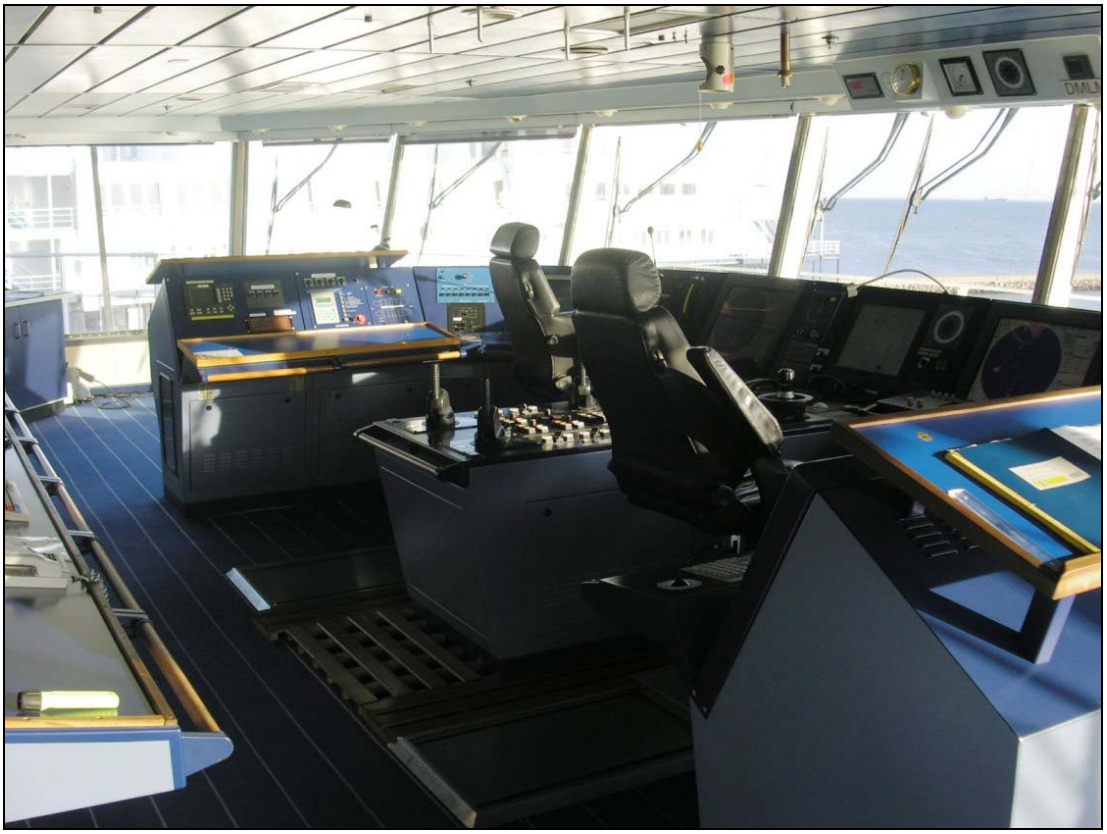


Figure 4: Bridge of the SCHLESWIG-HOLSTEIN (conning position)

The ferry passed the mole heads at the port entrance at about 0350 and was then steered using trackpilot (autopilot). At this point, the course over ground was 22 degrees and the speed, which was increased in the ensuing minutes to a cruising speed of about 15 kts, was approximately 12 kts. At 0355, the ferry changed her course to starboard to avoid the motor vessel WOLTHUSEN, which at the time was proceeding on a westerly course more than 3 nm away and crossing the course line of the SCHLESWIG-HOLSTEIN. At 0357, the ferry had completed her course change and was now steering a course over ground of 43 degrees. The SY MAHDI had still not been identified visually and no attention was paid to the associated weak and at times concealed echo on the displays of the two radar images.

The SY MAHDI was proceeding from Simrishamn (Sweden) to Sneek (Holland) via the NOK. Sailing from the southern tip of Falster, the yacht was headed for the waypoint 'North-western edge of Fehmarn' on a course of about 275 degrees at a speed of some 7 kts. In the process, she crossed the Kiel-Baltic Sea route[6] to the east of the Puttgarden - Rödby ferry route. The MAHDI was proceeding under sail and was steered by autopilot.

The skipper and his female co-sailor observed the busy traffic from the cockpit of the yacht and at different times made oncoming vessels aware of their presence with light signals and on VHF (the last times being at 035049 and 035129). The departure of the SCHLESWIG-HOLSTEIN was also observed. Her green sidelight was reportedly visible and it was said that there was initially no risk of a collision. The ferry's first course change after passing the mole heads (i.e. the one on a course of 22 degrees towards Rödby), which passed without any complications, was, unlike the 43 degrees course change made later, which caused the accident, reportedly recognised. The red sidelight of the vessel was reportedly not seen at any time. Therefore, until the very end the MAHDI's continued approach with the ferry was reportedly marked by the understanding that the ferry would respect the yacht's right of way in accordance with applicable international maritime law and cross the course line of the MAHDI in due time. Accordingly, the MAHDI reportedly acted as stand-on vessel in accordance with the requirements of COLREG Rule 17 (a) (i)[7] and maintained her course. The immediate risk of collision was recognised only a few seconds before the impact when it reportedly became clearly visible through binoculars that the bow of the ferry was pointing towards the yacht and undoubtedly on a collision course. At this point, it was reportedly far too late for light signals or a call over VHF. The skipper was reportedly able to make another course change of 20 degrees to starboard (last-moment action in accordance with COLREG Rule 17 (a) (ii) and (b) before the collision occurred.

On the bridge of the ferry, a relatively high red light was suddenly detected at 035930 2 degrees to starboard at a distance of about 200 metres, 9 seconds later this was identified as a sailing vessel. In the period from 035937 to 035944, a last-moment action was initiated in the form of a course change to port and a reduction in speed.[8] However, these actions did not prevent the vessels from colliding.

After the collision, the ferry was stopped and a general alarm sounded. A lifeboat was lowered and the ferry illuminated the sea area in the direction of the yacht.

[6] The Kiel-Baltic Sea route is a recommended shipping route plotted on the nautical chart, which links the Bay of Kiel to the Bay of Mecklenburg via the Fehmarn Belt and leads to Kadetrenden (Kadetrinne). Eastbound traffic is separated from westbound traffic by buoys.
[7] COLREG = International Regulations of 1972 for Preventing Collisions at Sea.
[8] This period is derived from the fact that the S-band radar image still displays a selected trackpilot course of 43 degrees at 035937, while at 035944 the X-band radar image displays a selected trackpilot course of 2 degrees.

Contact was made with the crew of the MAHDI from the lifeboat; this revealed that there had been no personal injuries and the yacht was still buoyant. The mast broke and together with the sail and damaged rigging hung in the water over the starboard side. The skipper started the engine so that power could be generated to operate the bilge pump. As a precautionary measure, they decided not to engage the engine and sail to the port of Puttgarden under their own steam. In that regard, it was feared that parts of the broken mast and/or rigging resp. sail could get into the propeller.
Accompanied by the search and rescue vessel EMIL ZIMMERMANN, the summoned tug BALTSUND towed the MAHDI to Puttgarden (see **Fig. 5).**

Figure 5: The tug BALTSUND towing the SY MAHDI[9]

3.2 Consequences of the accident

3.2.1 Personal injuries

The accident did not lead to any personal injuries.

3.2.2 Damage to the vessels

3.2.2.1 Damage to the SY MAHDI

The yacht was heavily damaged by the collision, but initially remained buoyant. The yacht took on water two days after the accident in the port of Puttgarden. The MAHDI was at risk of foundering and a crane was used to place her ashore on a trailer.

[9] The photo on which the broken mast and rigging can be seen protruding to starboard was taken at 0643 on the day of the accident.

Specifically, the following damage was caused:

- Water ingress via the superstructure following the yacht's considerable heeling motion, causing damaging to the interior fittings and navigational equipment
- Severe buckling above the waterline on the port side of the fore section of the hull
- Large indentation amidships on the port side with a hole in the outer skin
- Damage to the cockpit
- Aft damage to the mounting of the outboard engine and the engine
- Dents on the hull underbody at the bow and on the forward starboard side
- Starboard railing damaged or torn off along the entire length of the yacht
- Mast broken and rigging destroyed

Figure 6: Damage to the SY MAHDI (long shot)

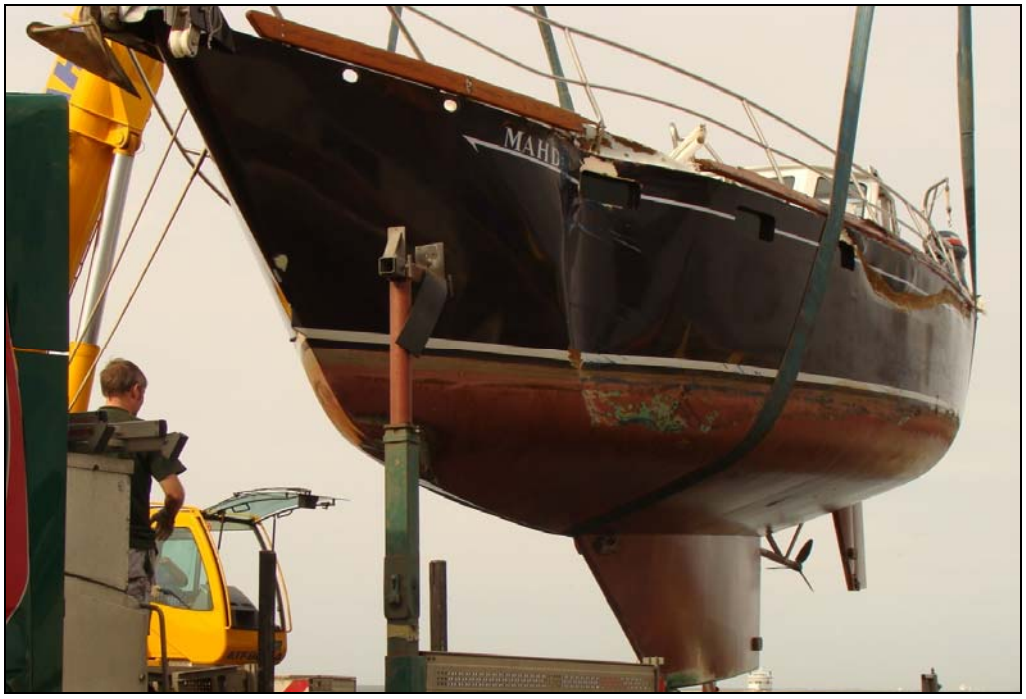


Figure 7: Damage to the SY MAHDI (port side)

Figure 8: Damage to the starboard railing of the SY MAHDI[10]

[10] The photo shows that the starboard side of the yacht's hull was largely unaffected by the collision.

3.2.2.2 Damage to the MF SCHLESWIG-HOLSTEIN

Contact with the MAHDI led to the ferry sustaining only very slight damage in the form of paint abrasions on the bow section (front and starboard side) and on the bulbous bow.

Figure 9: Paint abrasions on the MF SCHLESWIG-HOLSTEIN (1)

Figure 10: Paint abrasions on the MF SCHLESWIG-HOLSTEIN (2)

Figure 11: Paint abrasions on the MF SCHLESWIG-HOLSTEIN (3)

3.2.3 Environmental pollution

The environment was not affected by the collision between the two vessels. No pollutants escaped.

3.3 Investigation

In addition to the evaluation of various witness accounts, key sources for the investigation included the AIS[11] recordings of Vessel Traffic Service (VTS) Travemünde and, in particular, the recordings of the SCHLESWIG-HOLSTEIN's VDR[12].

