



## Investigation report

C1/2007M

# **M/S KRISTINA REGINA and barge CARRIER 5, collision in Danish territorial waters at Kadetrenden 29.5.2007**

Translation of the original Finnish report

This investigation report has been written to improve safety and prevent new accidents. The report does not address the possible responsibility or liability caused by the accident. The investigation report should not be used for purposes other than the improvement of safety.



## SUMMARY

The Finnish passenger vessel KRISTINA REGINA was on her way from Amsterdam, Holland to Helsinki, Finland, when she, in poor visibility in the maritime area between Denmark and Germany collided with the Swedish barge CARRIER 5 tugged by tug boat PIONEER sailing under the flag of Comoros on 29 May 2007.

There was no damage to persons nor did KRISTINA REGINA suffer significant damage. On the other hand, the barge PIONEER lost part of the logs it was carrying and it sustained significant damages in her hull which were later repaired at a shipyard.

At the time of the event KRISTINA REGINA was using two radars, one of which was scaled to 6 miles and the other to 3 miles. Due to the sea clutter, the close radar targets could not be monitored with ARPA. KRISTINA REGINA has an AIS transmitter and receiver and its display is located on the bridge next to the radar. The VHF equipment and fog signal device of KRISTINA REGINA were operational and in use at the time of the event. The navigation lights of the vessel were operational at the time of the event.

The tug boat PIONEER was using one radar and the watch officer was using various scales between 3 and 12 miles. The other radar was not functioning at the time of the event. PIONEER had no AIS device because the size of the vessel is below 300 GRT. The fog signal device was not functional. The VHF and the navigation lights of the vessel were operational at the time of the event.

Onboard neither vessel was the master called to the bridge although the visibility was poor.

After KRISTINA REGINA arrived in Helsinki, it turned out that the voyage data recorder of the vessel, VDR, had not recorded any information after 16 December 2006. Assistance in the investigation was obtained from the Swedish, Danish, German and British maritime investigation authorities.

The tug boat and barge combination had no AIS device; noticing the combination was only based on a radar echo or a visual observation. According to the provisions, a vessel exceeding 300 GT has to have AIS equipment. However, the requirement does not concern a barge combination, only a vessel. When the tug boat is under 300 GRT, the combination need not be equipped with an AIS device even if the combination were tenfold compared to that required. A mistake has been made when creating the provision. It has not been known that this type of combinations may make poor radar targets.

The investigators recommend that the Finnish Maritime Administration undertake measures to make the AIS requirement concern all vessel combinations exceeding 300 GT.



## THE ABBREVIATIONS USED

AIS	Automatic Identification System
ARPA	Automatic Radar Plotting Aid
DPA	Designated Person Ashore
EMSA	European Maritime Safety Agency
GPS	Global Positioning System
IMO	International Maritime Organization
ISM	International Safety Management System
MAIB	Marine Accident Investigation Branch
MBB	Maritime Black Box
MOU	Memorandum of Understanding
NM	Nautical mile
MRCC	Maritime Rescue Co-ordination Centre
PSC	Port State Control
PSU	Protected Storage Unit
RIB	Rigid Inflatable Boat
SOLAS	Safety of Life at Sea
VDR	Voyage Data Recorder
VHF	Very High Frequency
VTS	Vessel Traffic Service



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## FOREWORD

The Accident Investigation Board was informed of the collision of KRISTINA REGINA and the barge CARRIER 5 tugged by PIONEER on the morning following the event. Recordings of the AIS monitoring of the area were immediately obtained from German and Danish authorities.

On 4 June 2007 the Accident Investigation Board appointed by its decision an investigation commission to investigate the accident. Per their consent, an expert of the Accident Investigation Board Captain, Micael **Vuorio** was appointed a Chairman of the Commission and Captain, Special Investigator Risto **Repo** as member. A representative of the flag state of the tug boat, Comoros, was sent a notification on the event and the launching of the investigation.

The investigators have received material from the parties and from persons representing the parties. The master of KRISTINA REGINA gave a maritime declaration at the Maritime Court of Helsinki. The representative of the investigation was present at the event. At the request of the master, the court ordered that the maritime declaration material be confidential until the other party has given their own maritime declaration.

**Statements and comments regarding the Investigation Report.** The final draft of the Investigation Report was sent for a statement referred to in section 24 of the Decree on the Investigation of Accidents (79/1996) to the Finnish Maritime Administration and as information to the other parties and the assisting authorities.

Some changes to wording and phrases have been made based on the comments received.

The investigators want to thank the investigation authorities of Sweden, Germany, Denmark and United Kingdom for the help they have received.

## 1 EVENTS AND INVESTIGATIONS

### 1.1 Vessel

#### 1.1.1 General information



Figure 1. KRISTINA REGINA in Helsinki in summer 2007.

Name of the vessel	M/S KRISTINA REGINA
Type	Passenger vessel
Nationality	Finnish
Shipping company	Kristina Cruises Oy, Kotka
Home port	Kotka
Call sign	OGBF
IMO No.	5048485
Place and year of construction	Oskarshamn, Sweden 1960
Gross	4295
Net	1688
Length	99.8 m
Width	15.2 m
Draught	5.00 m
Engine power	3240 kW
Speed	16 knots
Number of passengers	245



Figure 2. Tugboat PIONEER.

(Figure Vesta Marine)

Name of the vessel	M/S PIONEER
Type	Tugboat
Nationality	Comoros
Owner	Lavington International Services Ltd, Gibraltar
Shipping company	Skanes Entreprenad Service AB, Skurup, Sweden
Home port	Moroni
Call sign	D6BV9
IMO No.	6705250
Place and year of construction	1967
Gross	231
Net	69
Length	29.0 m





Figure 3. Barge CARRIER 5.

(Figure Vesta Marine)

Name of the vessel	CARRIER 5
Type	Barge
Nationality	Sweden
Shipping company	Marine Carrier AB, Piteå, Sweden
Home port	Piteå
Call sign	SENQ
IMO No.	P920543
Gross	2198
Net	659
Length	76.20 m
Width	23.10 m
Year of construction	1969
Draught	5.10 m

### 1.1.2 Manning

The manning certificate of KRISTINA REGINA, which was valid until 21 May 2012, required a sailing crew of 14. During the accident voyage, KRISTINA REGINA had a crew of 51. The sailing crew consisted of Finnish seamen.

As the collision occurred, the crew on the bridge of KRISTINA REGINA was the first mate as the watch officer and the Ordinary Seaman as the lookout.

On the accident voyage, PIONEER had a crew of 7. The master was a citizen of Russia, the chief mate, the engine masters and the boatswain were Ukrainian and two deckhands were from Latvia. When the collision occurred, the crew on the bridge of PIONEER was the chief mate as the watch officer and the helmsman.

### 1.1.3 The bridge and its equipment

Table 1. Navigation equipment of KRISTINA REGINA.

1.	Radar	Raytheon M34 S-Band ARPA
2.	Radar	Raytheon M34 S-Band ARPA
3.	Gyro compass	Sperry SR 120
4.	Magnetic compass	Trepap Barcelona
5.	Autopilot	Decca pilot 450
6.	Depth finder	Furuno FE-700
7.	DGPS	Simrad CE 33
8.	GPS	Raytheon Nav 398 GPS/Loran
9.	VDR	Kongsberg
10.	AIS	Furuno AIS FA-100
11.	Wind gauge	Furuno RD 30
12.	Fog signal device	Zöllner-Kiel



Figure 4. The radar and AIS display of KRISTINA REGINA.



All the navigation equipment was operational at the time of the event except for the VDR, which did not record the event. The vessel had sufficient and up-dated nautical charts.

