Statens haverikommission
Swedish Accident Investigation Board

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Report RS 2005:03e

Collision between dry-cargo vessel Joanna and ro-ro passenger ferry Stena Nautica off Varberg, N county, Sweden, 16 February 2004

Case no. S-02/04

SHK investigates accidents and incidents with regard to safety. The objective of the investigations is the prevention of similar occurrences in the future. It is not the purpose of this activity to apportion blame or liability.

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Translated by Tim Crosfield, M.A., from the original Swedish at the request of the Swedish Accident Investigation Board. In case of discrepancies between the English and the Swedish texts, the Swedish text is to be considered the authoritative version.

2005-12-19 S-02/04

The Swedish Maritime Administration

SE-601 78 NORRKÖPING

Sweden

Report RS 2005:03e

The Swedish Accident Investigation Board (SHK) has investigated a collision that occurred at sea off Varberg, Hallands, N county, Sweden on 16 February 2004 between the cargo vessel Joanna and the ro-ro passenger ferry Stena Nautica..

In accordance with section 14 of the Ordinance on the Investigation of Accidents (1990:717) the Board herewith submits a report on its investigation.

The Board will be grateful to receive, by 26 June 2006 at the latest, particulars of how the recommendations included in this report are being followed up.

Göran Rosvall Hans Rosengren

Per Lindemalm Lena Bergön

Contents

Abbreviations

AIS	Automatic Identification System
ARPA	Automatic Radar Plotting Aid
BCR	Bow Crossing Range
CPA	Closest Point of Approach
DIP-plan	Damage Information and Procedures
EBL	Electronic Bearing Line
GPS	Global Positioning System
IMO	International Maritime Organisation
IPX	Degree of Ingress Protection
ISM	International Ship Management
LMC	Lloyd's Machinery Certificate
LR	Lloyd's Register
M	Nautical mile 1852 m
MAIB	Marine Accident Investigation Bransch
MES	Marine Evacuation System
OSC	On Scene Co-ordinator
MRCC	Maritime Rescue Coordination Centre
ROC	Radio Operators Certificate
SAR	Search And Rescue
SMC	SAR Mission Co-ordinator
SHK	Statens Haverikommission Swedish Accident Investigation Board
SSRS	Swedish Sea Rescue Society
SOLAS	Safety Of Life At Sea
STCW	International Convention on Standards of Training, Certification and Watch keeping for Seafarers
UMS	Unmanned Machinery Spaces
UTC	Universal Time Co-ordinated
VDR	Voyage Data Recorder
VTS	Vessel Traffic Service
VRM	Variable Range Marker
TCPA	Time to CPA

S-02/04
Report finalised 2005-12-19

Time, position, etc.

Time of event	16-02-2004, 04.33 hrs in darkness *Note: all times refer to Swedish standard time* (UTC + 1 hour)
Position	Kattegatt, N County, Sweden, pos. 56°57,5 ' N, 12°07,4' E;
Weather and sea conditions	Dense fog, no wind, calm sea

Joanna

Vessel: type, reg.designation.	Dry-cargo vessel
Sign letters (?)*	J8B 2750
Owner/operator	JS Shipping Company
Nationality/Flag state	St Vincent & the Grenadines
Class	Polish Register of Shipping
Vessel type/Activity	Bulk cargoes in North Sea and Baltic traffic
Numbers on board: crew	7
passengers	None
Injuries to persons	None
Damage to vessel	Limited
Damage to cargo	None
Other damage (environment)	None
Master:	Man, 63 years, Master mariner cert
Sex, age, time as master	1978, captain since 1982
Chief officer	Man, 54 years, chief officer for two years
Sex, age, time as chief officer	

Stena Nautica

Vessel: type, reg.designation.	Ro-ro passenger vessel
Sign letters (?)*	SGQU
Owner/operator	Stena Line Scandinavia AB, Göteborg
Nationality/Flag state	Swedish
Class	LR, 100 A1, UMS, LMC
Vessel type/Activity	Cargo and passenger transport
Numbers on board: crew	34
passengers	94
Injuries to persons	None
Damage to vessel	Considerable
Damage to cargo	None
Other damage (environment)	Limited
Master:	
Sex, age, time as master	Man, 58 years, master for 28 years
Second officer	
Sex, age, time as officer	Man, 49 years, officer for 25 years

The Swedish Accident Investigation Board (SHK) was informed on 16 February 2004 that a collision had taken place that day between the cargo vessel Joanna and the ro-ro passenger vessel Stena Nautica at sea off Varberg.

The event has been investigated by the Board represented by Göran Rosvall, chair, Hans Rosengren, chief maritime operational investigator, Per Lindemalm, chief maritime technical investigator and Lena Bergön, chief investigator for fire- and rescue services. The SHK was assisted by Lars-Olof Andersson as technical expert.

Summary

At midnight on Sunday 15 February 2004 the ro-ro passenger vessel Stena Nautica sailed from Grenå port, Denmark, on her regular service to Varberg on the west coast of Sweden. On board were 94 passengers and a crew of 34. The cargo holds contained private cars, trucks, trailers and seven racehorses. The weather was calm with intermittent fog.

At about 04.30 hours in the morning the course of the ferry was crossed from the port side by the smaller vessel Joanna en route from Amsterdam to Falkenberg. As the vessels' course lines crossed, Joanna made a violent turn to starboard and collided with Stena Nautica. Joanna's stem penetrated Stena Nautica's plating on the starboard side and tore a hole in the cargo deck space and engine rooms.

Water poured into the engine rooms and since watertight doors were open large parts of Stena Nautica's engine area filled rapidly. Her power supply and propulsion machinery were put out of action and she lay unsteerable. The master decided to abandon ship.

In the vicinity there were a tugboat and another ro-ro passenger ferry. The passengers and the majority of the crew were transferred to these and subsequently put ashore.

Stena Nautica was towed into port in Varberg. The work of sealing the damage and preventing her from sinking was extensive and took several days.

Nobody was injured. The cargo including the racehorses on board was saved, but Stena Nautica sustained extensive damage. She was repaired in a shipyard in Poland and returned to service in June 2004.

Joanna was able to continue to Falkenberg after the collision with a fairly small leak in her stem.

The Board's investigation had two main foci. These were the collision and its causes, etc, and what may be termed the second accident in the context, i.e. the flooding of Stena Nautica which involved risks that she would capsize and sink.

The collision was caused by the fact that neither watch officer on the two vessels took steps to avoid a close-quarters situation in time.

A contributory cause was that the officers on board the Joanna misjudged the Stena Nautica's position, course and speed and changed course far too late, and that the officer on board Stena Nautica did not realise that Stena Nautica had the same obligation as the Joanna to give way. A further contributory cause was that officers on board the Stena Nautica after some time had grown used to accepting meetings in close-quarters situations. Reasons for this were the relatively dense traffic on the vessel's route and the opinion of the officers that vessels obliged to give way increasingly gave way late if at all.