3.3.1 AIS recordings of VTS Travemünde

The following **Figures 12 to 15** illustrate the traffic situation in the area of the accident during the period before the start of the ferry's evasion manoeuvre to starboard in favour of the westbound WOLTHUSEN until the ferry's last-moment action: a change of course to port. In addition to the WOLTHUSEN, the eastbound cruise ship AIDALUNA and the cargo vessel GLOBAL ALLIANCE, which was on a parallel course to the AIDALUNA about 0.4 nm to the north, were of particular significance to the events. It is apparent from the radar recordings (see **sub-para. 3.3.2.1 f.** below) that the MAHDI, which was not shown in the recording of the VTS because she was not equipped with an AIS (not a carriage requirement), was sailing westward between these two vessels and thus temporarily 'in the shadow' of the AIDALUNA. Therefore, at times the yacht was neither identifiable on the radar nor could she be seen from the bridge of the SCHLESWIG-HOLSTEIN.

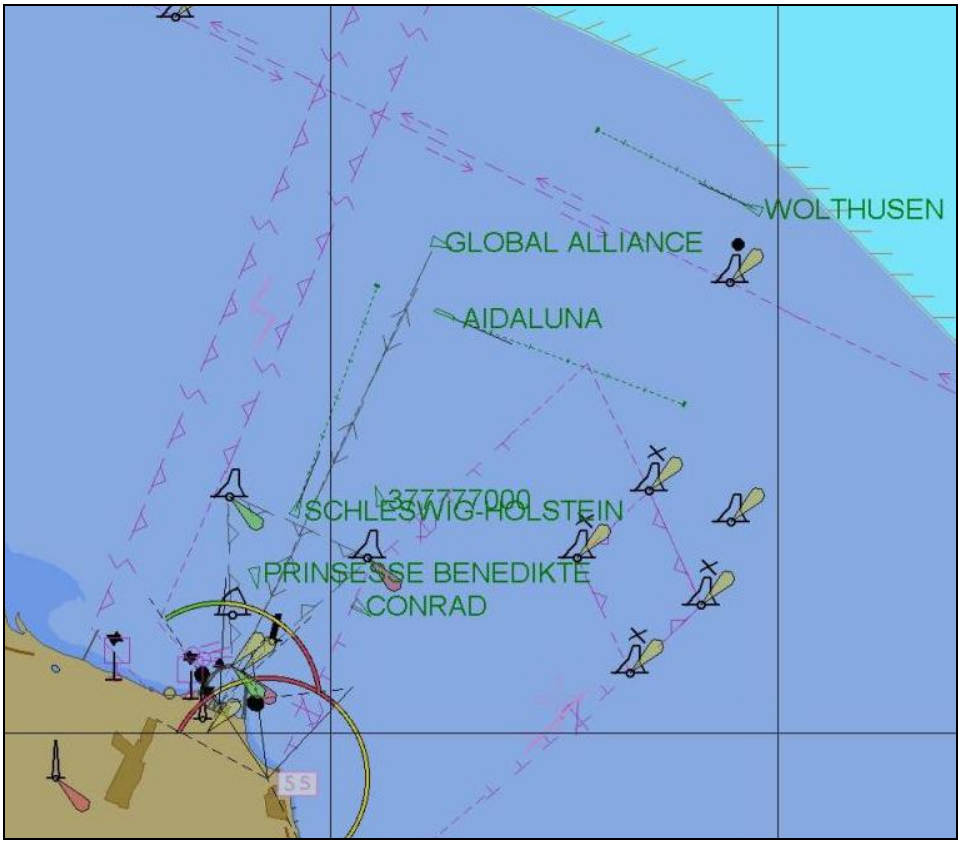


Figure 12: Traffic situation on the AIS of VTS Travemünde at 0353

[11] AIS = **A**utomatic **I**dentification **S**ystem.
[12] VDR = **V**oyage **D**ata **R**ecorder; carriage requirement on vessels of 3,000 GT and above; system for gathering data after an accident to make it possible to determine and analyse the causes thereof.

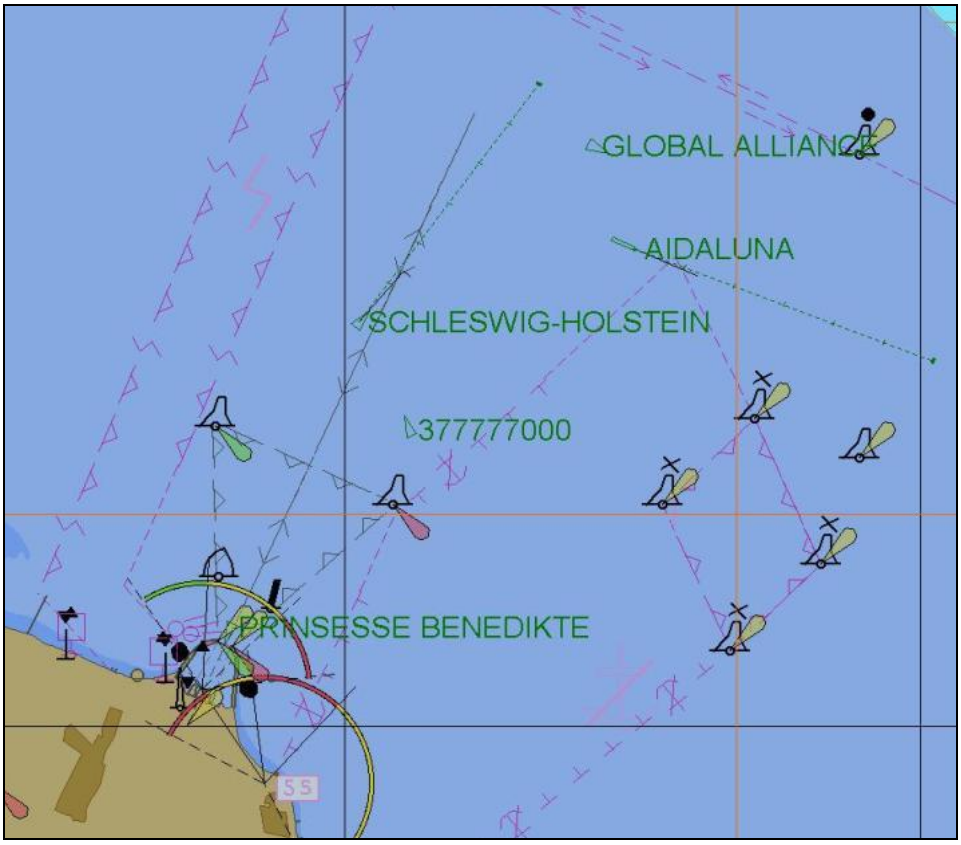


Figure 13: Traffic situation on the AIS of VTS Travemünde at 0356

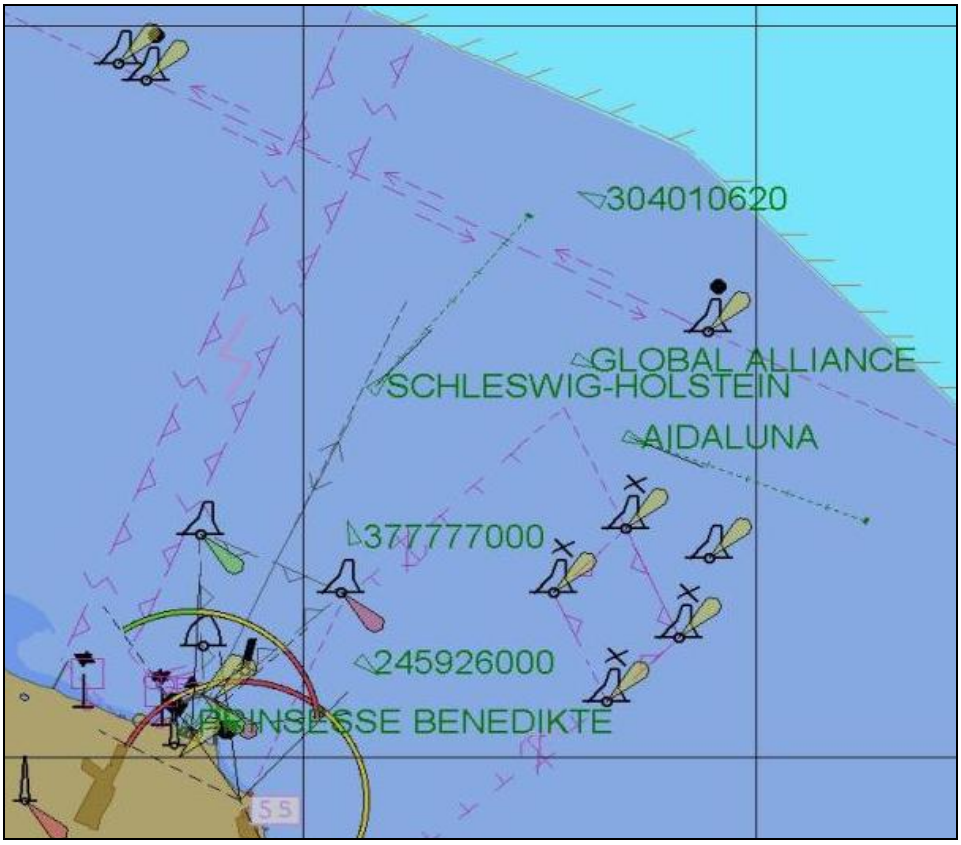


Figure 14: Traffic situation on the AIS of VTS Travemünde at 0359

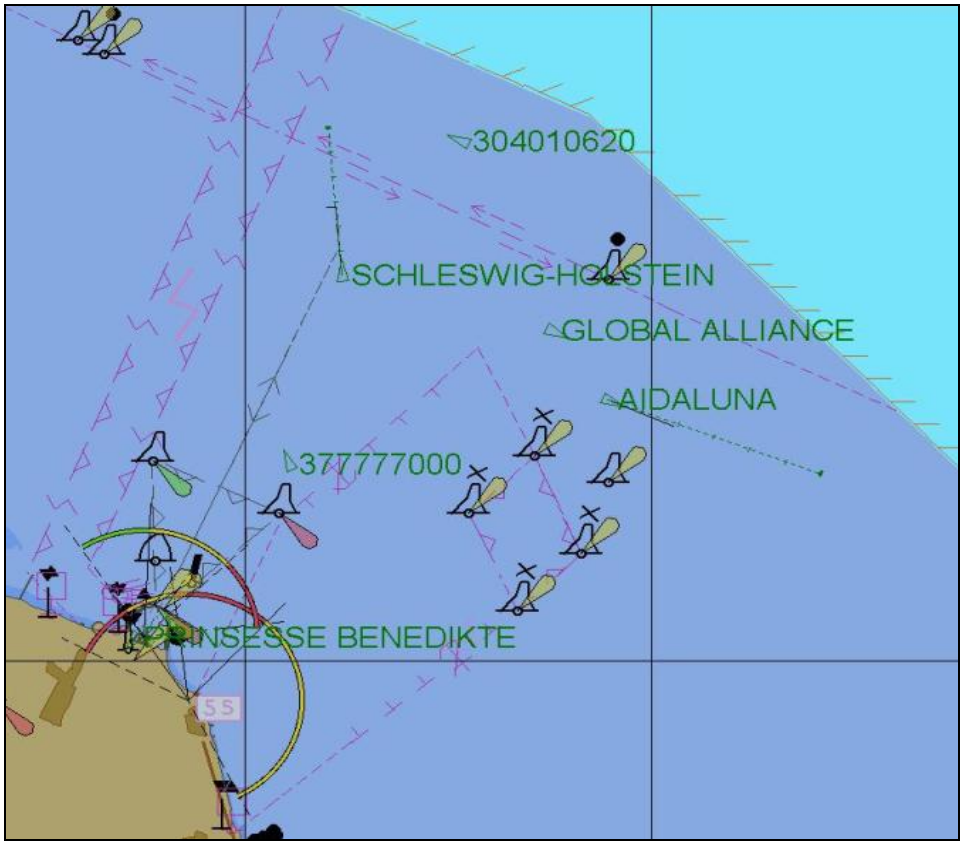


Figure 15: Traffic situation on the AIS of VTS Travemünde at 0401

3.3.2 VDR recordings of the SCHLESWIG-HOLSTEIN

The screenshots of the X-band and S-band radar[13], which are saved by the VDR at 15-second intervals[14], are of particular importance for establishing the times at which and how clearly the MAHDI was identifiable on the radar from the bridge of the ferry.