*Table 2. Navigation equipment of PIONEER.*

1.	Radar	Furuno 1831 MARK 2
2.	Radar	Furuno FR 7040 R
3.	Electronic nautical chart	Furuno/ Max Sea Software
4.	Compass	
5.	Autopilot	
6.	Depth finder	Furuno LS-6100
7.	GPS	Furuno GP-30/35
8.	GPS	Furuno GP-70
9.	Fog signal device	

The Furuno 1831 MARK 2 radar of the vessel as well as the autopilot and the fog signal device were non-functional at the time of the event. The vessel had no nautical charts or literature relating to navigation.

#### **1.1.4 Voyages before the accident**

CARRIER 5 barge, which was tugged by PIONEER, had loaded timber in Finland first in Inkoo and then at Halla, Kotka, a total of 5,294.5 cubic meters. It left Halla for Wismar on 28 April 2007. The vessel combination interrupted its journey going to Tallinn for repairs. The vessel had problems with propulsion machinery. The delivery of the spare parts took fairly long. In Tallinn, a PSC inspection<sup>1</sup> was carried out on PIONEER, and, as a result, the vessel was stopped for 7 days. The reasons for stopping the vessel were faults in both the vessel and in the certificates of competence and other certificates of the officers. After the repairs, the vessel combination left Tallinn for its original destination, Wismar, on 24 May.

## **1.2 The accident event**

### **1.2.1 Weather conditions**

According to the maritime accident report of KRISTINA REGINA the weather conditions at the time of event where the following: wind speed and direction NE 8 m/s, height and direction of the swell NE 1-1.5 m, fog, visibility 0.3 nautical miles, air temperature 14 C° and water temperature 15 C°.

<sup>1</sup> Port State Control, 2007-5-14



According to the report given by the chief mate and watchman of PIONEER at the time of the event the speed and direction of the wind were NE 8-10 m/s, the height and direction of the swell was NE 1.5-2 m. The visibility in the strong fog was about 50 metres.

### 1.2.2 The accident voyage and its preparation

KRISTINA REGINA was on her way from Amsterdam to Helsinki through the Kiel Canal. The vessel left Amsterdam on 27 May 2007. Before the start of the voyage, the mate of the vessel checked the functioning of the bridge equipment and filled in a 24-point checking list<sup>2</sup>. The checklist does not contain a mention of the VDR. KRISTINA REGINA had 201 passengers.

The vessel left the lock in Brunsbüttel at 12.50 (UTC +2) on 28 May 2007 and passing the Kiel Canal took about 7 hours. The vessel entered the lock in Holtenau at 19.41 (UTC +2) on 28 May 2007. When leaving Holtenau, the watch officers followed the route plan which had been made from Holtenau to Helsinki. The route plan contained the turning points, directions and distances between the turning points, separate information needed for the port of departure and port of arrival as well as during the voyage such as traffic notifications and nautical charts as well as the instructions of the master regarding the route plan. The route plan had been signed by the master and the watch officers. The route plan was also marked in the nautical chart. At the time of the event the vessel followed the route plan.

PIONEER and CARRIER 5 were on their way from Tallinn to Wismar, Germany. The tug combination left Tallinn on 24 May. The route plan of PIONEER had been marked on the electronic nautical chart by drawing the planned route and the turning points. The Investigation Board has not received information on other parts of the route plan. At the time of the event the tug combination was following the route plan.

### 1.2.3 The site

More than half of the vessel traffic to and from the Baltic passes through the relatively narrow sea area in question. The cross-traffic includes regular ferry traffic as well as the traffic in the area of Wismar-Travemünde-Lübeck in the south-west direction.

### 1.2.4 The event

KRISTINA REGINA turned towards the place of the event according to her route plan at 00:40 (UTC +2) on 29 May 2007 as the vessel passed the buoys T 67-68. The course was changed 090° towards the next route point at buoy T 70. Both radars had been set at a scale of 6 miles.

After the change in the course, the visibility weakened and a fog wall was created. After this, KRISTINA REGINA gave fog signals using an automatic horn. After the change of the course, the watch officer of KRISTINA REGINA said he had noticed in the radar an

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<sup>2</sup> Bridge checking list for KRISTINA REGINA 27/05/07



echo proceeding west in a true bearing of about 085 degrees and at a distance of 6.5 nautical miles. The route of the echo was monitored and it was noted that it would pass KRISTINA REGINA on the opposite course at a distance of about 0.6–0.7 nautical miles. The course of KRISTINA REGINA was 090° and her speed slightly over 14 knots. The vessel was on automatic pilot. It was noted from the AIS that the object did not give an AIS transmission. When the object was at a distance of about 1.5 nautical miles, it was noted to change its course to port. At this point, the scale of the X-band radar had been changed to a scale of 3 miles. Due to the sea clutter the ARPA function of the radar could not at that point follow the object; instead a bearing to the target was used. According to that told by the mate, the bearing to the target increased so that it would pass KRISTINA REGINA in front of her bow to the south-west without causing a danger of collision. The visibility continued to be poor.

The tug combination PIONEER and CARRIER 5 approached the place of the event using the course 191° and at 24:00 (UTC +3) on 28 May 2007 the place of the vessel combination was 54° 30'N and 12°10.9'E.

According to the electronic nautical chart, the tug combination turned at 00:15 (UTC +3) on 29 May 2007 to 265°. The watch officer of PIONEER said that he had seen<sup>3</sup> on the radar more than one targets when the tug combination was on the westward lane of the Traffic Separation Scheme. One echo was portside and it was coming towards the vessel. The vessel was steered in direction 265° until 01:35 (UTC +3) when it turned to direction 200°. The speed was about 3.4 knots. According to that told by the watch officer, he saw no dangerous radar targets when he started to turn across the eastern lane of the Traffic Separation Scheme. The radar was a Head-up radar and an 8-mile scale was being used. The watch officer said that he had changed the scale every 10–15 minutes so that he went through all the scales from 3 miles all the way to 12 miles.

When the target that was at times seen in the radar of KRISTINA REGINA was directly in front of her bow, the first visual observation was made. The watch officer noted that it was a tug boat which, according to the mast lights, was tugging another vessel. The vessel being tugged or its lights were not visible at that point. It was noted that the tug boat would pass by the bow, but in order to avoid collision with the tugging cable or the vessel being tugged, the boat turned to port. Thereafter KRISTINA REGINA collided with barge CARRIER 5 at 54°24.8' N–11°55.5' E.

The watch officer of PIONEER did not see<sup>4</sup> KRISTINA REGINA in the radar before it was seen in a relative bearing of 070° and its estimated distance was slightly over 100 m. The watch officer saw KRISTINA REGINA turn to the port at a high speed. The length of the tugging cable was 90 metres and CARRIER 5 was at a visible distance from PIONEER. About half a minute after PIONEER had seen KRISTINA REGINA she collided aft on the starboard side of tug boat CARRIER 5. KRISTINA REGINA was stuck in the tug boat for 5–7 minutes before she was able to get loose.

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<sup>3</sup> Memorandum from a hearing in Wismar, Ostsee-Kontoor, survey report OK/HW/SK/04/536/07

<sup>4</sup> Memorandum, Waterway Police Wismar 31 May 2007 Commissioner Wienke



### 1.2.5 Measures after the event

After the event at 01:01 (UTC +2), the master of KRISTINA REGINA came to the bridge and ordered the watchman and the mates who had come to the bridge to check the damage and the evacuation team to visit all the cabins to ascertain any damage to persons. The master made an announcement onboard about the collision as well as on the prevailing situation. After that those onboard were kept up-to-date with announcements in Finnish, English and Russian. KRISTINA REGINA contacted PIONEER on channel 16 and notified that it had collided with barge CARRIER 5. After that the vessels started to work on channel 9. KRISTINA REGINA gave a PAN-PAN message of the collision, which was answered by Bremen Rescue and Lyngby Radio. The master asked Bremen Rescue to send a maritime rescue vessel to the site in case the situation got worse and to examine the damage to the vessel.