The reason that Stena Nautica became flooded and nearly sank was because the shipping company lacked a sufficiently thought-out and implemented safety policy.

This in turn led to the vessel's watertight doors – incorrectly – being open and that the crew had not practised shutting the doors in the event of danger or accident.

Contributory causes of the shortcomings in the watertight doors were that the Maritime Safety Inspection had not inspected these sufficiently carefully and discovered the deficiencies in the electrical systems, not pointed out shortcomings in the vessel's safety manuals regarding the handling of the watertight doors and not checked the crew's skill in closing the watertight doors in a hazardous situation or accident.

Moreover the shipping company had received a positive answer from the Maritime Safety Inspection to its request for an exemption to sail with some of the watertight doors open in contravention of regulations in force.

In addition the Maritime Safety Inspection has not taken any effective action in spite of the fact that their inspector had at several occasions noted that the ship sailed with watertight doors open in breach of regulations.

Recommendations

The Swedish Maritime Administration is recommended to

– develop methods of assessing a shipping company's safety policy and the extent to which the same policy has been implemented and has permeated the company *(RS 2005:03 R1)*,

– develop an instrument for quality control of its own supervision- and inspection operations
(RS 2005:03 R2)

1 FACTUAL INFORMATION

1.1 History of voyage

1.1.1 According to information from Joanna

M/S Joanna was en route from Amsterdam to Falkenberg with a cargo of 1,500 tons of soy pellets. The vessel was equipped with two radars of which one, with Automatic Radar Plotting Aid (ARPA), had been out of order for ten days. Instead, the other equipment, RACAL-DECCA, River-radar RR 1250 without ARPA and a GPS receiver with a memory function were being used.

The voyage had gone normally, but at about 01.00 hrs, when the vessel was in the T lane and had passed Kummel Banke (N 57°19,5´ E 11°29´), visibility had deteriorated and the master had been called to the bridge.

At 04.00 the officer of the watch was relieved by the chief officer. Also on watch was an ordinary sailor who was alternately on the bridge and making rounds in the vessel. Course was 122° and speed 7–8 knots.

At around 04.20 hrs an echo was detected on the radar that later proved to be the Stena Nautica, approximately 30° to starboard at a distance of approximately 6 nautical miles (M). No actual plotting was done but by using an electronic bearing line (EBL) and a Variable Range Marker (VRM) an "electronic point" was achieved. The echo was followed, showing that the bearing did not change. The master and the chief officer have stated that they turned 40° to starboard when the distance to the echo had decreased to about 4 M. Because of the "head up" presentation, the echo moved to port on the radar screen, to almost right ahead, but not over to the port side of the heading line. Mandatory fog signals were being given but no signals from Stena Nautica were heard.

The distance continued to decrease and at approximately 2 M with the direction still unchanged another 40° starboard turn was made. At 04.40 hours Stena Nautica suddenly appeared out of the fog straight ahead and very close, on a course perceived to be at right angles to that of Joanna. The Joanna struck the Stena Nautica on her starboard quarter.

1.1.2 According to information from Stena Nautica

During the evening of 15 February the passenger ferry Stena Nautica was loaded in Grenå for the night's voyage to Varberg. On board were 94 passengers and a crew of 34 people. The cargo consisted of 52 lorries and 21 other vehicles. On the cargo deck there were also seven racehorses. Loading was completed at about 23.55 hrs.

Before departure the master checked the bridge equipment and supervised the starting-up of the engines. The chief engineer and second engineer were in the engine control room, on watch together with the mechanic of the watch.

At 24.00 hrs the vessel left the port. About 20 minutes later they reached open water. The master then left the bridge and the chief engineer left the engine control room.

The bridge watch was now taken by the second officer together with two ordinary seamen, of whom one remained on the bridge as look-out while the other made check rounds in various areas in the vessel according to a fixed schedule. He maintained constant radio contact with the bridge.

In the engine control room the second engineer was on watch together with the mechanic of the watch.

The weather was calm and the sea smooth. Visibility was impaired by intermittent fog. Initially visibility was estimated to 1-2 M but it had gradually

deteriorated to 0.1–0.2 M. Course was 022°, speed was reduced to approximately 12.5 knots and adapted to the timetable.

Traffic was periodically fairly heavy and several avoidance manoeuvres became necessary; but after making Knoben buoy (N 56°45´, E 11°54´), where several lanes meet, the traffic thinned out appreciably. It was noticed that very few fishing vessels were out.

At about 03.50 hrs a vessel that later proved to be Joanna was detected at a distance of 12 M approximately 30° to port. The vessel was followed on ARPA radar.

At 04.02 hrs the bearing was 349°, distance 8.8 M, Closest Point of Approach (CPA) 0.1 M and time to CPA (TCPA) 31 min. At the same time the ARPA radar showed that the vessel's course was 122° and speed 10.1 knots and that it would cross Stena Nautica's heading line at a distance, i.e. a bow crossing range (BCR), of 0.6 M.

At 04.18 hrs the bearing was 351°, distance 4.3 M, CPA 0.2 M and TCPA 14.9 min. The course was 121° and the speed 10.0 knots. At this point the Collision Warning (Red) alarm on the ARPA radar lit up. The alarm was set to go off when it was calculated that the Stena Nautica would come within 0.5 M or less of another vessel, i.e. CPA ≤ 0.5 M. This would occur in about 15 minutes, i.e. TCPA 15 min.

Stena Nautica maintained course and speed. At 04.26 hrs the bearing was 356°, distance 2.0 M, CPA 0.3 M, TCPA 6.9 minutes and BCR 0.6 M. The other vessel's course and speed were unchanged.

The second mate, who was used to close situations – owing to the often heavy traffic and vessels obliged to give way often do so late if at all – expected the other vessel either to turn to starboard and pass astern of the Stena Nautica or maintain course and speed and pass forward of her. He considered himself to have the situation completely under control and was all the time prepared to take various steps.

At the same time he observed the echo of the tugboat Freja, which however was considerably further away forward. He noticed e.g. that Freja made a turn to starboard.

At 04.30 hrs the bearing to the other vessel was 008°, distance 0.9 M, CPA 0.3 M and TCPA 3.1 min. The course was 121° and speed 10.0 knots. When the second officer realised that the vessel would cross Stena Nautica's heading line at BCR 0.6 M he assumed that she would maintain her course and speed. In order to increase the passing distance he turned to port onto course 016° and shortly thereafter onto course 010°. At approximately the same time Joanna turned hard to starboard. At 04.31 hrs the second officer and the ordinary seaman discovered that the Joanna's radar trace had changed direction and was pointing straight at the Stena Nautica.

The Stena Nautica now gave three long fog signals, first one of about 5 seconds and after 25 seconds two further signals of about 7 seconds and 5 seconds. The Joanna was making a sharp turn to starboard and shortly afterwards the two vessels came into sight of each other. Visibility was estimated to 0.1 M.