3.3.2.1 X-band radar

The system was initially operated at a range of 3 nm in the 'head-up, relative motion' display mode after the ferry set sail. The target vectors are set to 6 minutes. The display is off-centre, meaning that an actual range of about 5 nm ahead can be observed. Frequency alignment ('TUNE') between the transmitter and receiver is automated ('AFC').

[13] X-band and S-band radar systems operate in different frequency ranges. X-band systems provide better resolution and detectability of small objects, but are susceptible to interference from rain and sea conditions. S-band systems have a longer range and are less susceptible to the above mentioned interference, but are less sensitive in terms of detecting small vessels

[14] With regard to evaluation of the radar recording, it is important to note that in each case the screenshots only represent a snapshot of the displayed radar image for a fraction of a second. Therefore, it can on no account be concluded that the radar image or visibility/invisibility of an object remains absolutely unchanged during the 14 seconds to the next screenshot

The anticlutter rain ('RAIN') is more or less on 0, the anticlutter sea ('SEA'), which is relevant at close range and the amplification ('GAIN') are set to mid-range values. The proprietary noise suppression ('CLEAN SWP') is set to the value 'MEDIUM'. The interference rejection ('IR') to suppress interference caused by the radar emissions of other vessels is activated (see **Fig. 16).** Apart from the range, none of the settings were altered in the period that followed.

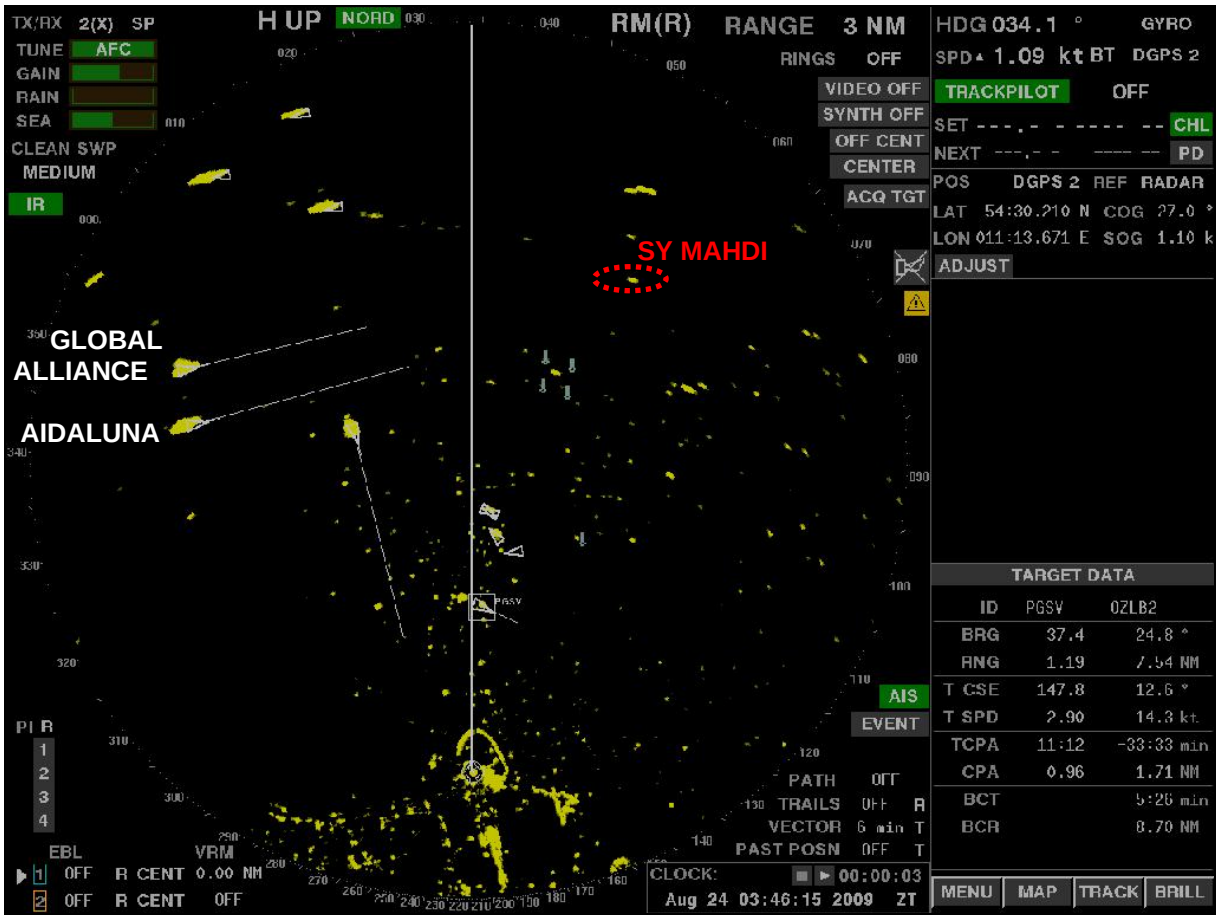


Figure 16: Traffic situation at 034615 (X-band radar)[15]

Figure 16 above shows the situation immediately after the ferry cast off. The course steered (HDG) at this point is 34 degrees, the speed is 1.1 kts. The WOLTHUSEN is still not identifiable because she is outside the selected range. Although subsequent evaluation of the following radar images reveals that the echo of the MAHDI is already identifiable, it is not possible to distinguish it from interference, probably caused by the sea, in this image.

Figure 17 below shows the first image after switching the display to a range of 6 nm at 034959. Meanwhile, the trackpilot is set to 22 degrees.

[15] The labels and markings on this figure and those that follow have been added by the author of the report for illustrative purposes.

Moreover, a range marker (VRM[16]) with a radius of one nautical mile has been activated around the ferry's own position.
The WOLTHUSEN is now acquired as an AIS target[17]. Due to the off-centred image setting, it is now possible to observe the sea-room about 11 nm ahead; the Danish coastline is already visible at the top edge of the image. The echo of the MAHDI is relatively easy to identify. However, at a distance of nearly 3 nm and on the assumption that the range of the navigation light is not significantly greater than the prescribed minimum standard of 2 nm, it can be assumed that the yacht is still not in sight, in particular, since from this point in time she was increasingly situated 'in the shadow' of an illuminated drilling rig[18], which was made fast by four vessels (see green line in **Fig. 17**).

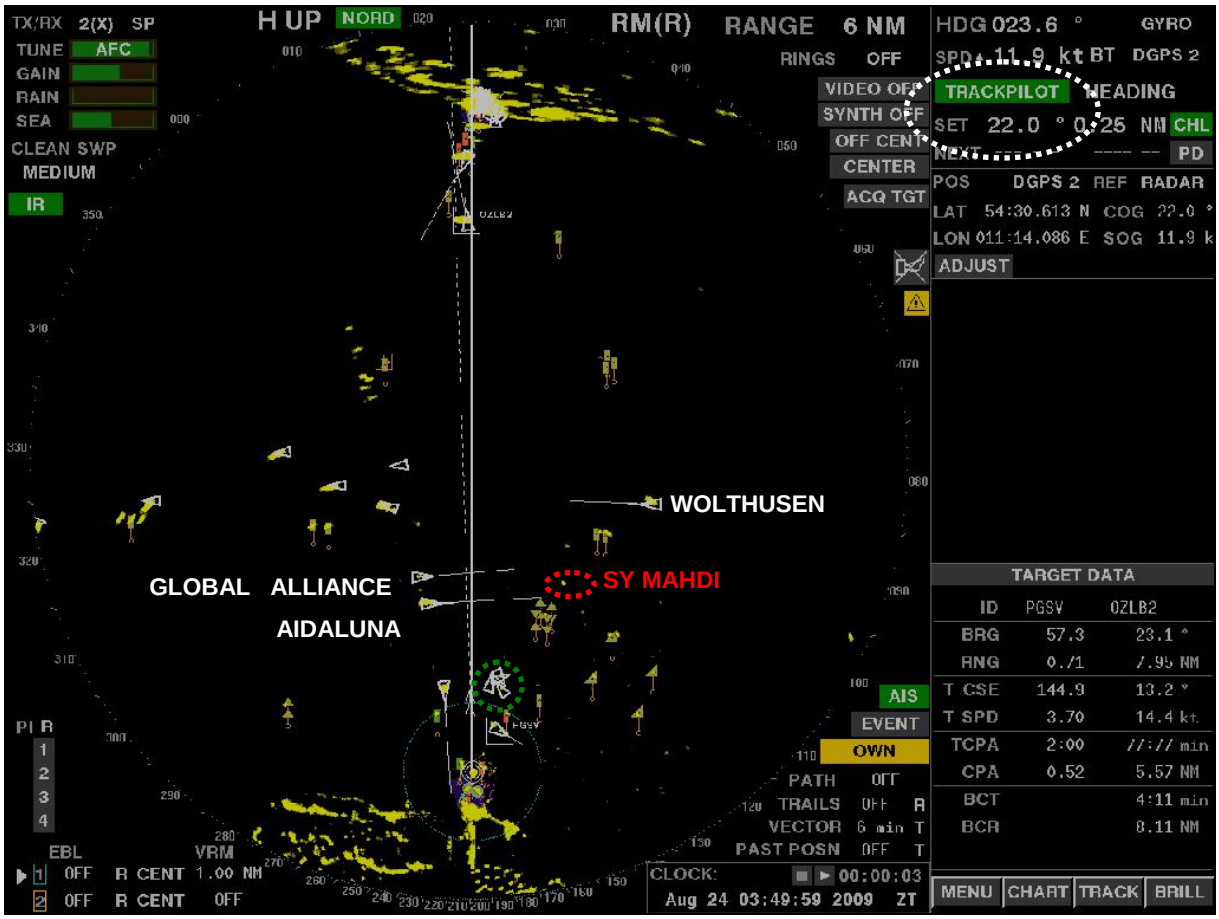
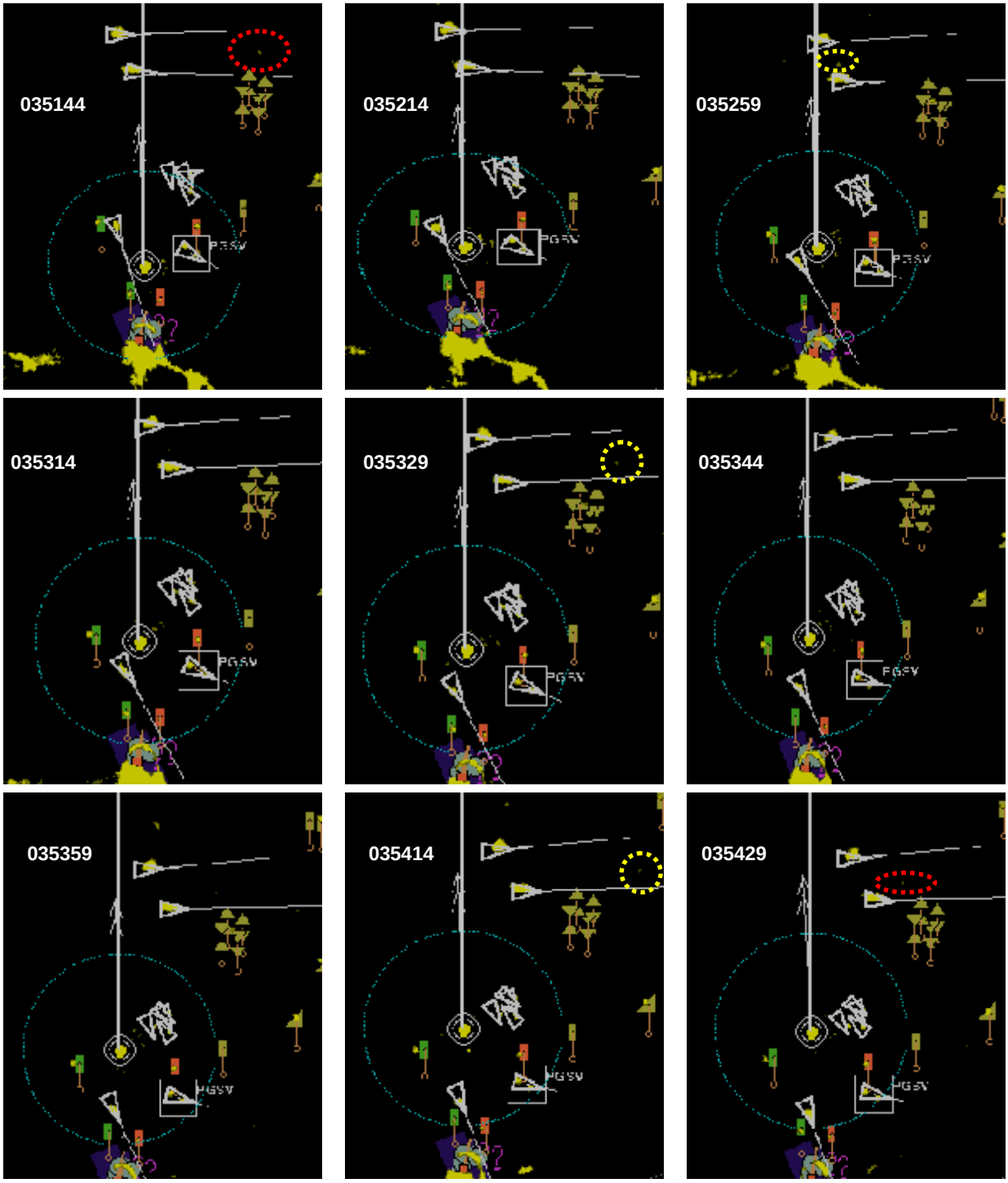


Figure 17: Traffic situation at 034959 (X-band radar)

In the ensuing minutes, the echo of the MAHDI 'roamed' ever further into the 'shadow' of the platform. Shortly afterwards, it was masked additionally and then later only by the 'shadow' of the eastbound AIDALUNA.