The rescue cruiser ESWEGEN arrived at the site and the chief mate and engine master of KRISTINA REGINA went to check the damage of KRISTINA REGINA in the RIB boat of the rescue cruiser. By 02:58 (UTC +2) the damage of the vessel had been checked and noted to be so small that she could continue her voyage to Helsinki.

After the collision the crew of PIONEER was alerted and they were informed of the collision. The master arrived on the bridge. After the collision the chief mate of PIONEER kept the towing cable tight to avoid the tug boat and the barge from colliding. The vessel prepared to assist KRISTINA REGINA and to ascertain the seriousness of the damage. When KRISTINA REGINA got loose of the barge, it disappeared into the fog. After the Federal Police boat had arrived at the site, it was noted that there were sawn logs in the sea. The RIB of the police boat checked the damage to CARRIER 5. Some of the load had fallen into the sea and the barge had structural damage. VTS-Centre Warnemünde gave PIONEER permission to continue her voyage to Wismar. The Federal Police boat NEUTSTRELITZ and the Emergency Towing Vessel FAIRPLAY 26 accompanied the tug and tow to Wismar.

### 1.2.6 Damage to persons

No damage to persons was noted on either vessel.

### 1.2.7 Damage to the vessel

The damage to KRISTINA REGINA was at the bow of the vessel. Portside to the vessel there was a hole in the Fore Peak tank above the water level and starboard to the aft the light valve of one passenger cabins was broken. Otherwise there was paint damage in the bow due to the collision.



*Figure 5. Damage to KRISTINA REGINA on the bb side*



*Figure 6. Damage to KRISTINA REGINA seen from the bow.*



Figure 7. Broken valve on the starboard side of the vessel.

The angle of dip of barge CARRIER 5 after the collision was 20°. About 10–15 % of the sawn timber load had ended up in the sea and the barge obtained rather large damage to the hull. The damage to the barge was on starboard between frames 23–31 as well as between tanks 4 and 5. The damage to the outer side starts from the level of the deck and continues downwards about 3.3 metres all the way to the water line. The railing of the barge had suffered serious damage on the starboard side and aft. The aft railing had ended so that the anchor wheel level had bended so that the supply container fell into the sea in the collision. The economic damage was significant.





Figure 8. List of barge CARRIER.

(Figure Sjöfartsverket.se)



Figure 9. Damage to the side of the barge CARRIER.

(Figure Sjöfartsverket.se)



Figure 10. Damage to the aft of the barge CARRIER. (Figure Sjöfartsverket.se)

### 1.2.8 Navigation and communications equipment

At the time of the event KRISTINA REGINA was using two radars, one of which was scaled to 6 miles and the other to 3 miles. Due to the sea clutter, the close radar targets could not be monitored with ARPA. KRISTINA REGINA had an AIS transmitter and receiver and its display is located on the bridge next to the radar. The VHF equipment and fog signal device of KRISTINA REGINA were operational and in use at the time of the event. The navigation lights of the vessel were operational at the time of the event.

The tug boat PIONEER was using one radar and the watch officer was using various scales between 3 and 12 miles. The other radar was not functioning at the time of the event. PIONEER had no AIS device because the size of the vessel is below 300 GRT. The fog signal device was not functional. The VHF and the navigation lights of the vessel were operational at the time of the event.

### 1.2.9 Registration equipment

A recording device of voyage information, VDR, had been installed on KRISTINA REGINA. It was not functioning so as to give the investigation information on the events



from the equipment. The main software of the device VDR.exe had stopped recording on 16 December 2006. This had not been noticed onboard.

An attempt was made to obtain the VDR recordings of other vessels in the area for use by the investigation, but in this a delay took place. The master of the FINNHANSA, which had passed the place after the accident, gave a statement on the radar echo given by the barge combination. He said that the barge did not give a proper radar echo. The barge gave an echo, but it was not very strong. Later on it turned out that the passenger car ferry KRONPRINS JOAKIM sailing regularly in the area had a VDR recording from the time of the accident. Thanks to the Danish maritime authorities, it was received by the investigators. The Maritime Accident Investigation Unit MAIB of Great Britain<sup>5</sup> has assisted in unloading the VDR information.

The co-operation forum held by the investigators of EMSA<sup>6</sup> and MAIB proved to be functional.

### **1.2.10 The operation of the VTS system and supervision systems**

The accident site is monitored by VTS Centre Warnemünde in Germany. Also the Danish Maritime Safety Administration records AIS-information at the area. Situation pictures were received from both regarding certain moments during the accident. The VTS recordings of Warnemünde indicate not only the AIS code but also radar echoes. The collision site is located 15 nm away from the radar antenna of VTS Centre Warnemünde. Certain recordings indicate poorly noticeable echoes from the tugging combination. It is the opinion of the expert of the Investigation Board that when monitoring the navigation space it would not have been easy for the VTS operator to identify these echoes as a tugging combination.

The German authorities mainly use the AIS-data in this area and in the Kadetrenden for traffic monitoring. Traffic monitoring in this area, seaward the German territorial sea, means traffic information and traffic assistance. It does not mean traffic regulation.

The VTS Centre Warnemünde is part of the German waterways and Shipping Administration.

## **1.3 Rescue operations**

### **1.3.1 Alerting activities**

PIONEER used VHF channel 16 to report the collision with the passenger vessel at 01:05 (UTC +2). KRISTINA REGINA gave a PAN-PAN message of the collision at 01:09 (UTC +2) and repeated it at 01:12 (UTC +2). Bremen Rescue and Lyngby Radio responded to the calls. At first there was uncertainty regarding the position of the vessel. KRISTINA REGINA at first notified a wrong position, but the AIS information indicated

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<sup>5</sup> Marine Accident Investigation Branch, UK

<sup>6</sup> European Maritime Safety Agency



the right position to the other parties. The investigators got the recordings of channel 16 from the time of the accident.

After that the discussions were held on other VHF working channels. The other channels have not been recorded. MRCC Bremen (call name Bremen Rescue) and VTS Centre Warnemünde undertook the rescue mission.

### **1.3.2 Getting the rescue operations started**

Bremen Rescue (MRCC Bremen) sent the rescue cruiser ARKONA to the area. The VTS Centre Warnemünde alerted the German Federal Police boat ESCHWEGE and the emergency towing vessel FAIRPLAY 26 and sent the spill response vessel ARKONA (two different ships with the same name). The German Federal Police sent furthermore the NEUTSTRELITZ. The RIB came from the ESCHWEGE and inspected the damages at the passenger ship.

The ESCHWEGE was near KRISTINA REGINA and the NEUTSTRELITZ was in the vicinity of the tug/barge.

### **1.3.3 Evacuation of the passengers**

No actual evacuation of the passengers or their gathering at the rescue stations was carried out. Soon after the collision it was noted that the vessel was not in danger of sinking or capsizing.

The passengers gathered in the facilities on the higher deck levels. The master of the vessel informed the passengers that there was no immediate danger and that it would be likely to be able to continue the voyage before long.

### **1.3.4 Rescue of the vessel**

After the sounding of the tanks and the inspection of the engine room it was noted on-board KRISTINA REGINA that there were no leaks. The Maritime Rescue vessel sent by MRCC Bremen arrived at the scene and as she had, for her own part, ascertained that the vessel was all right, KRISTINA REGINA was given permission to continue her voyage.

PIONEER continued her voyage to WISMAR after having received permission from Bremen.