No-one on board the Stena Nautica heard any fog signals from Joanna, and Stena Nautica did not give any fog signals either.

1.1.3 Point of collision and reconstruction of course of events

The vessels collided at 04.33 hrs at position N 56°57, 5´, E 12°07, 4´. The Joanna, then in direction about 250° and speed of about 7–8 knots, struck the Stena Nautica, course about 004° and speed 12 knots, approximately 35 m forward of her stern on starboard quarter at an angle of about 70° reckoned from her bow. The Joanna did not become caught in the Stena Nautica but slid free at an angle of about 70° reckoned from her stern.

An illustration of the course of events is given in *enclosure 1* and is based on data from Sjöcentral Väst in Gothenburg, the Joanna's GPS and the Stena Nautica's VDR.

Directly after the collision the master of Stena Nautica was called to the bridge, where he arrived after about one minute. Just before he arrived on the bridge, the ordinary seaman asked if the watertight doors ought not to be shut, but nobody pressed the button.

An attempt was made from the bridge via radio to ascertain from the engineering staff the position and extent of any damage. The engineer of the watch, who had ascended from the engine room to the cargo deck, reported that there was a hole in the vessel's side but no water was leaking in. More time was to pass before it was realised that water was entering the engine rooms.

Until 04.36 hrs (+3 min), when the main engines stopped, the Stena Nautica proceeded at unchanged speed of about 12.3 knots.

At 04.37 hrs (+ 4 min) there was a call on radio-telephone from the engine rooms that the watertight doors had to be closed. The call was repeated shortly afterwards.

At this moment or immediately before, the All doors button on the control panel on the bridge was activated and the doors started to close. No passenger warnings were announced before the closing.

Bridge personnel noted that the control lamps for the various doors showed both red and green, but did not realise that this indicated that it was uncertain whether the doors had really been closed. However, no attempts were made to hand-pump the doors shut from the safety stations on deck 3.

A few more minutes passed before information was received and understood on the bridge that the engine rooms were rapidly filling with water and that several watertight doors had not been completely shut.

At 04.41 hrs (+ 8 min) the master sounded the General alarm signal throughout the vessel.

1.1.4 Events in Stena Nautica's engine rooms

The Stena Nautica is fitted for watch-free machinery. This means that the vessel may be conducted without personnel in the engine room areas. The company, however, has chosen to have personnel on watch since the machinery requires much supervision and is divided into several engine rooms. Alarms from the machinery are shown on panels on the bridge and in the engine control room when problems arise. The engine control room is located together with the main electric switchboard room above the engine rooms between frames 42 and 66 on the port side.

Shortly after the vessel had reached open water the chief engineer went to his cabin for the night. In the engine area the second engineer was then on watch with a mechanic. The former's primary workstation was in the engine control room. The mechanic's job during the first part of the voyage was to clean the engine rooms. He went from room to room cleaning oily surfaces etc. For this he pulled hoses and other equipment through the open watertight doors.

Since all manoeuvres can be made from the bridge, the voyage was initially quite uneventful for the crew members in the engine rooms. The two noticed nothing unusual until they heard a heavy blow from the cargo deck above them.

The mechanic was resting in a small room after finishing his cleaning. He went to the engine control room to consult with the engineer of the watch. They agreed that it could have been a trailer falling over on the car vehicle deck.

The engineer went up to the cargo deck to check vehicles and trailers. On the starboard side he felt a draught of air and a smell which he later described as one “of burst steel plate” and found a large hole in the vessel’s side.

He contacted the bridge and, when asked about any leakage, informed that no water was entering the cargo deck. The engineer hurried back down into the engine room via a companion ladder down to the auxiliary engine room. There he was stopped by water that had started rising up the ladder, and he saw water spraying in over a generator.

He returned by a different route to the switchboard room but found the watertight door, no 12, to the engine control room shut. At the same time the mechanic arrived, soon followed by the chief engineer. They found that the door was closed from the bridge.

While the second engineer went up to the cargo deck the mechanic had gone a different way to the engine room. He found streaming water to the height of his knees. He tried to close the watertight door no 5 by hand pumping but did not succeed. Behind him he saw a mass of water filling the whole of the door aperture, pouring in from the workshop through the open watertight door no 6. He fled back through the door by which he had come, calling by communication radio to the bridge that they should shut the watertight doors. At about the same time all lights went out and the generators stopped.

After some seconds the emergency generator started automatically and the emergency lighting came on.

Shortly afterwards water began to force its way up through the floor in the switchboard room. The chief engineer the second engineer and the mechanic then made their way to the bridge.

After consultation with the master, the chief engineer and the second engineer went forward and down to deck 1, whence they intended to make their way aft to investigate what compartments were flooded. They found the forwardmost watertight door, no 1, closed and that there was no water on the other side. Thus they could open the door and continue aft. Door no 2 was also closed and without water on the other side. Door number 3 was also closed but a jet of water was coming through a tube in the door frame. They realised that the space aft of this door must be flooded and they returned to the bridge to report.

No member of the crew subsequently went down to the engine room area.

1.1.5 The tugboat Freja

Freja is one of the Röda Bolaget Company’s largest and most powerful tugboats (ca 5000 HP). She has two thrusters aft and bow thruster. She is further equipped with ARPA-radar and AIS. She is often employed to assist large tankers in Brofjorden and Gothenburg. The vessel normally has a crew of three.

On 16 February the Freja was en route from Gothenburg to Malmo. The crew had been reinforced by two seamen to man the watch.

The mate had the 00.00–06.00 hrs watch together with one seaman. Visibility was reduced, intermittently dense fog. Freja was sailing at about 12 knots on a southerly course.

At a distance of 12 M the Stena Nautica’s radar echo was identified. Another echo had also been received which later proved to be Joanna, whose vector showed that she was on a collision course with the Freja.

In order to pass astern of the Joanna, the Freja turned 20° to starboard. The mate followed developments concerning the other two vessels and noted that their courses and speeds were unchanged.

Both echoes later coincided to one point. Freja was then approximately 1.5 M north-east of the other two and visibility was approximately 50 m.

As soon as the mate heard the Stena Nautica call the Maritime Rescue Co-Ordination Centre he realised that the vessels had collided. He called out the crew and turned towards the location of the accident.

The master quickly came to the bridge and took command. He immediately ordered the rest of the crew to prepare to receive distressed persons.

Freja sailed towards Stena Nautica with reinforced lookout for distressed persons in the water. After approximately 20 minutes the Freja arrived and approached the Stena Nautica on her port bow. The master estimated visibility to 25-30 m.

1.1.6 Evacuation of Stena Nautica

When the General Alarm was sounded the vessel's safety organisation was activated. The bridge was manned by the master, the technical manager, the chief officer, second officer, second engineer, electrical engineer, evacuation officer and a seaman as bridge watch.

The personnel assigned to implement the evacuation belonged to ship's economy department. Three evacuation groups were tasked to clear their areas and to inform and direct passengers should the ship be abandoned. They also distributed lifejackets.