[16] VRM = **V**irtual **R**ange **M**arker.
[17] Acquiring means that the user has added the radar targets to the automated plotting function of the radar. The plotting of a target is represented graphically by the display of a vector. The echo of vessels which emit AIS signals are marked by a triangle.
[18] Platform for test drilling in connection with construction of the fixed Fehmarn Belt link.

Therefore, during the period 035214 to 035414, the echo of the MAHDI is likely to have been barely[19] visible on the X-band radar (see series of images below).



From the image at 035429 onwards, the echo of the MAHDI is visible in the vicinity of the AIDALUNA; however, a comparison of this echo and the one at 035444 (**Figs. 18** and **19** below), firstly with the apparent echo above the AIDALUNA at 035259, and secondly with the apparent echoes at 035329 and 035414 (see yellow markers at the

[19] See reference in footnote 13.

top in the series of images), illustrates that it can be difficult to differentiate between interference and an actual object.

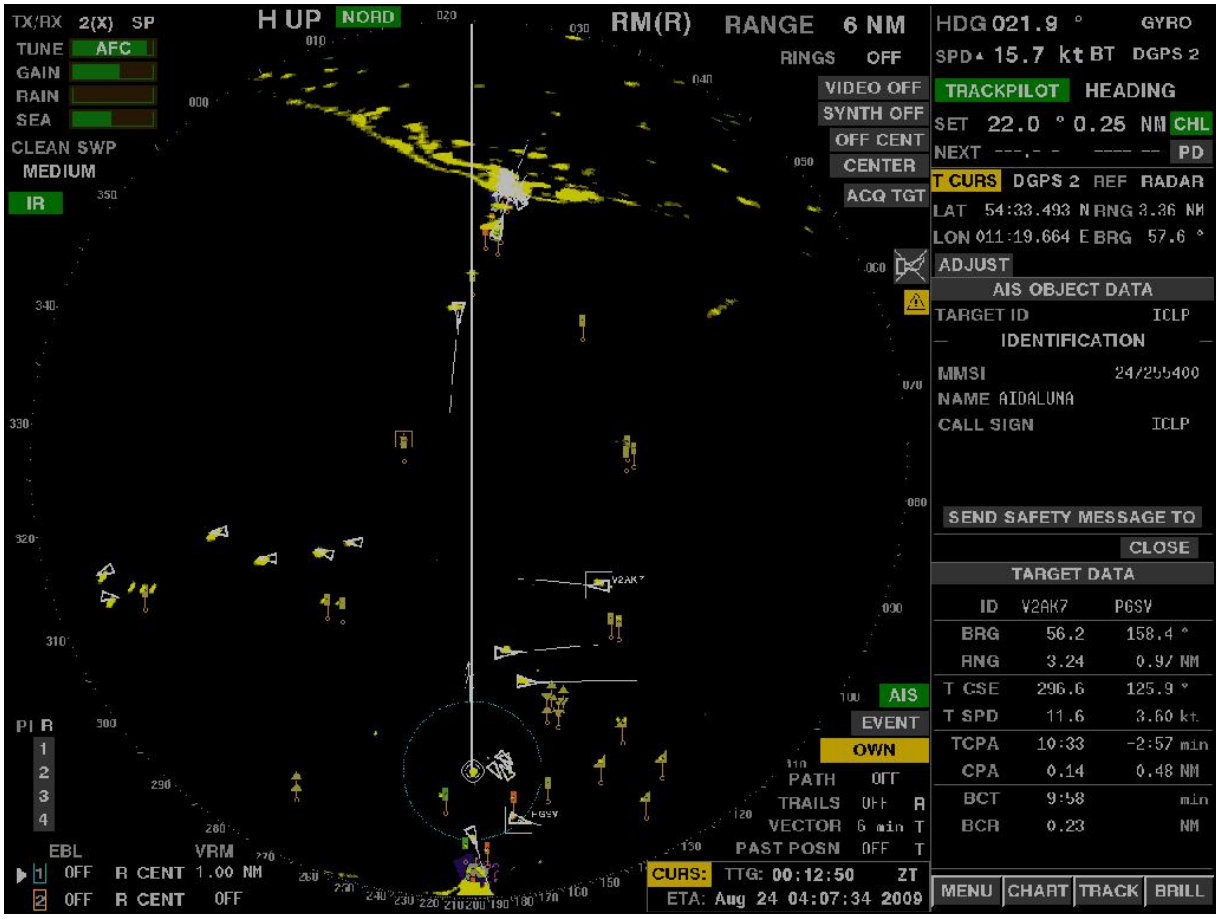


Figure 18: Traffic situation at 035444 (X-band radar)

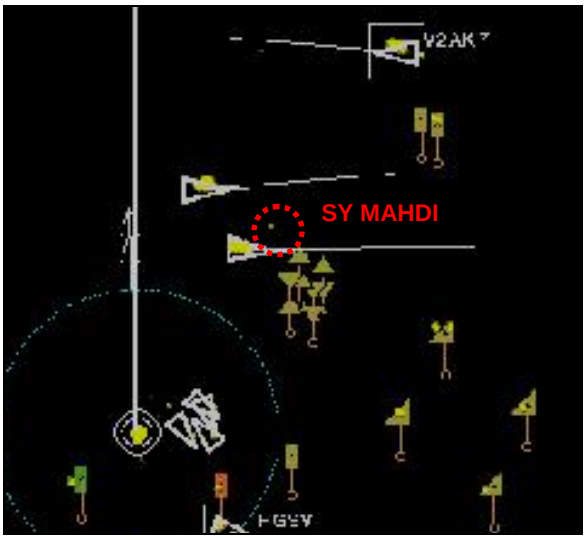


Figure 19: Excerpt from Fig. 18 (MAHDI between the AIDALUNA and GLOBAL ALLIANCE)

In **Figures 20** and **21** (035529) below, the SCHLESWIG-HOLSTEIN passes the drilling platform abeam on the starboard side at about 0.4 nm. The trackpilot was set to 43 degrees for the evasion manoeuvre with the WOLTHUSEN.

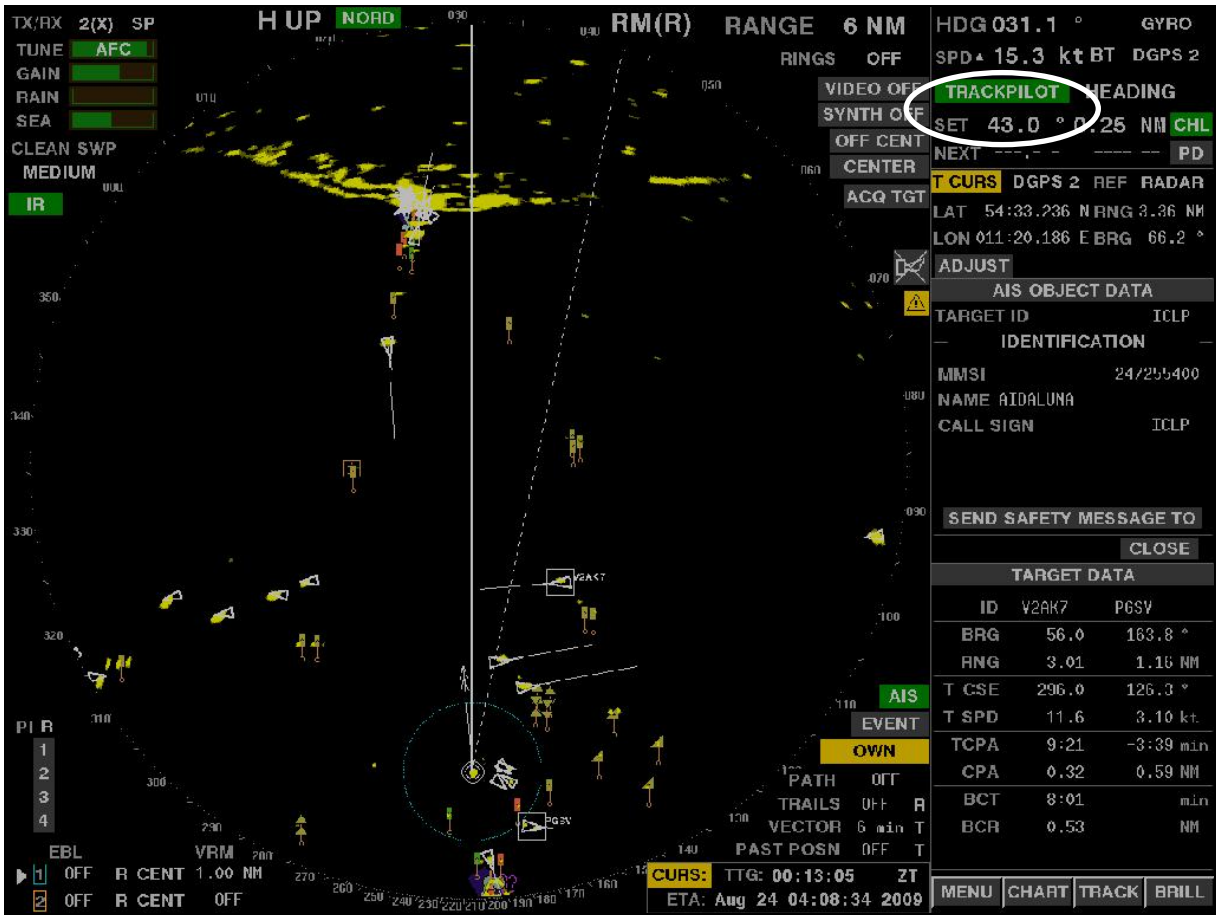


Figure 20: Traffic situation at 035529 (X-band radar)

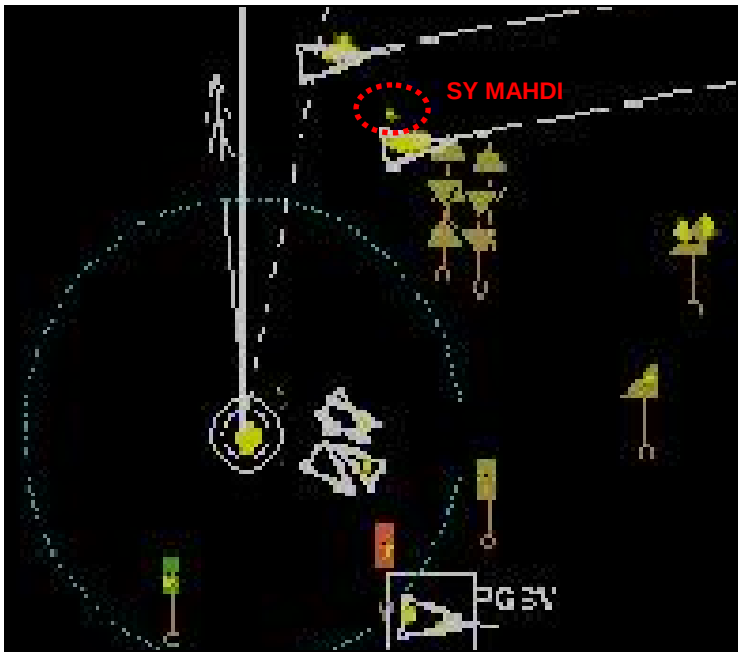


Figure 21: Excerpt from Fig. 20 (MAHDI astern of the AIDALUNA)

When looked at very closely, it can be seen that the MAHDI (see **Figs. 20** and **21** above) is identifiable as a separate echo astern of the AIDALUNA.