## **1.4 Separate investigations conducted**

### **1.4.1 Investigations onboard the accident vessels**

After KRISTINA REGINA arrived in Helsinki on 29 May 2007, the Finnish representative of the VDR equipment went to take the recording from the equipment. The representati-



ve revisited the vessel on 21 June 2007, at which time he unloaded the information from the VDR capsule. It turned out that the VDR had not recorded any voyage information after 16 December 2006.

As the obligation to install the VDR equipment entered into force, it had to be acquired. The obligation does not include the inclusion of a playback activity in the equipment. In the VDR of KRISTINA REGINA there is no playback function.

The investigator visited the Luonnonmaa dock in Naantali on 31 May 2007 to familiarise himself with KRISTINA REGINA and the damage that had occurred. Present were inter alia the master of the vessel and the DPA of the shipping company<sup>7</sup>, who presented the vessel and the damage.

On 4 June 2007, a representative of the company AT-Marine carried out an inspection of the functional ability of the radar of KRISTINA REGINA at the request of the accident investigators. The radar was operational<sup>8</sup>.

Two inspectors from the company OSTSEE-KONTOR checked the barge CARRIER 5 and the tug boat PIONEER upon the assignment of Vesta Marine.

The inspectors of various authorities and the classification society carried out their inspections as follows:

- 29.5.2007 Preliminary investigation.
- 30.5.2007 Inspection and measurement of the hull and inspection of the navigation equipment of the tug boat.
- 31.5.2007 Inspection of the barge as well as the questioning of the master and the chief mate.
- 4.6.2007 An inspection together with the Swedish maritime inspector as well as an investigation conducted by a diver.
- 5.6.2007 Hearing of the master and the chief mate and the testing of the navigation equipment of the tug boat as well as the inspection of the tanks and pumping systems of the barge.
- 6.6.2007 An inspection of the ballast tanks as well as the Port State Control.
- 7.6.2007 The last inspection on the barge before the departure of the tug boat combination.

The investigators have had available all the above documentation as well as the VTS recordings from the area from both the German and the Danish VTS centres. Assistance

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<sup>7</sup> Designated Person Ashore, a safety manager of the shipping company on land required by the ISM code who acts as the contact person between the shipping company and the authorities in exceptional situations.

<sup>8</sup> AT Marine, inspection report 4 June 2007



in the investigation has been obtained from the Swedish, German and Danish authorities.

#### **1.4.2 Organisation and management**

Kristina Cruises is a family company operating two passenger vessels with a fairly small organisation.

KRISTINA REGINA is in global traffic inter alia in the Mediterranean, the Red Sea, the waters of western Africa and Europe as well as northern Atlantic. The other vessel KRISTINA BRAHE operates in the Saimaa area and in the coastal areas of Finland.

The managing director of the shipping company acts as the rotating chief of KRISTINA REGINA. The brother of the managing director works as the engine master of KRISTINA REGINA. The contacts from the vessel to the office of the shipping company are daily and the organisation is thin. A deviation reporting system exists. Most of the reports relate to events regarding the service profession.

The operator of the tug boat was Skåne Entreprenad AB (SESAB) from Sweden, which had chartered it. PIONEER had been chartered for a so-called trial voyage and the purpose was that if everything went normally the traffic would continue throughout the summer 2007.

CARRIER 5 is owned by Rederi AB Nestor, which is part of the company entity Marine Carrier AB, Sweden. Marine Carrier handles the day-to-day functions.

Timber cargo had been chartered in co-operation by Marine Carrier AB and the orderer of the cargo was KNT Tyskland through its agent.

Marine Carrier has been carrying 100,000–300,000 m<sup>3</sup> timber to KNT using barges since 1997.

### **1.5 Provisions and regulations guiding the operations**

#### **1.5.1 Provisions**

The International Regulations for the Prevention of Collisions at Sea, 1972 (Rules of the Road) were implemented in Finland on 15 July 1977 and the latest amendments were implemented by Decree 1207/95 issued on 27 October 1995. The Rules of the Road are in force with the same contents in all maritime nations.

The *STCW-95 Convention* adopted in London in 1995 by the International Maritime Organisation on standards on training certification and watch keeping amended the 1978 STCW Convention.

The International Maritime Organisation (IMO) adopted with its Resolution on 5 December 2000 MSC.99(73) a new chapter 5 to the International SOLAS Convention for the



Safety of Life at Sea. The new chapter 5 entered into force internationally on 1 July 2002. In Finland it was implemented on 1 February 2003. Rule 19 of the new chapter 5 defines the requirements regarding the navigation systems and equipment of a vessel, such as the AIS and the VDR.

The new rule 19 (point 2.4) of the new chapter 5 of the SOLAS Convention requires that any-size passenger ships in international traffic as well as cargo ship with at least 300 GRT and domestic-traffic cargo ship with at least 500 GRT have to have an automatic identification system (AIS).

Rule 20 of the new chapter 5 of the SOLAS Convention requires that vessels of international traffic have to be equipped with a voyage data recorder system (VDR) or a simplified voyage data recorder (S-VDR) system recording voyage data automatically during the voyage.

### 1.5.2 Supervision by the authorities

The Port State Control (PSC) is an international inspection and supervision system, according to which the member states are liable to check vessels at their ports to ensure that they comply with internationally approved standards and that international regulations are complied with. Inspections by the authorities of the Port States (Port State Control) are based on the Paris Memorandum of Understanding. The inspection of the vessels having any defects, remedies and, where necessary, the stopping of the vessels are means which the Port States can use if the faults endanger the security of the vessel, crew or the maritime environment.

#### Port State Control in 2007

##### KRISTINA REGINA

Port State Control had been conducted on Kristina Regina:

March 6, 2007 control conducted at Santa Cruz, Tenerife, Spain.

- *Defects found 2.*

May 25, 2007 control conducted in Brest, France.

- *No notified defects found.*

June 3, 2007 control conducted in Tallinn, Estonia.

- *Defects found 1.*

##### PIONEER

Port State Control conducted on Pioneer:

March 3, 2007 control conducted in Newhaven, England.



- *Defects found 20.*

April 12, 2007 control conducted in Copenhagen, Denmark.

- *Defects found 9 and the vessel was stopped for 1 day.*

May 14, 2007 control conducted in Tallinn, Estonia.

- *Defects found 3 and the vessel was stopped for 7 days.*

After the accident, control conducted in Wismar, Germany.

- *Defects found 9 and the vessel was stopped for 8 days.* The vessel did not have the necessary nautical charts, the existing nautical charts lacked corrections and literature relating to navigation was lacking. The second radar was not functional. The master did not know English, which was the working language of the vessel. A new master had to be engaged for the vessel.

After the accident and the inspection by Wismar that followed it, PIONEER had been inspected in July 2007 in Denmark and in August 2007 in Great Britain. In Denmark three defects were found and the vessel was stopped for 4 days. In the August the inspection defects were found 13 and the stopping took 12 days.

The inspection in Germany in September 2007 indicated six defects but no stopping. The inspection in October 2007 in Denmark resulted in 9 notifications but no stopping.

### **CARRIER 5**

No Port State Control entries were found regarding the barge CARRIER 5 in 2007 before the collision.

The control made after the accident in May 2007 in Wismar indicated 8 defects and the barge was stopped for 9 days. The defects consisted of damage incurred in the collision.

### **1.5.3 Safety management systems**

The ISM auditing of KRISTINA REGINA had been made on 28 June 2006 and the Safety Management certificate based thereon is valid until 2011.

Very little ISM material regarding PIONEER has been available. The last updated information in the PSC files was "20 November 2006: ISM Manager; Unknown." The charterer of the tug boat notified that due to the small GRT the vessel was not required to have a safety management system.