The two-man first aid group met at the hospital cabin and was prepared to take care of injured persons.

All groups reported on the position to the evacuation officer, who in turn informed the master and gave orders to the groups.

Passengers and crew were check-counted.

At 04.50 hrs it was decided to transfer the passengers to Freja. At first the master planned to use the starboard Marine Evacuation System (MES) – an inflatable slide down to the water surface terminating in a platform. The Freja manoeuvred into position at the starboard side. However a fault arose in the inflation of the MES. The slide twisted and the platform landed upside-down. The device became unusable. Instead, the port side MES was released and functioned without problem.

The Freja was obliged to come around to position on the port side. She was in place and started to receive passengers and parts of the crew at 05.07 hrs.

Everybody wore lifejackets and the evacuation passed off at a calm, controlled pace. As there was a certain difference in levels between the platform and the Freja's railing, her crew had a heavy job lifting the distressed persons on board. As these came on board they took an active part in lifting the others on board.

Starboard malfunctioning MES

The port side functioning MES

After just over 20 minutes, at 05.30 hrs, the Freja had received all 94 passengers and 23 crew members. Remaining on board Stena Nautica were then 11 crew members. Three of these were later evacuated to the Swedish Sea Rescue Society rescue vessel Odd Fellow, while eight men remained to assist with handling tow-lines and preparing for the tow.

At 06.10 hrs the Stena Line ro-ro passengervessel Stena Germanica arrived on the scene of the accident and the Freja transferred all the evacuated passengers and crew members to her. The Stena Germanica then continued her voyage to Gothenburg, arriving at approximately 10.30 hrs.

1.1.7 Towing of Stena Nautica, etc

While the evacuation was in progress an inspector from the Swedish Maritime Safety Inspection came on board the Stena Nautica. He subsequently took an active part, among other things deciding where the vessel should be towed.

While awaiting Stena Germanica Freja was made ready for towing the Stena Nautica. Heavy equipment was transferred to the aft deck. While this was going on the evacuees were obliged to huddle together on the foredeck.

At 06.40 Freja returned to Stena Nautica as soon as the passengers had been transferred to Stena Germanica. Using Freja's deck crane the towing-line was lifted up to Stena Nautica's foredeck, where eight crew members received it and made it fast. As soon as the link was ready those remaining on board left Stena Nautica and were taken on board Odd Fellow.

At 07.00 hrs Freja started the tow to Varberg at a speed of 5–6 knots. Odd Fellow followed aft of Stena Nautica and reported on the increase in her draft.

The tow was performed with 100 m of cable, which from Freja was seen disappearing into the fog. As they were approaching Varberg they were informed by the inspector that they should make for Apelviken and run the Stena Nautica aground on the level sea bed. This involved a slow, wide turn of about 180°.

When at about 08.00 hrs they had nearly reached Apelviken, and Freja was entering shallow water, they were ordered to make for Varberg again since new stability calculations and draft observations indicated a possibility of making it to the quay.

The tug and ship again turned about 180° and made for Varberg. The tow went well and when at 09.30 hrs they were approaching Varberg port, four members from Stena Nautica's crew went on board to receive a towline from Balder, a tugboat belonging to Varberg port. This tugboat was to act as stern tug to reduce the speed for mooring in Farehamnen.

Once in port, the mooring began at 10.30 hrs. Freja was ordered to speedily release the towline and push the Stena Nautica, approximately amidships, against the quay and thus keep her stable. Here the failed starboard MES acted as fender.

The tugboat Per, which arrived about an hour after Freja had started pushing, was also involved in this work. Freja and Per subsequently took turns in pushing Stena Nautica against the quay to keep her stable. This continued until 24th January by which time Stena Nautica was pumped dry and could be moved over to the ferry terminal.

1.2 Injuries

None.

1.3 Damage to the vessels

1.3.1 Stena Nautica

Stena Nautica was seriously damaged in the collision. Joanna's stem struck her side plating almost at right angles at frames 44-45 on the starboard side. Joanna's speed was approximately 7-8 knots and the collision was brutal but brief. The sharp part of the Joanna's stem was met by the heavy cargo deck of the ferry. The deck split about one metre inwards.

The upper projecting portion of the Joanna's forebody, the fo'c's'le, was pressed against the Stena Nautica's plating above the cargo deck, deck 3, and forced the plating and frames to stretch as they were pressed into the cargo hold. This resulted in the plate splitting along a horizontal line just under a heavy stringer that runs horizontally about three metres above the cargo deck. The plate with its vertical frames was folded into the cargo hold, opening a hole of about 10 m² from the level of the cargo deck up to the stringer. The hole was about 5 metres long in the vessel's longitudinal direction.

Simultaneously the lower, sharp portion of the Joanna's stem pressed against the Stena Nautica's plating under the cargo deck. The plating split along a vertical line from the cargo deck down to a stringer approximately 3 metres below the cargo deck. When the Joanna's stem entered, the split plating edges with the frames were folded inwards. The result was a hole of about 2 m² under the cargo deck, the greater part under the waterline.

The vessels were not caught up in one another partly because Joanna was halted by Stena Nautica's heavy cargo deck and partly because the former's sharp bow largely retained its form, and partly because the Stena Nautica was under way. Hence the vessels were immediately torn away from one another.

The engine rooms of Stena Nautica were quickly flooded. Water poured first into auxiliary engine room no 5 with workshop and welding shop. The room is bounded by watertight bulkheads with door no 6 in the forward bulkhead and door no 7 in the aft one. The latter was shut and so the water could not flow aft from there.

Door nr 6, like the three doors forward thereof, was open. The water could therefore flow freely forward, filling in turn the generator room, the main engine room and the stabiliser room. Here too are shaft- generators powered by the main engines.

In the four engine rooms which were first filled the water level rose up to the underside of the cargo deck. All machinery and equipment including electric cabling and electronics in the engine room area were damaged by water. In addition, water gradually penetrated to parts of the passenger facilities on deck 2, both forward and aft of the engine room area. Here fittings, insulation and the cladding of bulkheads, insulation and floorings were damaged by the water.

Above the workshop and generator room the engine control room was flooded, as was the main switchboard room with the vessel's main electrical panel.

As the water poured in, the All Doors-button to close all the watertight doors was pressed on the bridge. Thereby door no 3 in the watertight bulkhead at frame 102 closed in time and prevented the water from penetrating further forward in the first phase.

Later on, at quay in Varberg and before the hull damage had been completely sealed, more water entered and penetrated up onto the cargo deck and also down into the propeller tunnels via an emergency escape.

The damage to Stena Nautica was repaired at a shipyard in Poland and took approximately four months to complete.

The upper part of the damage in to the cargo deck

The damage in Stena Nautica seen from the cargodeck

1.3.2 Joanna

Damage to the Joanna was comparatively minor. The fo'c's'le with bulwark and deck was demolished. The sharp part of the stem was compressed and sustained fairly small dents and scraped paint. A fairly small leak was sprung into the forepeak tank. The leak was repaired at quay in Falkenberg and the Joanna continued unassisted to a yard for further repairs.