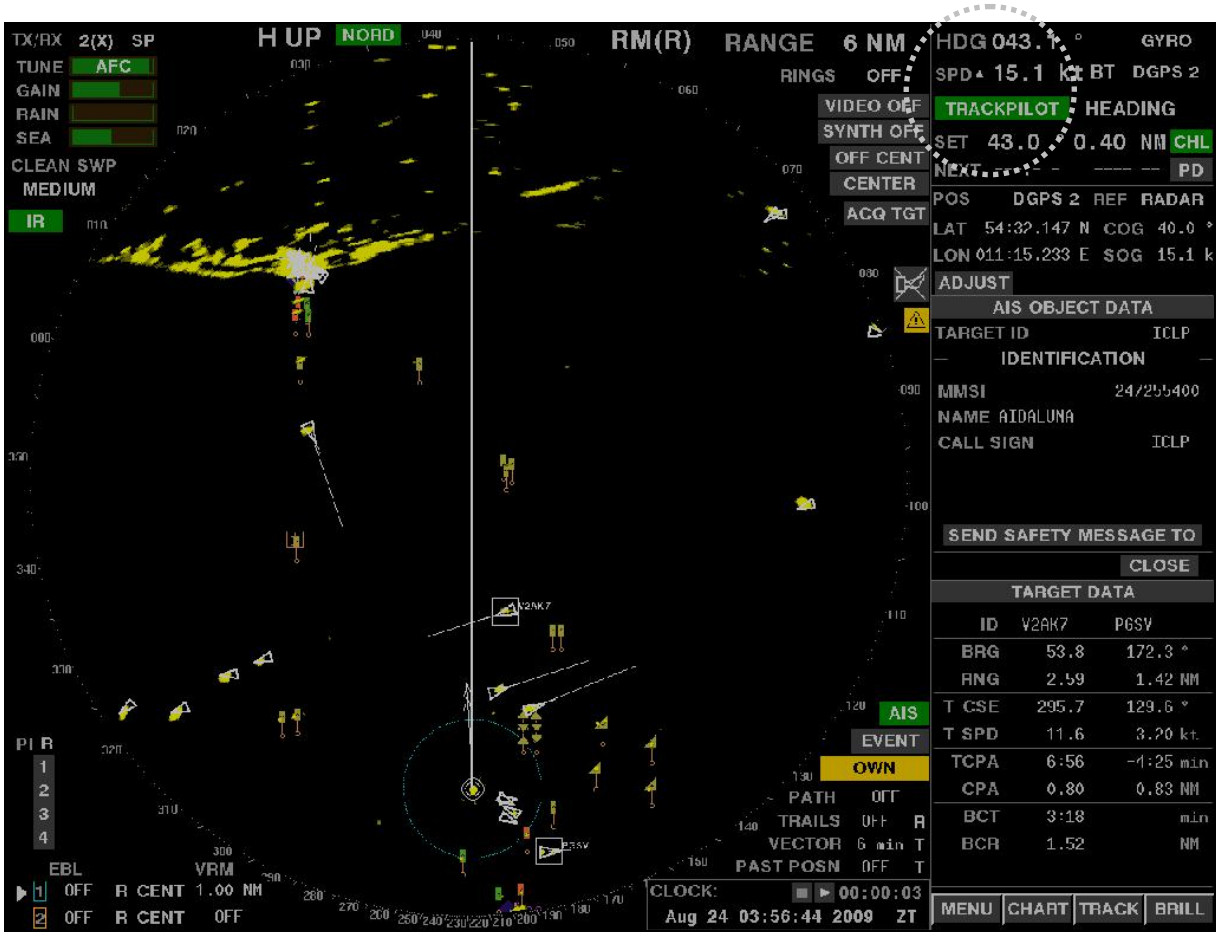
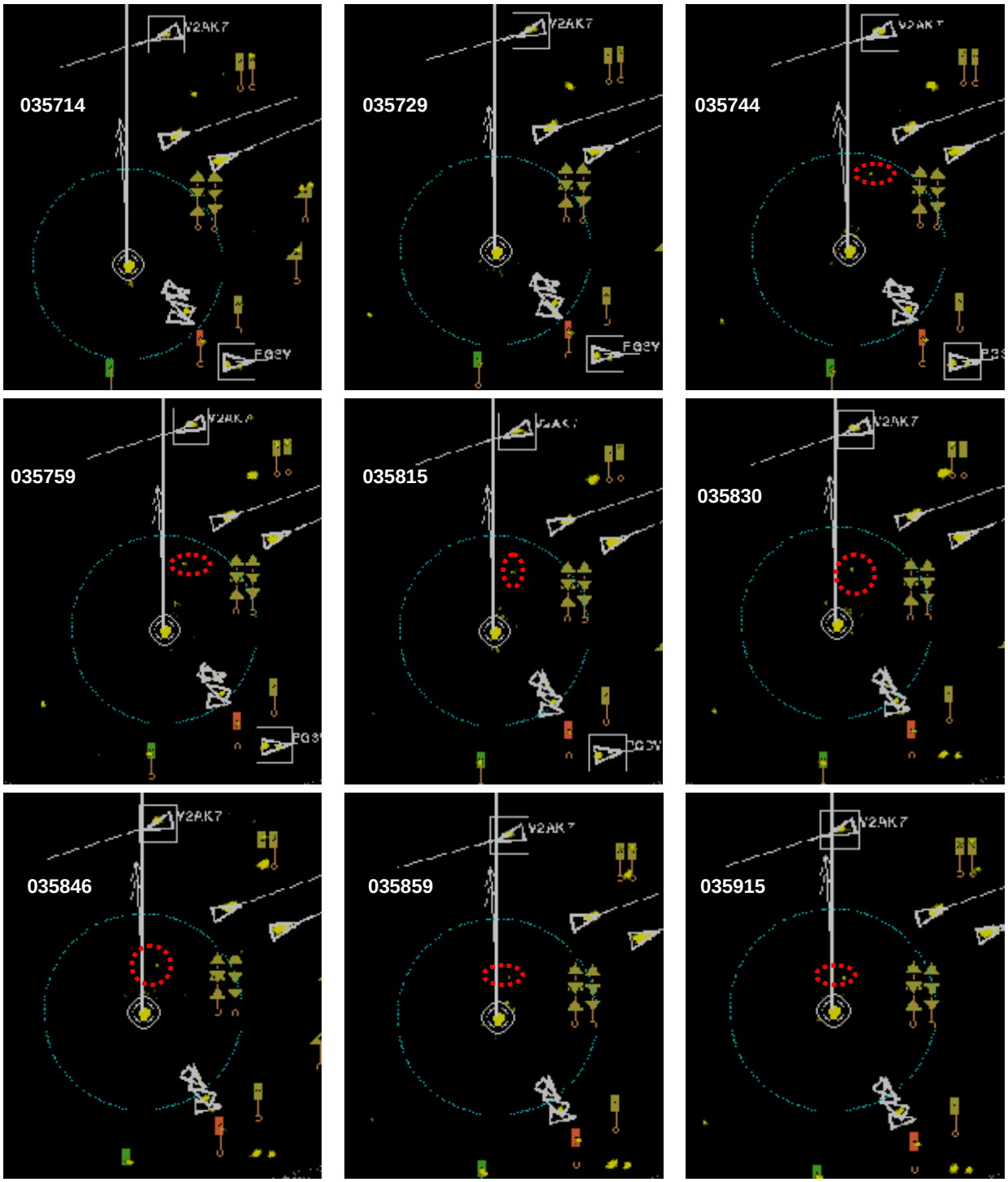


Figure 22: Traffic situation at 035644 (X-band radar)

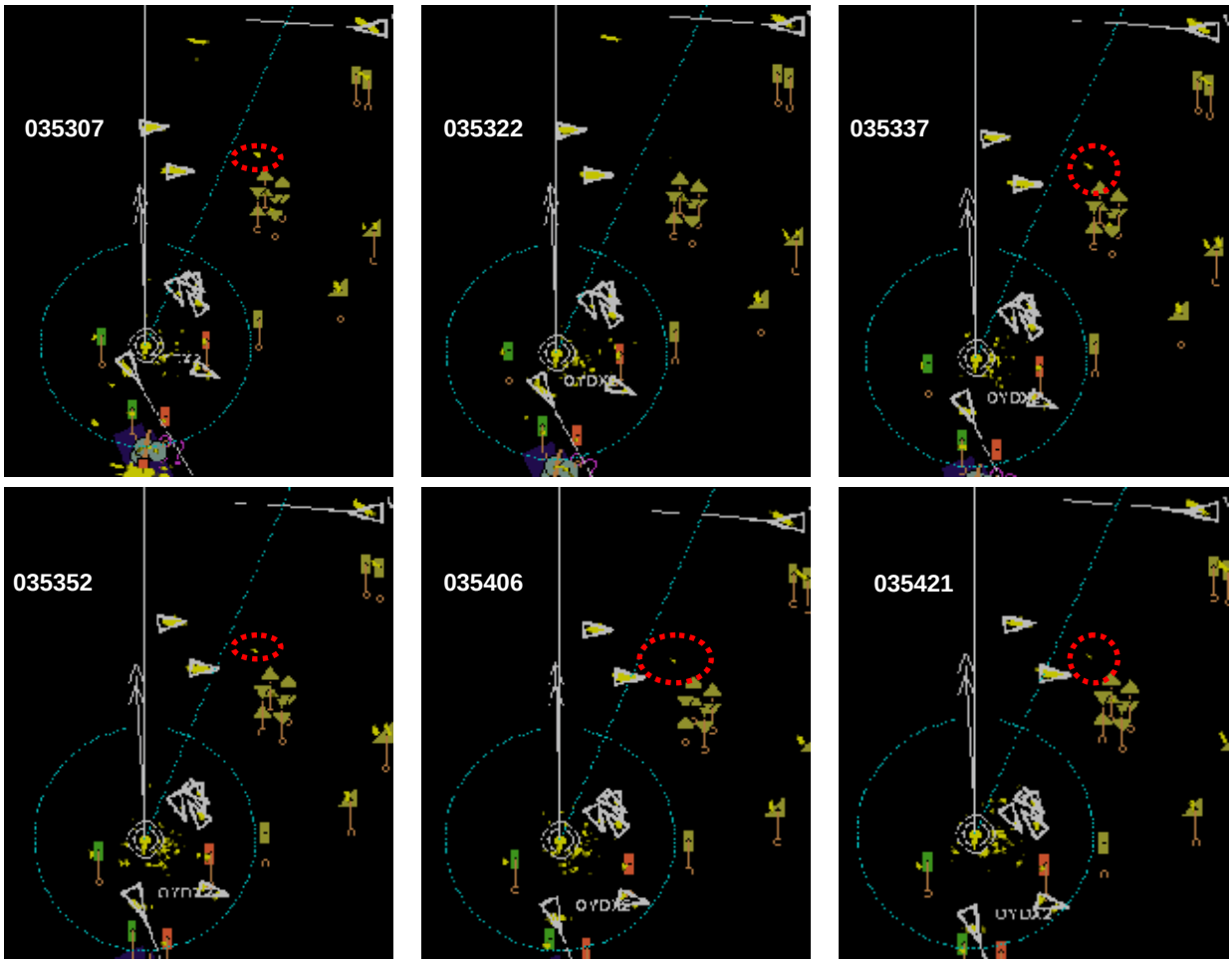
Figure 23: Excerpt from Fig. 22 (MAHDI in line with WOLTHUSEN and GLOBAL A.)