## 2 ANALYSIS

In the following the event is first studied from the view of the Rules of the Road and thereafter in the light of the stories and event information available regarding the event. This is followed by a discussion on the quality of the radar targets, their visibility and the usability and necessity of other technical equipment facilitating navigation. Last follows a discussion of the rescue measures and other measures made after the event as well as of the matters making the investigation more difficult.

### 2.1 Rules of the Road

At the time of the event the visibility was 0.3 nautical miles, which means that the visibility was restricted due to the fog and that the navigation took place with the Traffic Separation Scheme and so the following rules were to be complied with:

#### Rules of the Road, Section I, Operation of the vessel in all visibility situations

**Rule 5** Look-out,

**Rule 6** Safe speed,

**Rule 7** Risk of collision,

**Rule 8** Action to avoid collision,

**Rule 10** Traffic Separation Scheme

#### Rules of the Road, Section III Operation of a vessel in restricted visibility

**Rule 19** Restricted visibility

**Rule 19**

a) This rule applies to vessels (not in sight of one another) in or near of restricted visibility waters.

*b) All ships shall reduce to a safe speed for the condition of visibility. A power-driven vessel shall standby her engine for immediate use or stop.*

KRISTINA REGINA proceeded at a normal speed and PIONEER slowed down slightly due to a technical problem.

*c) Every vessel has to pay appropriate attention to the prevailing situation and the circumstances due to restricted visibility when complying with the rules of this Part I.*

Onboard neither vessel was the master invited to the bridge although the visibility was poor. The route plan of KRISTINA REGINA mentions that the master has to be woken up and called to the bridge when visibility weakens.



PIONEER had no lookout on the bridge, the helmsman was at the helm.

*d) Take early and substantial action to avoid collision if detecting another vessel by use of radar alone (not in sight). If this is the case, the vessel has to start measures to give way in good time and, if this measure is a change in direction, it must, where possible, avoid:*

*1) any change of course to port for a vessel forward of the beam should be avoided except for a vessel being overtaken;*

*2) any change of course toward a vessel abeam or abaft the beam should be avoided.*

According to that told by the watch officer of KRISTINA REGINA he followed the approaching radar path and noticed that the sideways distance would be 0.6-0.7 nautical miles. Due to the sea clutter the radar target could not be monitored with ARPA. As the radar target was at a distance of about 1.5 nautical miles, it was noted to change direction to the port and the bearing to the target changed so that the radar targets would pass in front of the bow without causing a danger of collision. The estimated passing distance contained no safety margin. The closest passing distance of a vessel passing diagonally in front of the bow would be very small. The watch officer did not confirm the changed situation as a situation of uncertainty by slowing the speed as the Rules of the Road would have required. As the bow of the vessel in front became visible in front of the bow, the watch officer said that he turned portside. Portside therefore that if he had turned starboard it would have been likely that the vessel would have collided with the other vessel noticed.

The investigators do not consider it credible that the watch officer could, right after seeing the traffic and signal lights of the vessel he saw, been able to realise that it was a question of a tug.

The watch officer of PIONEER did at no point see KRISTINA REGINA in the radar before it came visually into sight at about 70 degrees starboard with a distance of about 100 m. KRISTINA REGINA and the other vessels in the area WORLD SPIRIT, KING DARWIN and ELISABETH gave good echo sounds.<sup>9</sup> The fact that the watch officer of PIONEER did not see the echo of KRISTINA REGINA on the radar has been due either to a poor adjustment of the radar or the fact that he did not follow the radar image at all.

*e) All vessels, when they hear any unknown fog signal of another vessel apparently forward should reduce the speed to minimum or to make all way off (stop all water speed by astern engine) and navigate with extreme caution unless risk of collision does not exist. If it is necessary, the vessel has to stop completely and it must, in any case, navigate extremely carefully until the danger of collision has passed.*

The fog signal device of KRISTINA REGINA was operational and at use during the event, but the fog signal device of PIONEER was not functional. The watch officer and lookout of PIONEER did not hear the fog sign given by KRISTINA REGINA. It is evident that the doors to the bridge of PIONEER were shut and that there was no audio lookout.

<sup>9</sup> Figures of the Warnemunde VTS Centre.

## 2.2 Approaching of the vessels before the collision

As KRISTINA REGINA changed course at buoy T 67-68 to 090°, PIONEER was one minute later at its own turning point 54° 26,1'N and 11°57.7'E and it changed its course to 200°.

Both vessels changed their courses towards the collision site almost at the same time. The distance to the radar target after the turning given in the maritime accident notification of KRISTINA REGINA coincides with the turning point given by PIONEER.



Figure 11. The approaching of the vessels before the collision.

According to the watch officer of PIONEER, the new course after the turning point was 200° and the speed was lowered three minutes later to 3.4 knots due to the repair of the fastening of the towing rope. According to the watch officer of PIONEER, there were no radar targets, which would have been approaching when the tug combination turned south-west towards the Wismar approach. The radar was a Head-up radar and an 8-nautical mile scale was used. At this point KRISTINA REGINA was at a distance of about 6.5 nautical miles from PIONEER.

The direction of the tug combination relative to the bottom from the turning point to the point of collision has been 225°. This has been due to drift and manual steering, and the actual speed has been 5.4 knots. Thus the drift has been 2.7 knots in direction 259°.

According to KRISTINA REGINA the radar echo was monitored and it came with an opposite course so that the sideways distance would have been 0.6–0.7 nautical miles. If the vessels kept the above courses and speeds, PIONEER was at a sideways distance of 0.6 nautical miles after about 10 minutes from the turning point of both vessels, i.e., halfway to the point of collision. See figure 11.

The following presents the recordings obtained from various sources so that we can inspect to movements of the vessels. The first picture is the radar image recorded by the VDR of KRONPRINS FREDERIK about 8 minutes before the collision.

M/S KRISTINA REGINA and barge CARRIER 5, collision in Danish territorial waters at Kadetrenden 29.5.2007

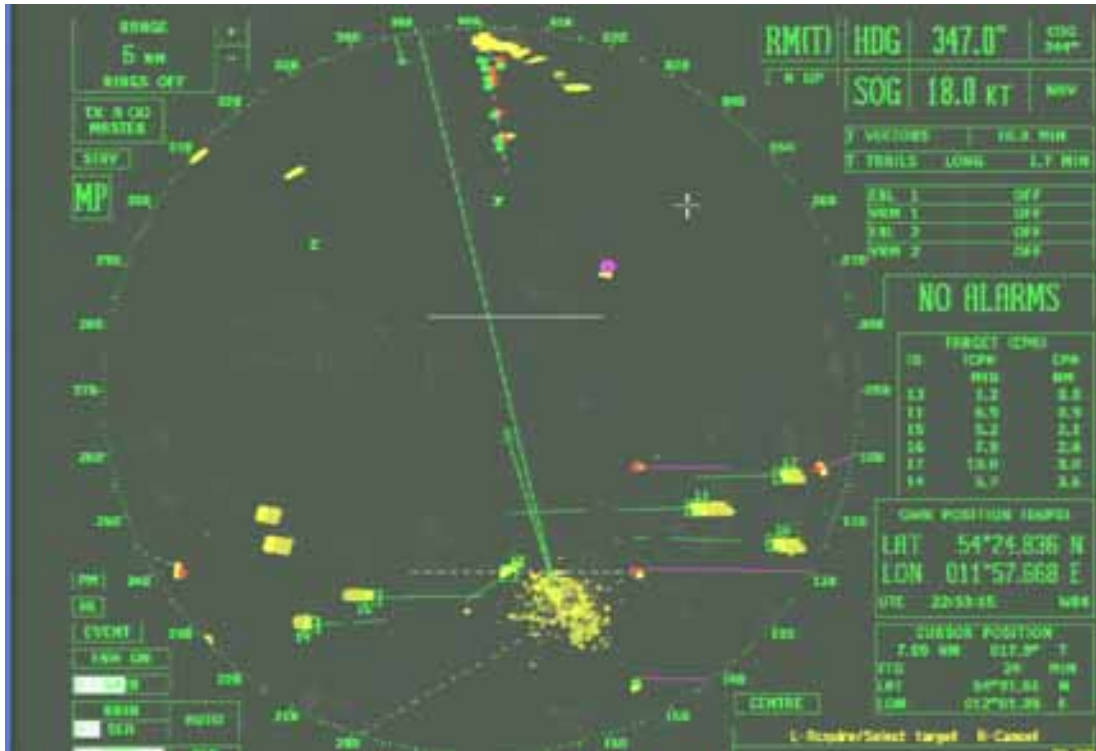


Figure 12. The vectors describing the directions of PIONEER (13) and KRISTINA REGINA (15) meet, and the length of the vector is 10 minutes. PIONEER and the barge CARRIER 5 give one echo.