1.4 Other damage

1.4.1 Damage to cargo

No substantial cargo damage has been reported to the Board.

1.4.2 Damage to the environment

In Varberg booms were laid out round the Stena Nautica and about 100 cubic metres of oil and oil-and-water mixture were collected by the Coast Guard environmental protection vessel. Decontamination firms were employed to collect oily rubbish along the beaches. No long-term or permanent environmental damage has been reported.

The environmental rescue operation is described in paragraph 1.16.6.

1.5 Personnel information

1.5.1 Stena Nautica

The master

The master, male, was 58 years old at the time and held a Master Mariner Certificate. He had served as master for 28 years. He also held a Pilot Exemption Certificate, Radio Operator's Certificate (ROC) and ARPA certificate.

The second officer

The second officer, male, was 49 years at the time and had served as an officer for 25 years. He held a STCW Class 3 Certificate, ARPA certificate and ROC.

The chief engineer

The chief engineer, male, was 57 years old at the time and had served as an engineer since 1971. He had been established chief engineer for 20 years and held a Chief Engineer Certificate.

1.5.2 Joanna

The master

The master, male, was 63 years old at the time and held a Polish master mariner's certificate. He had served at sea for 40 years, mostly with Poland's largest shipping line, the Polish Steamship Company, in international traffic and in vessels between 4 000 and 70 000 tons deadweight. He had been a master since 1982 and has served on board the Joanna since September 2003.

The chief officer

The chief officer, male, was at the time 54 years old and had worked at sea for 24 years. He had Polish certification as chief officer aboard vessels between 500 tons and 3000 tons gross. He had served as chief officer for two years and aboard the Joanna for about 3 months.

1.6 The vessels

1.6.1 Stena Nautica

The Stena Nautica is a roro-passenger vessel. This means that she has cabins and other areas for passengers and with the design and life-saving equipment required for passenger traffic, and has cargo holds for vehicles such as trucks, cars and trailers.
She was built in 1986 at Nakskov Skibsverft, Denmark with newbuilding number 234. She has nine decks, of which nos 3, 4 and 5 are for ro-ro cargo. There are vehicle ramps both astern and forward from deck 3.

Cabins and other passenger areas are on deck 2, forward and aft of the engine room and on deck 6 and above.

The machinery with tanks and service areas occupy deck 1. This is divided into seven compartments separated by transverse watertight bulkheads with watertight doors. The main engines on deck 1 reach up through deck 2 and, together with the engine control room and the switch board room, occupy the middle portion of deck 2.

Below deck 1 is the double bottom that accommodates tanks for fuel and ballast water.

Deck 3 is the freeboard deck, under which the hull is divided into watertight compartments with transverse bulkheads. There are a number of watertight doors in the bulkheads.

Two main engines drive each one variable pitch propeller via long shafts. Electric power is produced by four diesel generators in one of the engine rooms and by shaft generators coupled to the main engines.

Main data

Length overall	134 m
Length between p.p.	122 m
Beam, max	24 m
Draft	5.65 m
Gross tonnage	19 763
Deadweight	2568 mton
Max no. passengers	900
Main engine power	12 480 kW

At the time of the collision Stena Nautica was classed at Lloyds Register of Shipping and flew the Swedish flag. She was originally built for Danish domestic traffic, when she was called the Niels Klim. She has since been renamed the Isle of Innisfree and the Lion King. Since December 2001 she has sailed between Grenå and Varberg under the Swedish flag.

Equipment on the bridge included a Kelvin Hughes, Nucleus 7000 ARPA-radar 3 cm, a Raytheon ARPA radar 10 cm, a Sperry Autopilot with a Sperry gyro compass and electronic charts.

In addition there was equipment for AIS identification. This is a system by which vessels automatically transmit their identity and other data. This can be received and presented at the echo on a radar screen and/or electronic chart on receiving vessels and at shore-based stations.

Stena Nautica also had a voyage data recorder, VDR, which stores data from the vessel's engines and instruments. According to regulations in force data must be recorded continuously for 12 hours, whereafter they can be overwritten with new data.

Apart from the compulsory VDR the shipping company had installed a parallel-recording computer as reserve or backup. The computer, which recorded considerably more data than required by the rules, had recording capacity for 14 days. Among the data saved in the back-up computer were voice recordings from the bridge and the status of the watertight doors and fire doors as "open" or "closed".

After the collision and the subsequent evacuation of the vessel, towing to port and efforts to save her from sinking, those responsible for the bridge equipment forgot to turn off the VDR, which continued to record for more than twelve hours. Thus a portion of the data from the collision was over-

written and destroyed, but since the same data were available in the backup computer, the Board was able to access data from the whole course of events.

1.6.2 Joanna

The Joanna is a conventional dry-cargo vessel. She was built in 1983 at the Lemmer Verf in Holland with newbuilding number 383. Her single cargo hold is covered with a long cargo hatch. The engine and the bridge are placed aft. The main engine drives a fixed-pitch propeller.

The arrangement of the propulsion machinery requires that, to go astern, the engine must first be stopped and then restarted with the opposite direction of rotation. This can take about half a minute.

Main data

Length o.a.	78.5 m
Length, between p.p.	74.2 m
Beam	12 m
Draught	4.05 m
Gross tonnage	1525
Deadweight	2319 mton
Main engine power	920 kW

At the time of the collision the Joanna was classed with the Polish Register of Shipping and flew the flag of St Vincent & the Grenadines. She was earlier named the Elisabeth S. and the Union Robin.

The most important navigational instruments on the bridge during the voyage in question were a radar type RACAL-DECCA, a 'River radar' model RR1250 without ARPA but with Variable Range Marker (VRM) and Electronic Bearing Line (EBL). In addition there were an autopilot and gyrocompass of type Plath and GPS of type Furuno WAAS Navigator.

The vessel was also equipped with ARPA radar of type JRC JMA-6132 from 1997, but this had been non-functional for the previous 10 days.

Joanna did not have equipment for AIS identification, which was not required.

SHK has accessed the data stored in the GPS receiver from the time just before the collision until the time just after.

1.7 Meteorological information

The weather during the night and at the time of the event was calm, with light winds, no sea and intermittent fog. During the actual collision the fog was dense and visibility some hundred metres.

1.8 Medical information

Nothing has emerged to indicate that the physical or mental condition of the bridge command of either vessel was impaired.

1.9 Safety organisation

1.9.1 Safety organisation in Stena Line

The company has a safety manager who is assisted by senior officers from the seagoing vessels to revise manuals and perform internal audits regarding compliance with company regulations and in work to ensure safe conduct of the vessels according to the International Ship Management Code, ISM.