The ferry completed the course change (see identical values 'HDG' and 'TRACKPILOT SET' at the top right of **Fig. 22**) at 035644 (see **Figs. 22** and **23**). The echo of the MAHDI is in line with the echoes of the GLOBAL ALLIANCE and the WOLTHUSEN 'further above' at a distance of about 1.1 nm. Subsequently (series of images below), the echo of the MAHDI increasingly nears the ferry on a constant bearing and remains in line with the WOLTHUSEN until 035915 (= approximately 50 seconds before the collision). The images at 035714 and 035729 show, that the MAHDI is not permanently detected by the X-band radar even after she left the 'shadow' of the AIDALUNA.

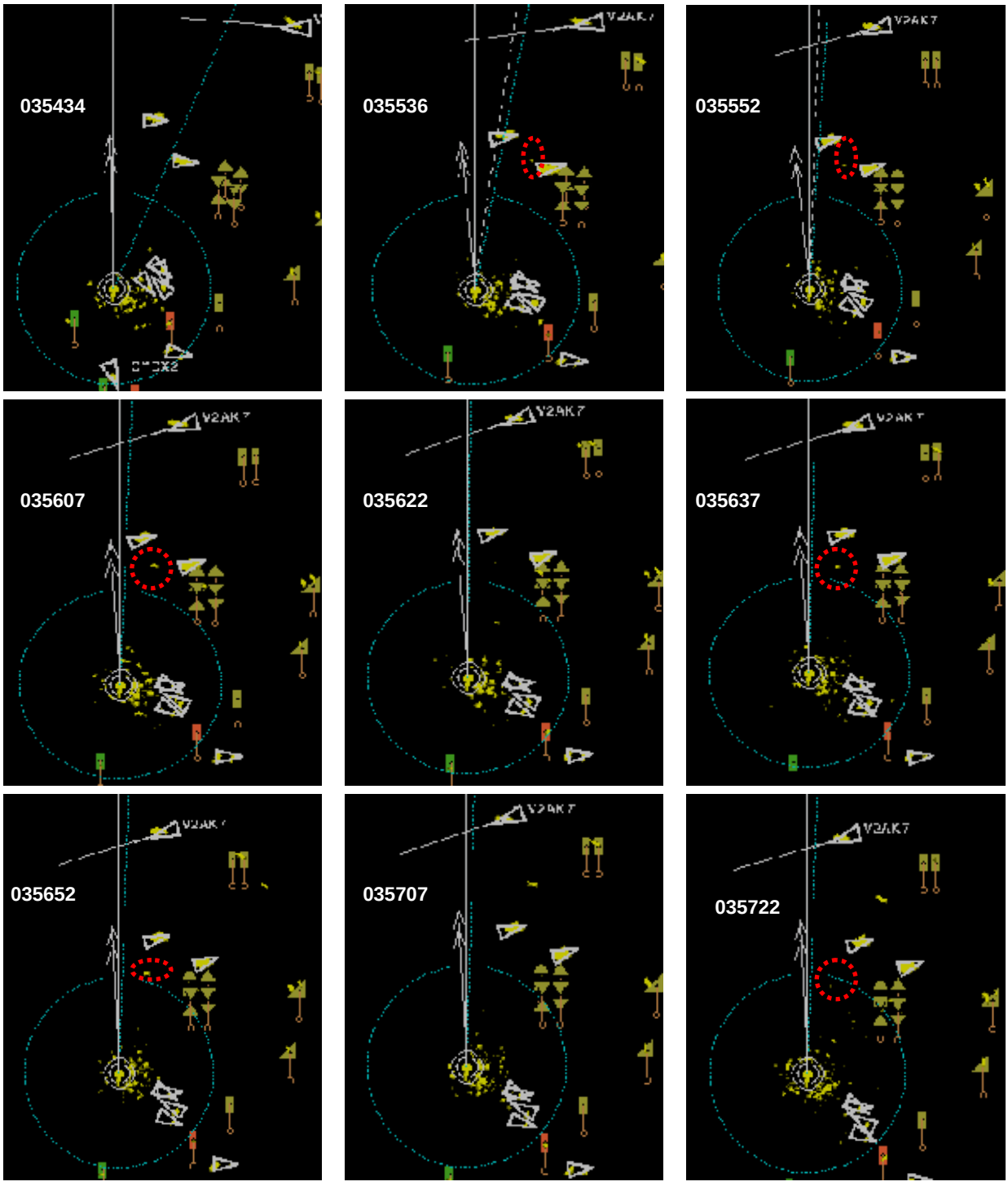


3.3.2.2 S-band radar

After setting sail, the S-band radar was initially set to off-centre with ranges varying between 0.5 and 12 nm. From 035037 onwards, it was set at a range of 6 nm continuously; the Danish coastline is already detected. The range marker (VRM) is set to one nautical mile. The 'head-up, relative motion' display mode was also selected for this device. The target vectors are set to 6 minutes. Frequency alignment ('TUNE') between the transmitter and receiver is automated ('AFC'). The anticlutter rain ('RAIN') is more or less inactive, the anticlutter sea ('SEA'), which is relevant at close range, is approximately 3/4 and the amplification ('GAIN') approximately 2/3 of the maximum value. The proprietary noise suppression ('CLEAN SWP') is switched off. The interference rejection ('IR') to suppress interference caused by the radar emissions of other vessels is activated. Apart from the range, the settings were not altered during the relevant period in this system either. At 035053, the WOLTHUSEN was acquired as an object for plotting. The AIDALUNA and the GLOBAL ALLIANCE were not plotted on this system. At 035307, the echo of the MAHDI appears on the screen for the first time. The following excerpts illustrate the sporadic visibility of the yacht on the radar. Here, too, it can again be assumed that especially the echo of the drilling platform and/or the AIDALUNA were responsible for the temporary invisibility of the MAHDI.

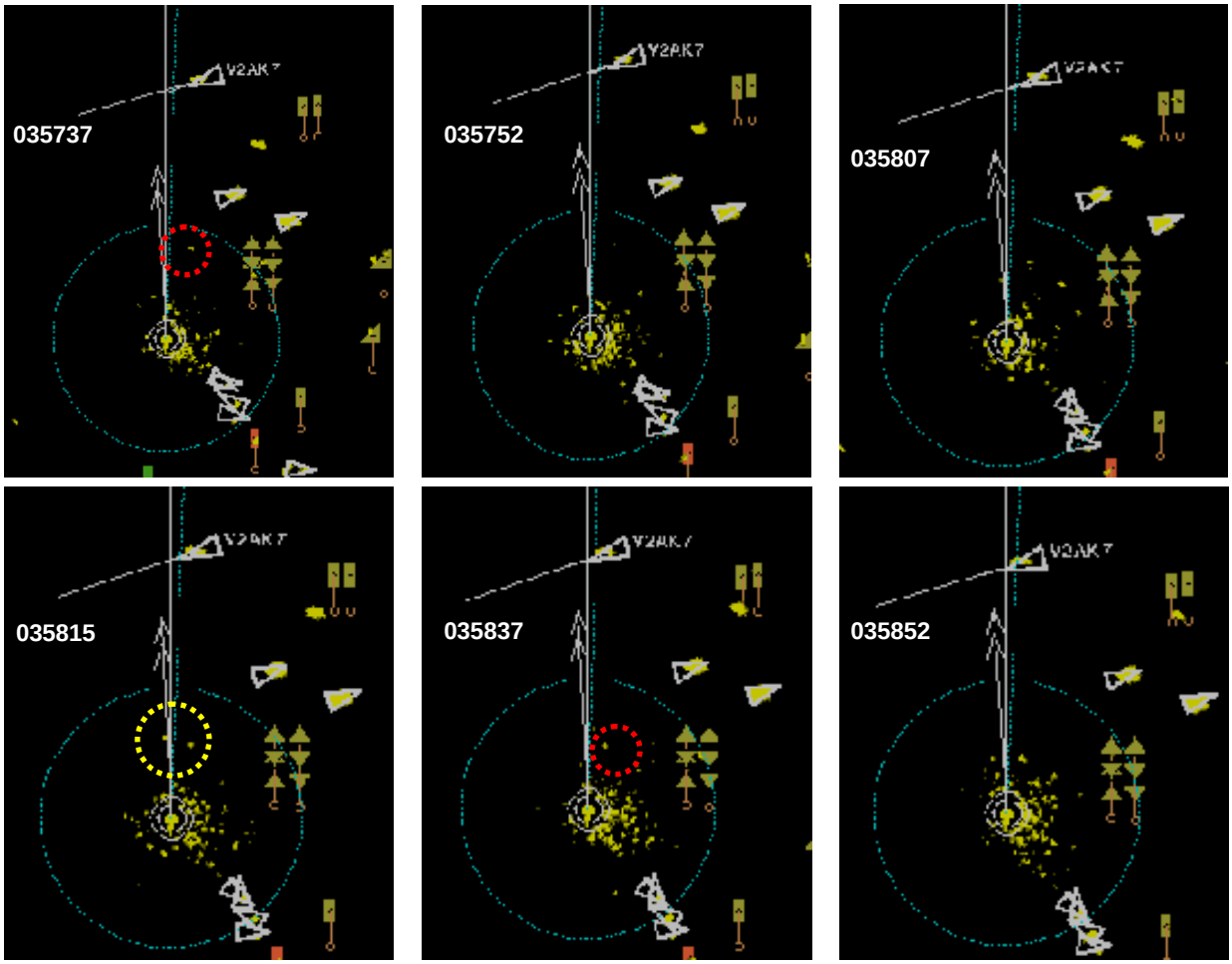


From the screenshot at 035434 onwards (series of images below), the echo of the MAHDI is initially no longer visible on the radar screen. Starting with the image at 035536, the MAHDI leaves the shadow of the AIDALUNA and is then at times clearly and at other times not so clearly visible on the radar image.



The continuous approach of the MAHDI, which is now within the 1 nm range marker, is evident in the following series of images. The echo is finally lost in the interference on the radar image at short-range at a distance of about 0.5 nm (image at 035852). Even before that, it is virtually impossible to distinguish the echo of the MAHDI from

short-range interference. (By way of example, see image at 035822 – yellow marking. The echo of the MAHDI 15 degrees to starboard at a distance of about 0.7 nm is confusingly similar to the apparent echo just to port at a distance of about 0.75 nm.)



3.3.2.3 Audio recording by the VDR of the SCHLESWIG-HOLSTEIN

At 035049, the MAHDI – without indicating her own coordinates – reported in English on VHF Channel 16, stating the name of the vessel, that she was crossing the 'channel'[20] and asked an eastbound vessel (presumably the AIDALUNA) if she could see the yacht. The MAHDI did not receive an answer.
At 035104, the question "Where is he?" was asked internally on the bridge of SCHLESWIG-HOLSTEIN. Apart from the internal response "No idea," this question is not addressed further. At 035129, the MAHDI, re-stating her name and again without providing positioning information, asks again in English on Channel 16 (presumably the AIDALUNA and/or the GLOBAL ALLIANCE) whether she can be seen.

[20] Refers to the Kiel-Baltic Sea route.

A response by radio cannot be heard on this occasion either. The bridge communication on the ferry too, which intermittently concerns the approaching AIDALUNA and a tug operating in close proximity, but is otherwise of a private nature, does not include the MAHDI.

At 035930, a red light is suddenly reported with a surprised undertone on the bridge of the ferry. 9 seconds later this is associated, almost in disbelief, with a yacht two degrees ahead. It is quite apparent that the bridge crew is immediately aware of the dramatic nature of the situation. Collision noises are then audible at 040005.