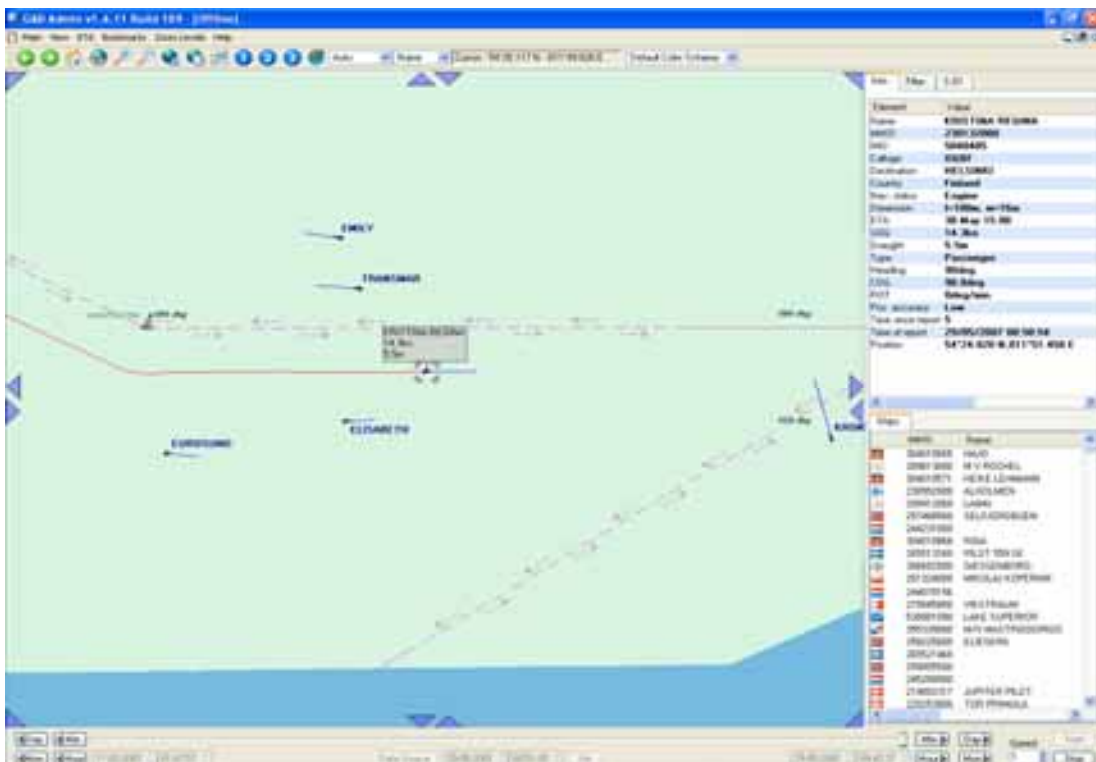


Figure 13. The image recorded by the Danish Maritime Safety Administration with AIS-targets 10 minutes before the collision.

C1/2007M

M/S KRISTINA REGINA and barge CARRIER 5, collision in Danish territorial waters at Kadetrenden 29.5.2007

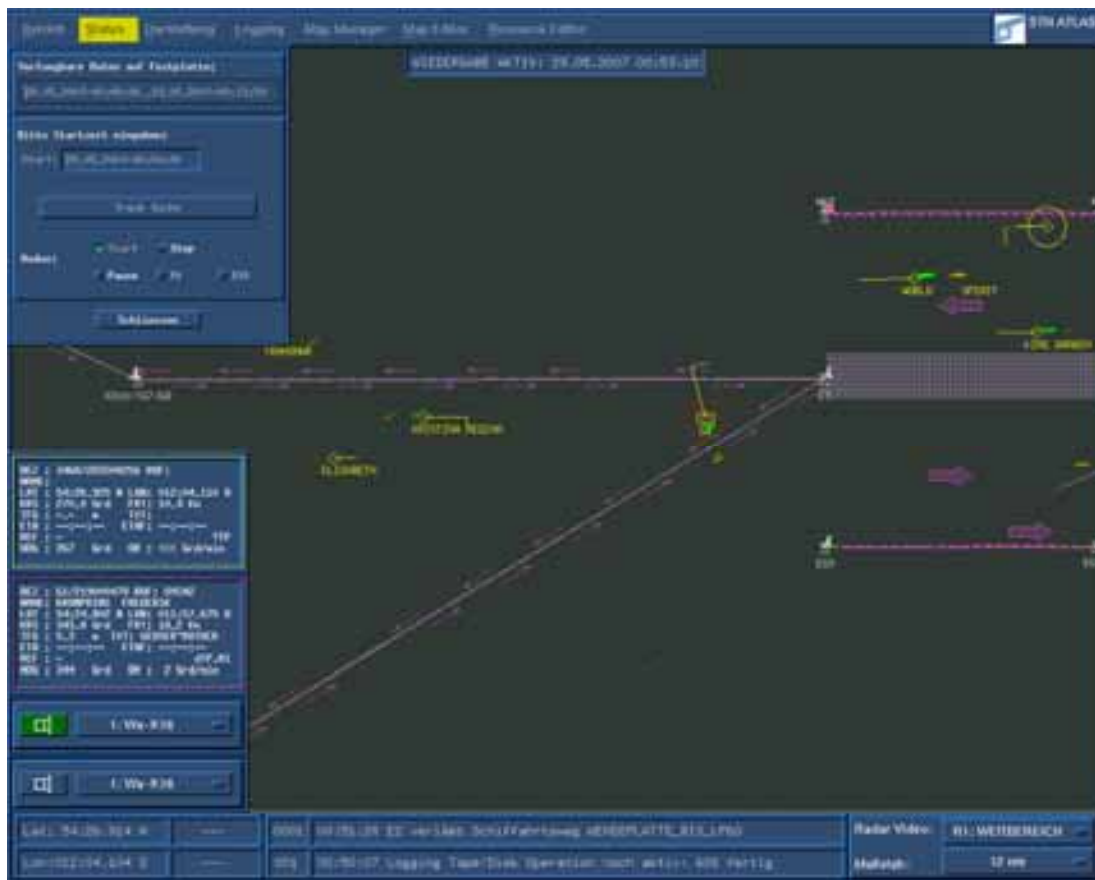


Figure 14. The radar/AIS image of the VTS Centre Warnemünde at about the same time. The barge combination gives no echo image. KRONPRINS FREDERIK has been circled in red.

The maritime accident report of KRISTINA REGINA notes that PIONEER turned port-side when it was at a distance of 1.5 nautical miles from KRISTINA REGINA. The vessels kept the above courses and speeds and PIONEER was at a distance of 1.5 nautical miles from KRISTINA REGINA only 5 minutes before the collision point. PIONEER was at a distance of 0.4 nautical miles from the point of collision and KRISTINA REGINA at a distance of 1.2 nautical miles.