1.9.2 ISM manuals pertinent to the Stena Nautica, specially regarding watertight doors

The shipping company has produced manuals according to the ISM code requirements. The manuals have been scrutinised and approved by the Maritime Safety Inspection.

In the manuals the organisation and functions of the company are described, how responsibility is distributed and how reporting is to take place within the company, between vessels and company and with third parties such as authorities, customers and suppliers under various circumstances.

The Ship's Handbook describes functions of machinery and equipment onboard. Job descriptions for those on board are included and descriptions of actions to be taken in various situations such as grounding and collision: what is to be done, in what order and by whom.

1.10 International Maritime Organisation (IMO), classification societies and the Swedish Maritime Safety Inspection

1.10.1 Division of functions and responsibility

In international seafaring, three kinds of institutions create rules for how vessels are to be built, equipped, maintained and manned.

The various institutions have divided the responsibility among themselves and normally cooperate in an efficient manner.

The oldest institutions are the classification societies, commonly and collectively termed the Class. These are independent organisations that publish rules for vessels to be employed in international traffic. The rules cover primarily the design and construction of the hull with dimensions of components and the vessel's machinery and technical equipment. They also specify time schedules for inspections. The classification societies were

initially the insurer's guarantee that a vessel was built and equipped in a safe manner.

The second type of institution – the International Maritime Organisation (IMO) – is a cooperative body for the world's seafaring nations, where rules are made for how vessels are to be designed and equipped technically.These rules and regulations for Safety Of Life At Sea (SOLAS) cover technical systems affecting people's safety on board, except for parts covered by the class rules.

In recent years IMO has started to make rules for training and certification of crews for safe operation of ships (the STCW-convention).

and how shipping companies should organise their operations to guarantee safe operation of vessels according to the ISM code.

Sweden is participating in these conventions.

The third type of safety institution is the national maritime safety authorities. In Sweden this is the Swedish Maritime Administration, with the Maritime Safety Inspection as supervisory authority.

All vessels used in commercial traffic under the Swedish flag and in Swedish waters are inspected by the Maritime Safety Inspection. The inspections check that sizeable vessels are built following the rules of one of the recognised international classification societies, that they comply with SOLAS and that the company follows the ISM code. The Maritime Safety Inspection must also, through what is termed auditing, check the shipping company's safety organisation and the knowledge and skills of the crew.

Apart from the sets of regulations mentioned, ships in international traffic must comply with many other rules and requirements. These are not treated here since they are judged not to be relevant to the present accident.

1.10.2 The role of the classification society concerning Stena Nautica

As mentioned above the Swedish Maritime Administration with its Maritime Safety Inspection is the supervisory authority for Swedish vessels. The Administration has contractually delegated the inspection of vessels from different aspects to various classification societies.

The agreement that applied between the Maritime Safety Inspection and the class in the present event, in this case the Lloyds Register of Shipping, termed the Agreement Governing the Delegation of Statutory Survey Services for Ships Registered in Sweden, came into force on 22 July 2003.

Annex 1 describes what inspections, and their ensuing certificates, the class may carry out and issue and what are reserved for the Inspection. This states that for passenger vessels in international traffic and traffic between the mainland of Sweden and Gotland, only the Maritime Safety Inspection may issue safety certificates for passenger vessels. The class may conduct bottom inspections and issue international load line certificates.

For the mandatory inspections to be conducted to enable the vessel to receive and maintain its passenger vessel safety certificate, the Maritime Safety Inspection could thus delegate inspections of the external hull openings with their doors and ramps to the class. On-board openings such as watertight doors between the watertight compartments, should on the contrary, be inspected and approved by the Inspection itself.

1.11 Watertight division of Stena Nautica

In order to prevent that the hull of a ship is flooded if damaged it is subdivided into smaller watertight sections. A modern ro-ro passenger ship has a weather tight cargo deck, also called the bulkhead deck. Below this deck the hull is subdivided by watertight transverse bulkheads and when needed also

longitudinal bulkheads. To allow passage between the watertight compartments there are watertight doors in the bulkheads.

Stena Nautica has 14 watertight doors, of which seven are on the bottom deck, deck no 1, and seven on the next level, deck 2, *enclosure 2*.

1.11.1 Design and operation of the watertight doors

Each watertight door is opened and closed by power from a hydraulic cylinder. This is fed with oil from a system of pumps, valves and electrical relays. The system is individual for each door and components are placed together beside the door. Electrical power and signalling current come from the vessel's main electric switchboard and – in the event of damage to the normal electrical system – from the emergency switchboard.

In a normal situation each door can be opened and shut with push-buttons at the door. If there is an electrical failure the door can be opened or closed by a hydraulic hand pump, also placed by the door. A signboard shows how this is done.

In addition there are two stations on deck 3, the cargo deck, from which each door can be remotely closed with its own hydraulic hand pump.

At each door alarm bells and light signals ring or blink, respectively, before a door starts to move and during the whole movement.

A panel on the bridge shows the location of each door in the vessel and whether it is open or closed, Green lamp means closed and red means open. The panel includes a knob for each door with the positions Open and Closed. Another knob shows "All doors": this also has the same two positions.

Normally, all the operating knobs on the bridge panel are in the Open position. In this position each door can be operated locally at that door with the push-buttons or the hydraulic hand pump.

In danger the officers on the bridge can shut a door with its operating knobs on the panel by turning it from Open to Closed. This activates the alarm bell and the light signal and the local hydraulic system shuts the door after a number of seconds. When the door is fully closed the light signal on the bridge panel changes from red to green.

As long as the knob on the bridge remains in the Closed position the door cannot be opened with the local push-buttons. However, it can be opened with the local hand pump, but as soon as pumping stops, the door shuts again because of the signal from the bridge.

If an officer on the bridge decides to shut all the doors simultaneously the All doors knob is used, whereupon all open doors close.

From the bridge and from the two stations on deck 3, the doors can only be closed. Opening has to be done locally at the actual door.

1.11.2 Relevant SOLAS rules

SOLAS includes special rules for passenger vessels with special modifications for roro-passenger vessels such as Stena Nautica. The rules concern the division into watertight compartments, how decks and bulkheads may be designed and what openings there may be in the hull and between compartments. The rules are quite detailed. For watertight doors between the compartments the design, operating force and strength of the doors are prescribed, as are details of how they may be operated, monitored and controlled, and what warning signals must be issued before the doors start to move.

The doors must have sufficient force to close even if there are foreign *objects* in the doorway. They thus become dangerous for, e.g. passengers and crew members who may get caught in them.

The electrical system controlling the doors must be protected against the ingress of water and accompanying short-circuiting. The electrical components must either be placed outside of the space where water may conceivably enter in the case of an accident or be waterproofed to what is termed IPX standard. Doors that do not meet this standard may not be open at sea but must remain shut.

According to SOLAS the doors of Stena Nautica should have been kept closed at sea as they were not built to IPX standard.

The current SOLAS rules for watertight doors are given in Chapter II-I, Part B, Regulation 15.