3.3.2.4 Representation of the time of the accident on the electronic nautical chart

The 'Electronic Nautical Chart' display mode showing the acquired AIS targets WOLTHUSEN, GLOBAL ALLIANCE and AIDALUNA in the VDR of the SCHLESWIG-HOLSTEIN illustrates the ferry's track to the scene of the accident (see **Fig. 24).**

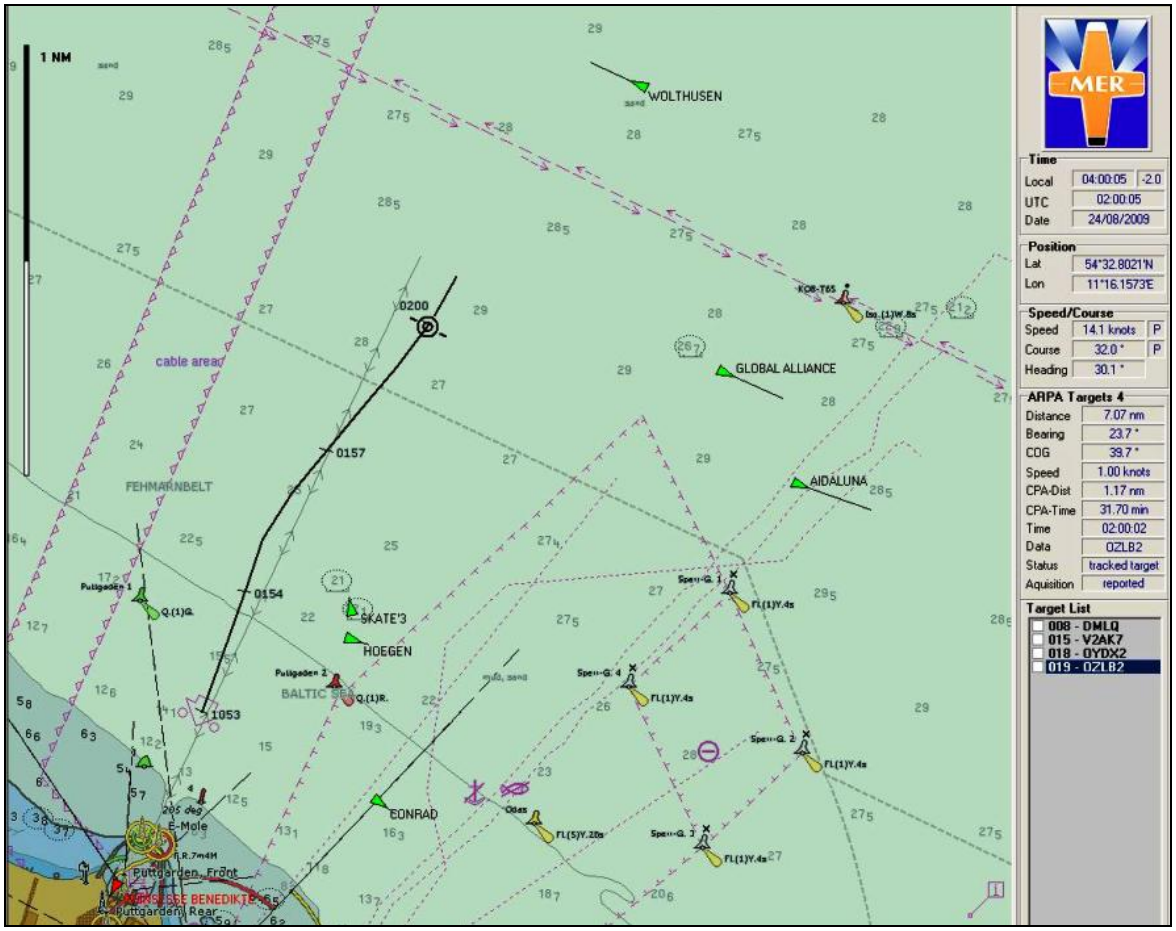


Figure 24: Track of the SCHLESWIG-HOLSTEIN to the scene of the accident

3.3.3 Visibility of the SY MAHDI, radar use

3.3.3.1 Illumination

It is regarded as certain that the MAHDI was properly illuminated with a tricolour light at the time of the accident (and also before) in accordance with COLREG Rule 25 (b). The light was lost during the collision; however, the skipper was able to submit a sales receipt for a certified AQUA SIGNAL TRICOLOR ANCHOR LT series 40 light from February 2009. A mounting device and cable connections were found at the top of the mast.

3.3.3.2 Radar reflector

A radar reflector was not on board. The skipper assumed that his yacht, nearly 14 metres long and made of steel, would be sufficiently identifiable by radar without a (non-mandatory) radar reflector.

3.3.3.3 AIS

The MAHDI was not equipped with an AIS system or AIS receiver. A carriage requirement did not exist in this regard.

3.3.3.4 Radar use

The MAHDI was equipped with a radar system made by FURUNO without an automated plotting feature. The system was not in use because according to the skipper safety would not be enhanced by using it due to interference caused by large vessels at close range; apart from that, very good visibility prevailed.

3.3.4 Witness accounts

Both the ferry's bridge crew and the skipper and female co-sailor of the MAHDI spoke at length after the accident. Here, the results of the technical recordings were confirmed.
According to that, the yacht was indeed seen from the bridge of the ferry in the form of a bright red masthead light at eye level immediately before the collision. The skipper and his female co-sailor emphasised in their statements that they saw only the green sidelight of the ferry until the very last and were therefore reportedly in no doubt that the ferry would respect the MAHDI's right of way in accordance with COLREG Rule 18 (a) (iv).

As a third party, the bridge crew of the AIDALUNA were asked about their observations. An X-band and an S-band radar were also active on the cruise ship at the time of accident. The MAHDI is described as a relatively weakly illuminated vessel that reportedly became visible, first on the radar and shortly after physically, at a distance of about 2 nm. The AIDALUNA changed her course to starboard up to the restricted area buoys to provide the yacht with enough room (see above on p. 18 ff and the Figures 12 ff). The MAHDI was then reportedly monitored until she had passed the cruise ship safely.

3.3.5 Weather and visibility conditions

Calm summer weather prevailed at the time of the accident. The wind blew from a south-easterly direction with a force of between 4 and 5 Bft. The wave height was 0.5 to 1.0 m. Visibility was good and between 15 and 20 nm. The moon had already set at the time of the accident. Sunrise was at 0615 and dawn set in at 0448, meaning that the visibility of navigation lights – apart from any interference by objects obstructing one's view and their deck lights – ought not to have been substantially physically limited.

3.3.6 Human factors relating to the accident

The skipper of the MAHDI, who is a commissioned navigational officer, and his female co-sailor have been circumnavigating the world on their yacht since 1995 and during this period have gained experience in many busy traffic areas around the world. They reportedly took turns at the helm and observed the required rest periods.
The entire bridge crew of the ferry is very experienced and the watchkeeping schedule as well as the time spent on board the ferry by the respective crew do not give rise to the suspicion that the accident may have been due to fatigue.

4 ANALYSIS

Looked at superficially, the collision between the SCHLESWIG-HOLSTEIN and the MAHDI is purely the result of inadequate monitoring of the sea-room as defined in COLREG Rule 5 by the bridge crew of the SCHLESWIG-HOLSTEIN and consequent non-observance of right of way by the ferry. However, such an assessment of the situation is most certainly too simplistic.

If one considers all the circumstances surrounding the development of the collision, the accident is predominantly the result of an unfortunate, but from the perspective of the ferry in the accident area hardly unusual traffic situation, which was essentially determined by a build up of traffic crossing from the east (WOLTHUSEN) and west (AIDALUNA and GLOBAL ALLIANCE) as well as the drilling platform together with auxiliary vessels in close proximity to the course line of the ferry. The radar images recorded by the ferry's VDR clearly demonstrate how the yacht, in the 'shadow' of the drilling platform, and the AIDALUNA approached the course line of the ferry. It is also clear that until the collision a constant bearing to the yacht existed, in the extended line of which the WOLTHUSEN was located. Therefore, it can be assumed that based on physiological and psychological mechanisms[21] the eyes of the bridge crew – if they were on the horizon – were focused primarily on the drilling platform, the brightly illuminated cruise ship, and then on the WOLTHUSEN, which was 'behind' the MAHDI and passing the course line. In the process, the yacht's tricolour light was apparently overlooked.

The MAHDI's ability to perceive the situation was also limited due to the particular circumstances (presence of a variety of light sources and objects in the environment of the ferry). The SCHLESWIG-HOLSTEIN's course change from 0355 that was causal for the accident was therefore not recognised as such. Indeed, the emission of a sound signal by the ferry according to Rule 34 (a) 1. dash COLREG would have attracted the attention of the skipper; however, the ferry was not required to emit such a signal. The sole purpose of COLREG Rule 34 is to make those vessels, for which a course change is being made in the interest of collision prevention, aware of this by sounding an audible alarm.[22] In this regard, the course change of the ferry was only in favour of the WOLTHUSEN, but did not concern the MAHDI, which as a close range target had remained undetected. However, according to COLREG Rule 34, an audible warning signal was not sounded with respect to the WOLTHUSEN because the distance of the vessel was more than 3 nm at the time.[23]

[21] That in darkness the human eye focuses more or less inevitably on very bright spots in the environment is a phenomenon which, based on a vehicle ahead with rear fog lamps switched on, is commonly known in road traffic.
[22] See Hilgert/Schilling, Kollisionsverhütung auf See [Preventing Collisions at Sea], p. 159 to Rule 34 (a).
[23] That the requirement to sound audible warning signals exists only for (identified!) targets at close range is, in addition to the purpose of such signals, also derived from the fact that in accordance with COLREG Annex III, Section 1 (c) their range must be merely 1.5 nm.

With regard to the visibility of tricolour lights and possible misinterpretations, in particular, from the perspective of large vessels, the Cruiser Section of the German Sailing Association e.V. (DSV)[24] drew attention to an optical phenomenon on its Web site www.praxistraining-navigation.de. This is that under certain circumstances a light mounted at the top of the mast of a sailing boat located at close range is easily confused with a navigation light presumed to be situated much further away on the horizon.
The training document, which is available as a PDF file on the above Web site, is published below courtesy of the Cruiser Section of the DSV.