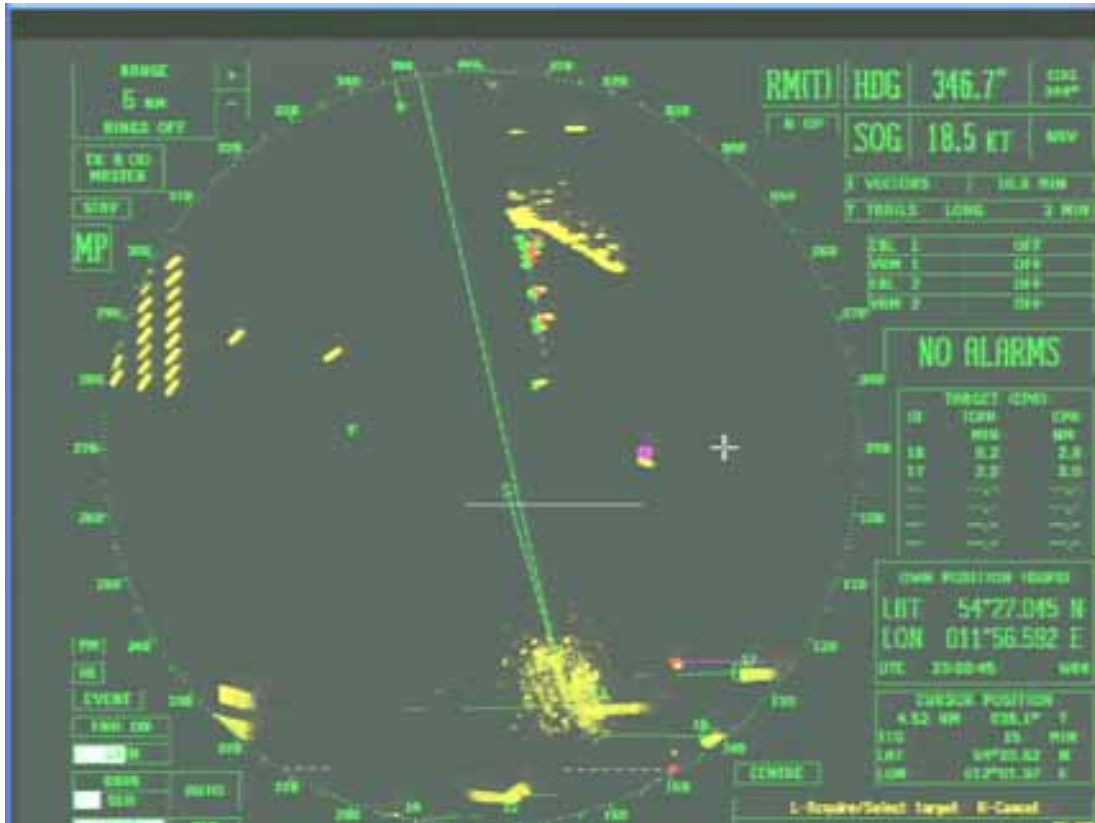


Figure 15. The collision takes place, the echoes of the vessels together at the lower part of the display.

## 2.3 AIS, radar targets, VTS

### VHF - AIS

The observation distances of fixed supervision as well as that of other vessels on the radar and by means of the AIS equipment are based inter alia on the radio horizon. Both the VHF and the radio signal leave the antenna directly, which means that their nominal radio horizon distances are largely dependent on the installation height of the antennas.

Due to their wave length (~2 m), VHF signals are not restricted by rain, fog or sea clutter due to swelling. Due to this, the recognition of a vessel equipped with an AIS device as well as the reception of its location information and movement factors is, in ordinary circumstances, possible a long time before it appears on the radar. Its showing on the AIS is not dependent on the size of the installation platform of the equipment or on reflection characteristics like radar images nor restricted by changes in the atmosphere and swelling.

A vessel exceeding 300 GRT has to have AIS equipment, but the requirement does not concern a barge combination, only a vessel. When the tug boat is under 300 GRT, the combination need not be equipped with an AIS device even if it were tenfold in size. A mistake has been made when creating the provision. It has not been known that this type of combinations may make poor radar targets.



## Radar targets

Despite the length of the combination, a traditional tug boat-barge combination does not necessarily make a good radar target except when measured from the side at a 90 degree angle. The hull, deck and mast structures of a tug boat form peaklike reflections on the radar whereas a barge sailing deep in a heavy timber load is not necessarily reflective with regard to all of its parts above the sea. The hull structure of a barge with its peaklike forms could even be a good reflective surface, but even a relatively low swell mixes the return echoes among the sea clutter. Timber that has been loaded above the deck level does not, even when wet, form a similar reflective surface to electromagnetic radiation as the metal hull of the vessel.

Generally taken, the whether conditions were normal with the exception of the fog, which, at places, formed very thick fog fronts making it difficult for the X-Band radars of the vessels to observe the targets among the fog and the sea clutter caused by the swell.

The likelihood and quality of the radar image obtained from a usable target **under normal circumstances** is effected by:

- distance to the target
- the repeat frequency of the signal (measurement area)
- the size and reflective characteristics of the target
- the transmission power and wave length of the radar
- attenuations in the atmosphere.

The following factors restrict observation due to the time of the year and the weather circumstances;

- the swell
- fixed ice, its edges and narrow channels
- snow
- fog
- rain
- strong wind together with rain.

Rain and strong fog have a two-way effect; they attenuate the transmission signal and the reception signal and they affect the reflection. Swell and ice affect the quality of the image through return echoes reflected from the surface of the sea.

The return echoes due to a thickening of rain/fog as well as the molecular resonance of water are, with regard to their reflection characteristics, very good "material" and thus a well visible target surface in the radar. The effect of rain and sea clutter is bigger with shorter wave lengths for which reason an X-area (3-cm) radar is more sensitive and correspondingly an S-area radar does not tolerate clutter so well in bad weather and sea conditions.





*The radar of PIONEER was a fairly small Furuno X-band radar and that of KRISTINA REGINA was a Raytheon Pathfinder M34 radar, which was used in the X-band area during the accident.*

The effect of sea clutter is at its greatest at a short distance up to 2–3 miles. This is an area in which interest, even in normal conditions when its dark, is very high, not to speak of rain/fog with simultaneous swelling.

*The last 10 minutes before the collision were critical with regard to radar observations on both vessels. The radar observations of KRISTINA REGINA could not be placed in ARPA monitoring due to sea clutter/other disturbances.*

The (vertical) opening angle of the rotating antenna of a traditional maritime radar is big making it possible to receive transmission and return echoes also during swelling and stamping. The vertical and horizontal angles of the antenna together with the transmission pulse affect the echo volume and thus, in poor weather conditions, the amount of interrupting return echoes that are received and disturb the noticing of the targets.

The selections of the measuring distance affects the length and power of the transmission pulse of the radar so that in nearby areas ( $\leq 3$  nautical miles) the vessels use the shortest transmission pulse together with the highest return frequency. With this selection it is possible to handle as many transmission/return pulses in a time frame as possible at the width of the horizontal angle of the antenna. Correspondingly also the resolution ability of distance and the exactness are at their best using the shortest pulse.

The quality and the reliability of the radar image is, in addition to the above worsening conditions, affected by the use of the radar and very strongly by the adjustments and settings made by the user in different conditions and at vary measuring areas.