1.11.3 Watertight doors in the Ship's Handbook

The Ship's Handbook describes the technical system: how to open and shut a watertight door locally, i.e. at the door itself; and that there are two stations on the cargo deck from which the doors can be remotely closed.

The bridge panel is also described with its signal lamps and knobs. However there are no explanations of what is signified by the lighting of warning lamps marked Low pressure, Overload or Power Failure when the doors are being shut with one of the panel knobs.

In the description of measures to be taken on the situations Collision or Running aground, the checklist starts with the instruction: "Close watertight doors".

There is no description of what action steps to take or how to identify whether a door has shut. Nor is it stated what to do if the signal lamp for a door being shut does not change from red to green. Further, there are no instructions on when to shut doors remotely from the deck 3 stations.

Moreover, the Board has been unable to trace any instructions to the crew regarding the importance of guarding the doors to avoid injury to persons when the doors are being shut for reasons other than acute danger.

The Ship's Handbook contains instructions that the functioning of the watertight doors is to be checked by the crew by moving them every day, i.e. opening and shutting them. In the Maintenance and Spare Part System, MASP, of the ship there are routines and time schedules for checking of the doors.

1.11.4 Emergency shutting of watertight doors

Regular checks and exercises with the hydraulic pumps at the deck 3 stations are carried out by the crew under officer supervision. It is a fairly slow and laborious job to shut a watertight door by hand pumping. Thus it takes considerable time to shut all 14 doors from the stations unless several people cooperate. In the Onboard Safety Plan, however, no crew position is appointed to shut the watertight doors from the deck-3 stations in an emergency.

1.11.5 The shipping company's policy regarding watertight doors

In the Ship's Handbook under the heading: Policy Watertight Doors it states:

"All watertight doors must be shut when the vessel is under way. Exceptions can be allowed for certain doors. A total risk assessment of the vessel's safety must form the basis for the decision.

The risk is to be assessed by the company together with the ship's management, to be presented for final approval by the Maritime Administration.

It shall be stated on the checklists of the ship and noted in the DIP Plan which doors are excepted.**"**

On the bridge panel two plastic strips were affixed with the texts:

”1 At sea, all watertight doors, except numbers 8, 9, 10, 11, 12, must be kept closed.”

” 2 At sea, in potentially hazardous conditions, all watertight doors must be kept closed.”

1.11.6 Compliance with company policy regarding watertight doors

The technical managers, i.e. chief engineers on board the Stena Nautica have, as far as the Board has been able to establish, to a considerable extent disregarded the company's instructions that the watertight doors should be kept closed at sea. To the Board they have presented the opinion that it would take too long to reach and combat a possible fire in an engine room if the doors were shut. With shut doors, ordinary routine work in the engine rooms would also be time-consuming and create a great deal of labour. There is also a risk of being jammed when passing watertight doors.

The masters have seemingly to a greater extent attempted to comply with company policy regarding closed watertight doors. They have stated that they are checking the positions of the doors before departure and, if too many are open they phone down to the engine control room on departure or during the voyage and request that the doors be shut. The deck officers, however, seem to have varied in diligence in this respect. The issue also created controversy between those responsible on the bridge and those in the engine room.

Many of the crew, however, before the accident, felt secure in the belief that the watertight doors could be closed quickly with the All doors knob on the bridge panel if anything should happen.

1.11.7 Protection against ingress of water into components of the watertight doors

When water entered the Stena Nautica after the collision many of the watertight doors stopped functioning because water penetrated their electrical systems, causing short-circuiting. The doors lacked protection against this.

1.12 The Maritime Safety Inspection

1.12.1 Inspections aiming at bringing Stena Nautica under Swedish flag

As stated above Stena Nautica was built for Danish domestic traffic. She was then named Niels Klim. In 1990 the vessel was purchased by a shipping company in the Stena-group. The company chartered the vessel a few times for traffic on European shipping routes. Later the same year the company tried to bring her under Swedish flag. For various reasons this did not take place. Instead the vessel came under Swedish flag in 1995. After about a year she was flagged out again, in 1996, and traded in various European routes. In 2001 however she returned to the Swedish flag and has since been employed on the Varberg-Grenå route.

On three occasions between1990 and 2004 the Maritime Safety Inspection carried out extensive checks to ascertain whether the vessel met the requirements to receive a safety certificate for passenger ships. However the Board has not been able to find information from these surveys whether the watertight doors met the requirements.

In the vessel's Survey Register following the 1995 and 2001 surveys, when the vessel came under the Swedish flag, there are no remarks concerning deficiencies in the watertight doors.

1.12.2 Checks of watertight doors, etc

The Board has found no documentation to show that the Swedish Maritime Safety Inspection has ever checked the design of the watertight doors. In the minutes of an annual inspection the inspector noted that the watertight doors should be kept shut, but without specifying any rule or provision as a reason.

Later on the inspector responsible at the time noted several times during visits on board that the watertight doors were open when the vessel was under way. When he pointed this out, the doors were closed each time. The inspector did not, however, report the matter to his superiors.

1.12.3 Special permission to keep watertight doors open at sea

For passenger vessels built before 1 February 1992 and not meeting SOLAS rules 15. 6. 1- 4 and 15. 7, then rule 15. 6. 5 applies. This provides that watertight doors must be kept permanently shut at sea. They may thus not even be opened temporarily to permit passage.

The Accident Investigation Board has been unable to find any remark from the Swedish Maritime Inspection that the electrical system for the watertight doors did not meet SOLAS requirements as to water resistance, i.e. the IPX standard according to SOLAS rule 15. 7. 6.

Nor has the Board found any remark from the Inspection to the shipping company regarding the need to convert the electrical system if it was desired to be able to open, or keep open, the doors at sea.

According to rule 15.9. 3 the safety authority may, after careful consideration, permit certain watertight doors to be kept open permanently. This possibility, however, applies only to doors that meet all the requirements of rule 15 i.e. including 15. 7. 6 on water resistance.

In a letter to the Maritime Safety Inspection dated 20 November 2002, the shipping company requested special permission to have doors nos. 8-12 open at sea, among other reasons to facilitate the free passage for evacuation of passengers in the event of fire.

According to information from the Maritime Safety Inspection their internal working regulations state that only the Director of Maritime Safety and his deputy may grant exemptions. Such exemptions shall be given in writing.

The Board was informed that neither the Director nor his deputy has however issued a decision of exemption. In spite of this the shipping company was informed by the inspector that the requested exemption had been granted. The decision was however not conveyed in writing, but verbally during a visit on board.

1.12.4 Verification of the ISM system

The Maritime Safety Inspection makes an introductory audit of a vessel's ISM system when it is brought under the Swedish flag, and also an annual check. The introductory check is to ascertain how the company has implemented its routines described in the ISM manuals for safe conduct of the vessel, including both its land organisation and on board.

The annual check should lead to renewal of the vessel's ISM certificate and includes a demonstration by the crew of their skill in handling an event such as a fire, evacuation or launching of a lifeboat.