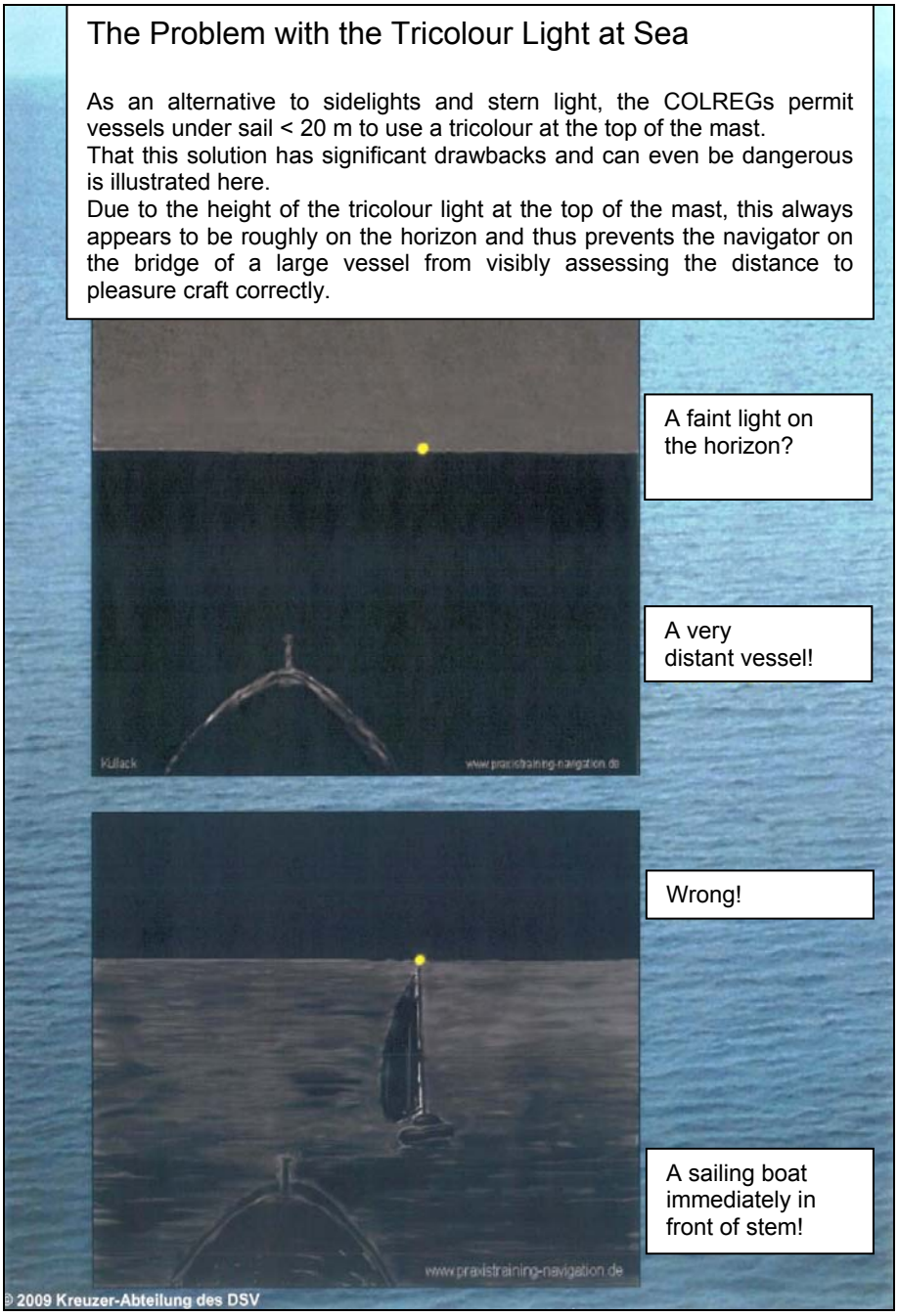


Figure 25: Training document of the Cruiser Section of the DSV 1/2

[24] DSV = **D**eutscher-**S**egler-**V**erband.

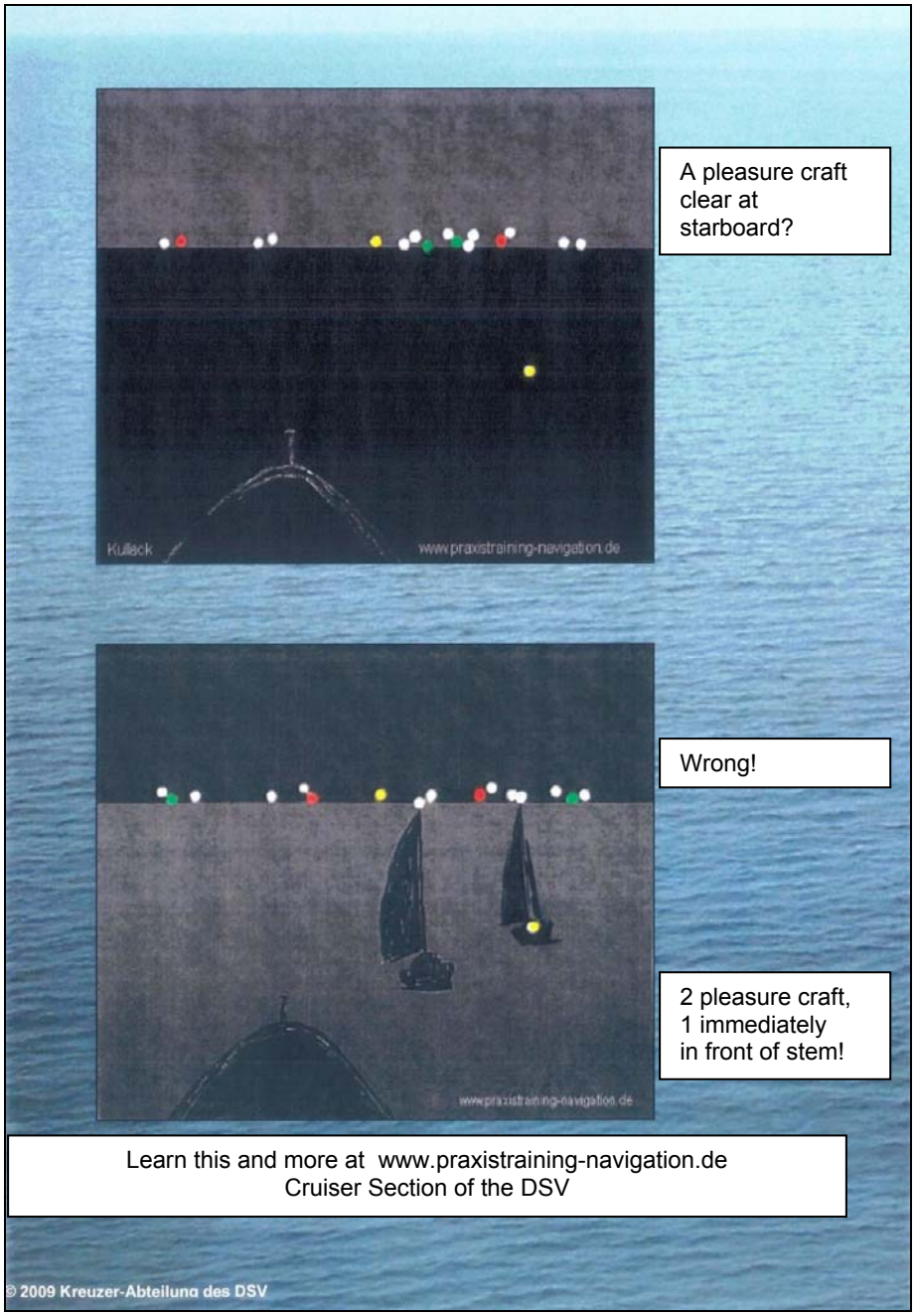


Figure 26: Training document of the Cruiser Section of the DSV 2/2

Observation of traffic by the ferry using radar could play a secondary role in a clear, dark night with generally good visibility. Nevertheless, precisely this accident demonstrates that even in good conditions the detectability of navigation lights is not always reliable with the human eye and therefore that available radar equipment needs to be used consistently.

It is striking that no adjustments were made to the radar images of the two systems apart from the range after the ferry departed. It is possible that detectability of the

MAHDI would have been better on the radar image if certain parameters had been changed (TUNE, GAIN, RAIN, SEA, CLEAN SWP).

However, detectability of the yacht would have been better on the radar image if she was equipped with a radar reflector. The Federal Bureau of Maritime Casualty Investigation addressed the issue of enhanced safety through the use of passive or, better still, active radar reflectors and clearly affirmed this in Investigation Report 56/09 on the collision between the MS CHRISTA and the ODIN, a pleasure craft.[25] Vessels made of steel too, in particular those with relatively slim hulls, such as yachts, reflect only a limited percentage of the radio waves back to the radar antenna depending on their position in relation to the radar station. It is often the case that only faint echoes are then visible on the radar image, which especially at close range are easily confused with interference.

As with the investigation of accidents in the past, the collision between the MAHDI and the SCHLESWIG-HOLSTEIN also represents an opportunity to draw attention to the fact that broadening the AIS equipment on smaller vessels on a voluntary or mandatory basis could lead to an increase in safety. The current coexistence of vessels with and without AIS, in this case additionally reinforced by the coexistence of strong echoes with AIS and a weak echo without AIS, increases the risk of the radar operator's attention being focused too much on clearly identifiable objects.[26]

Finally, it should be noted that in his choice of route and with respect to navigating in the vicinity of large vessels, the skipper of the MAHDI did, indeed, comply with the relevant international rules and was therefore entitled to expect the oncoming traffic to do the same. However, in view of the specific circumstances (passing diagonally through a recommended east-west shipping route with traffic flows separated by buoys on the one hand and crossing a ferry route on the other) and especially in darkness, it is noted that the skipper's decision to pass large vessels in their immediate vicinity was very hazardous. Moreover, his warnings on VHF in the course of approaching the AIDALUNA and the GLOBAL ALLIANCE, which were only of limited value because information on his own position was not included, in which he intended to draw the specific attention of shipping to his yacht, demonstrate that the skipper was quite aware of the risk of not being seen at all or early enough by other traffic.

The attempt of the ship's command of the SCHLESWIG-HOLSTEIN to implement a course change to port at the last minute to avoid the collision is not open to criticism.

[25] See p. 23 ff with further notes of 'Investigation Report 56/09 – Very Serious Marine Casualty – Collision between Motor Vessel CHRISTA and Pleasure Craft ODIN off Timmendorf/Poel on 28 February 2009 dated 15 April 2010'.
[26] See p. 22 with further notes of 'Summary Investigation Report – Marine Casualty – Collision between the Fishing Vessel GITTE and the Ferry SKANIA on 17 February 2009 13 nautical miles east of Rügen'.

Indeed, the COLREGs requirement to change course to starboard – as far and as soon as an obligation to do so arises – to avoid a collision (see COLREG Rules 14 ff) applies in principle. However, the MAHDI was already very close to the ferry when she was detected visually (bearing: about 2 degrees to starboard, distance: 200 m). Having regard to the size of the ferry and the approach speed as well as the time it would take for the change of course to take effect (so-called turning), it is understandable that rather than a starboard manoeuvre, i.e. turning towards the yacht, coupled with the imminent hazard of a frontal collision, an attempt was made to avoid the collision, or at least – in accordance with the circumstances – achieve a less dangerous point and angle of collision at the last second by implementing a hard course change to port.

The actions taken on board the ferry after the accident were marked by a high degree of professionalism. A lifeboat was deployed very quickly, the situation on board the yacht was clarified and assistance was offered to her crew.

5 CONCLUSIONS

This accident confirms, yet again, the crucial importance of an effective lookout and careful observation of the radar in the interest of collision prevention. The BSU has already commented at length in an investigation report on the use of active or passive radar reflectors to increase safety for pleasure craft.[27] Therefore, the publication of safety recommendations can be dispensed with. Instead, the BSU is limiting itself to publishing a summary investigation report on the accident.

The investigation and determination of the cause of the accident was largely made possible by the available VDR data from the SCHLESWIG-HOLSTEIN. Once more, the particular value of a functioning voyage data recorder has been confirmed with respect to a reliable marine casualty investigation.

The accident factors and circumstances discussed within the scope of the investigation and evaluation of the collision between the SY MAHDI and ferry SCHLESWIG-HOLSTEIN (see sub-para. 3.3 and para. 4) concern, in particular, the coexistence of pleasure craft (resp. small vessels) and merchant shipping (large vessels). Reading this report should assist in gaining a better understanding of the other vessel's perspective (in the literal and also in the figurative sense) and on that basis reconsidering one's own practises critically. At any event, this would lead to an increase in safety.

[27] See reference in footnote 25.

6 SOURCES

- Written and oral statements
  - Ship's command of the MF SCHLESWIG-HOLSTEIN
  - Crew of the SY MAHDI
  - Cruise ship AIDALUNA
- Excerpts from the deck log books and other written documentation of the MAHDI and the SCHLESWIG-HOLSTEIN
- Nautical chart and vessel particulars, Federal Maritime and Hydrographic Agency (BSH)
- Findings of the Federal Police (Maritime Investigation and Detection Group Neustadt) and Waterway Police Schleswig-Holstein – WSP District Heiligenhafen
- Recordings of the VDR of the SCHLESWIG-HOLSTEIN
- AIS recording of Vessel Traffic Service Travemünde
- Helmut Hilgert, Rolf Schilling, Kollisionsverhütung auf See, Kommentar zu den Internationalen Regeln zur Verhütung von Zusammenstößen auf See [Preventing Collisions at Sea – A commentary to the International Regulations for Preventing Collisions at Sea], transpress VEB Verlag für Verkehrswesen, Berlin, 1985
- Training document of the Cruiser Section of the DSV 'The Problem with the Tricolour Light at Sea', www.praxistraining-navigation.de