## 2.4 The VDR

A representative of the VDR equipment visited the vessel to load from the PSU box a full recording to an MBB computer. Using the replay programme Raw2ToLog.exe he was able to raise among others the following files:

- Parameter files 20061212\_120351\_145.PAR - 20061216\_030000\_781.PAR
- Configuration files 20061212\_130000\_990.CFG - 20061216\_030000\_781.PAR
- Radar image files 20060916\_170747\_695.ROO - 20061216\_030000\_921.ROO

The files indicate that the main software VDR.EXE had stopped recording at about 3:00 (UTC) on 16 December 2006. This is the very time when the system should automatically restart. The restart means that VDR.EXE and the related DLL, EXE and ActiveX components are restarted ensuring the optimal use of the computer memory.

The problem with KRISTINA REGINA was that the only display on the bridge was the LOS panel of Kongsberg. This panel gives the user error notifications of faults in the





system and they can be acknowledged were quickly. The panel in question is hard to understand for an occasional user.

With separate computers it would have been possible to monitor the main software of the VDR VDR.EXE and through that, the status of the system. At Kristina Regina this alternative was not in use.

The replay function of the VDR is useful onboard inter alia to practise nearby situations and difficult channel parts. Objective information about an event – including voice recordings – is especially valuable for investigators and the operator when trying to understand the cause of events and to identify operational problems in the activities of the actors.

The investigation of the accident was slowed down by the fact that information on the events had to be searched for also from other vessels.

## **2.5 Measures after the event**

After the collision, KRISTINA REGINA started checking the damage to the vessel and at the same time she started taking contact to the other parties and the Maritime Rescue Centre. The passengers onboard received active communications and the passengers from the lower cabin flaws were transferred to the upper decks. The passengers gave the crew of the vessel an excellent grade of their communications and action.

PIONEER notified the event using the VHF and it remained in place waiting for rescue vessels. After getting permission, the tug combination continued to Wismar. The master of the Finnish vessel, who had arrived at the scene, described the radio traffic calm and proper.





### **3 CONCLUSIONS**

#### **3.1 Observations**

The circumstances were poor for a 3-cm radar. The barge was sailing deep, carrying wet timber as her load and there was a lot of sea clutter. The above factors caused the facts that the echo given by the tug combination was weak, for a long time totally invisible. Also the fog affected the transmission of the radar echo and the reception signal attenuating them.

The speed of KRISTINA REGINA was not decreased as required by the Rules of the Road. The master was not called to the bridge after the visibility had weakened.

The navigation equipment of PIONEER was not functional in all respects. The manning of the bridge was deficient and the fog signal device and the second radar were broken. The port control history of the vessel shows that it lacked a safety management system.

The VDR equipment of KRISTINA REGINA had not worked for six months. The equipment is not mentioned in the pre-sail checklist.

The tug combination vessel did not have AIS equipment. If it had had one, it would have been easy for KRISTINA REGINA and also other vessels to notice it and its movements. The AIS display of KRISTINA REGINA is right next to the radar.

The Port State Control system is not able to ensure that all vessels are permanently at a level required by the provisions as to their equipment and the qualifications of the crew. Repeated stoppages do not bring the condition of the vessels and the qualifications of the crew to the level required.

This is indicated by the control history of PIONEER before the accident and during 2007.





#### 4 SAFETY RECOMMENDATIONS

The accident shows that even a big tug boat does not necessarily give a good-quality radar echo. A barge combination, the barge and the tug boat form one entity, which even when exceeding 300 GRT does not at present require the installation of the AIS. A mistake has occurred in the introduction of the AIS requirement, and it should be corrected. The investigators recommend that

- 1) *The Finnish Maritime Administration undertakes measures making the AIS requirement concern all vessel combinations exceeding 300 GRT.*

Helsinki, 3.9.2008

Micael Vuorio

Risto Repo



Merenkululaitos

1354/335/2008  
MMk 49/2008

Meriturvallisuus

11.6.2008

SAAPUNUT

13-06-2008  
286/507Onnettomuustutkintakeskus  
Risto Repo  
Sörnäisten rantatie 33 C  
00580 Helsinki

Lausuntopyyntönnne 15.5.2008, 226/5M

**MS KRISTINA REGINA,  
YHTEENTÖRMÄYS TANSKAN ALUEVESILLÄ**

Olette lähettäneet kommentteja varten luonnoksen tutkintaselostuksesta C 1/2007M, M/S KRISTINA REGINA ja promu CARRIER 5, yhteentörmäys Tanskan aluevesillä Kadetrendenissä 29.5.2007. Meriturvallisuus-toiminto on tutustunut luonnokseen ja toteaa, että tutkinta on suoritettu huolellisesti ja johtopäätökset ovat johdonmukaisia.

Merenkululaitoksen Meriturvallisuus-toiminto lausuu kuitenkin asiasta seuraavaa:

1. AIS-laitteen sovellutusvaatimukset päätetään kansainvälisesti IMO:ssa, jossa joidenkin valtioiden rajalliset voimavarat usein estävät uusien laitteiden sovellutusalan viemistä pieniin aluksiin. Merenkululaitos voi soveltaa sääntöjä omiin kansallisiin aluksiin tiukemmin, jos näkee siihen syytä. Muiden lippujen alla purjehtiviin aluksiin emme voi vaikuttaa.
2. Ainoa säännöstö, jota sovelletaan alusyhdistelmiin, on COLREG.

Merenkululaitoksen Meriturvallisuus-toiminto ei näe syytä lausua asiasta enempää.

Vt. Meriturvallisuusjohtaja

  
Pekka Korhonen

Merenkulunylitarkastaja

  
Tapio Gardemeister
**Merenkululaitos**

PL 171, 00181 Helsinki, Puh. 020 4481, Faksi 020 448 4355, www.fma.fi



Accident Investigation Board Finland  
Sörnåisten rantatie  
FIN -00580 HELSINKI  
FINLAND

Your ref: C 1/2007 M

Dear Sirs,

**Re. Investigation Report regarding collision between KRISTINA REGINA and barge CARRIER  
5**

We hereby wish to make the following preliminary comments on the draft Investigation Report dated 15 May 2008.

1. A maritime inquiry has been held at the Maritime Court of Helsinki which remains confidential, and a Maritime Accident Report seems to have been filed by Kristina Regina, which is however not attached to the draft Investigation Report. Therefore we do not have a complete picture of the accounts given by the parties concerned.

2. However, to the best of our understanding, the following scenario appears.

On board Kristina Regina the watch officer noticed a radar echo proceeding west in a true bearing of about 85 degrees, at a distance of 6,5 miles. It was assumed that the object would pass Kristina Regina at a distance of about 0,6 - 0,7 mile. Kristina Regina was proceeding at a speed slightly in excess of 14 knots.

Despite this observation, the watch officer did not follow the object, although the ARPA-function of the radar was operational at this distance.

Not until the echo was at a distance of 1,5 miles from Kristina Regina, and only five minutes before the collision occurred, it was noted that the object turned to port. Also after this second observation Kristina Regina maintained her speed.

According to the statement rendered by the chief officer of Pioneer, and the electronic chart, Pioneer proceeded on a course of 265 degrees until 00,35 hrs (when consideration has been taken to the different time-zone settings), when the course was altered to 200 degrees. Accordingly Pioneer altered course to

port approximately 25 minutes before the collision occurred, and at a distance from Kristina Regina of at least 6,5 miles.

In the light of the foregoing, it would be desirable with a clarification of the remarks made on page 27, third paragraph from the top, in the draft Investigation Report.

3. Since many years huge quantities of wood products are carried on barges pulled by tugs from the Baltic States and Russia to ports in Sweden and Germany. This is well known by seafarers in the relevant waters, and so is the fact that a barge may give weak radar echoes, in particular when proceeding in dense fog.

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We should be most obliged for obtaining copies of the comments provided by the other parties concerned, as well as the Maritime Accident Report filed by Kristina Regina.

Yours sincerely,

Anders Hellman  
Area Manager Sweden