As far as the Board has been able to establish the Inspection during its scrutiny of the company's ISM manuals has not commented on, nor required modifications to, the text regarding operation of the watertight doors or measures to be taken in the event of collision or grounding.

The Board has also investigated what checks the Inspection has made of the company's ISM system as regards safety routines for handling of risks and accidents involving the Stena Nautica's watertight subdivision.

In the reports from audits conducted in the years 1997, 1998 and 2002 the practical demonstrations (operative controls) consisted of fire in combination with evacuation and in one case the launching of a lifeboat. From 2003 there is a draft report which does not state the type of operative control.

As far as the Accident Investigation Board can find, during the past five years no operative control has been conducted which included operation of watertight doors in the presence of the Maritime Safety Inspection.

Between the Maritime Safety Inspection's annual audits, the ship carried out internal audits and exercises following a weekly timetable.

1.13 Tests and investigations concerning Stena Nautica

1.13.1 Status after pumping dry

When the hull had been rendered watertight, pumping dry was started. As each area was emptied, the position of the watertight doors, other openings, etc, and objects such as floor plates were documented at the Board's request.

In the attempt to pump the engine rooms dry it was found that they communicated with one another.

A diver using "umbilical" life-support equipment was sent down to dive through the engine rooms. He found the watertight doors nos5 and 6 open. In no 6 doorway he found a loose floor plate. He could not reach door no 4 since his umbilical did not reach far enough; nor could he see the door in the muddy water. Once the diver had shut doors nos 5 and 6, the engine rooms could be pumped dry.

After emptying, it was discovered that door no 4 was open. Thus doors nos 4, 5 and 6 on the lowest level had remained open when the water streamed into the workshop through the hole in the hull plating. Due to this reason, four of the engine rooms were completely flooded.

The floor plates in the engine rooms had been loose and were washed away by the gushing water. One of the plates had come to rest in no 6 doorway. It is however unclear whether the door, which stopped near the edge of the plate, had really been stopped by the plate; it may have been stopped by a short-circuit before it reached the plate.

The watertight door no 3 in the bulkhead at frame 120, which was open at the time of the collision, was shut. There had evidently been time for it to be shut by the All doors knob before the gushing water caused a short-circuit.

1.13.2 VDR readings concerning the positions of the watertight doors before the collision

The Accident Investigation Board has read out the positions of the watertight doors for the whole of the 14-day period before the collision. The reading showed that between six and ten doors had remained open more or less permanently while Stena Nautica was at sea. When the ferry was in port, up to 13 of the doors had been open, *enclosure 3*.

On Sunday morning 15 February at 11.00 hrs, when the ferry was at the quay in Grenå, all the watertight doors except nos 13 and 14 were open. At 03.00 hrs on the Monday morning, i.e. at sea and one and a half hours before the collision, doors nos 3-6 and 8-13 were open, i.e. ten doors. Just

before the collision, at 04.25 hrs, door no 13 had been shut. Thus at the time of the collision nine doors were open.

The VDR recording also showed that all the watertight doors were closed after the collision. However this gives a false picture of the situation. On the bridge panel, both green and red indicator lamps were alight because of the short-circuits down at the doors. The signal to the VDR that a door was shut was connected to the green lamp.

1.13.3 The watertight doors, function and force

While at the yard in Poland, the Board had Stena Nautica's doors tested. Both the functions of and the pressures in the individual hydraulic systems were tested. In the doors that had been entirely or partly under water, salt water had leaked into the systems. All electrical material belonging to the doors was severely corroded while the hydraulic systems were operational.

The result of the tests showed that before the collision the doors should have been fully functional as long as there was electric supply. Two of the doors had insufficient gas pressure in their accumulators. This had no significance as long as there was power to the electrical pumps. Without a power supply the gas pressure in these two doors was however insufficient for the three door movements required for emergency operation, i.e. open – shut – open.

1.13.4 Tightness of the watertight bulkheads

To check the degree of water resistance of the fixed watertight subdivision consisting of bulkheads, floors and tanks in the double bottom, the Board had the water tightness investigated in the whole of Stena Nautica that was affected by the accident. Only a few fairly small holes where electrical cables had been removed were discovered.

The stuffing boxes where the propeller shafts went through the bulkheads leaked moderately. However, this probably had little effect on the speed with which the engine rooms were flooded, or on the later pumping dry of the ship.

1.13.5 Stability of Stena Nautica in damaged condition

The Maritime Safety Inspection and the shipping company independently investigated the vessel's stability with the engine rooms flooded. The reports show the vessel's position and stability at different stages of the sinking process. The results are largely in agreement.

While the four central engine rooms were flooding and the water had not yet penetrated to the cargo deck, no. 3, the vessel remained stable, but with an increasing list. When she had sunk so deep that the water flooded over to the passenger accommodations forward and aft of the engine rooms, stability was lost and she would have capsized if she had not been stabilised by tugboats pushing her against the quay and a pontoon crane with a sling around her stern.

1.14. Tests and investigations concerning Joanna

The Board has arranged tests of the radar which was in use on Joanna. The result of the test performed by the company C A Clase of Gothenburg shows that the radar in all essential aspects would have been functional.

1.15 Regulations for the Prevention of Collision at Sea

The rules consist of three sections:
Section I covers vessels´ conduct in any condition of visibility.
Section II covers conduct of vessels in sight of one another.
Section III covers conduct of vessels in restricted visibility

Rule 6
Every vessel shall at all times proceed at a safe speed so that she can take proper and effective action to avoid collision and be stopped within a distance appropriate to the prevailing circumstances and conditions.

In determining a safe speed the following factors shall be among those taken into account:

(a) By all vessels:
i. The state of visibility;
ii. The traffic density including concentrations of fishing vessels or any other vessels;
iii. The manageability of the vessel with special reference to stopping distance and turning ability in the prevailing conditions;
iv. At night, the presence of background light such as from shore lights or from back scatter from her own lights;
v. The state of wind, sea and current, and the proximity of navigational hazards;
vi. The draft in relation to the available depth of water.

(b)Additionally, by vessels with operational radar:
i. The characteristics, efficiency and limitations of the radar equipment;
ii. Any constraints imposed by the radar range scale in use;
iii. The effect on radar detection of the sea state, weather and other sources of interference;
iv. The possibility that small vessels, ice and other floating objects may not be detected by radar at an adequate range;
v. The number, location and movement of vessels detected by radar;
vi. The more exact assessment of the visibility that may be possible when radar is used to determine the range of vessels or other objects in the vicinity

Safe speed shall be kept in all states of visibility. In this respect the requirement for look-out is, as in rule 5, more stringent for vessels with radar than for vessels without radar.

Safe speed in fog may often for small and medium vessels be considered to correspond to the earlier term moderate speed, i.e. that the vessel shall be able to stop within half the distance of the range of vision. “

Rule 7

(a) Every vessel shall use all available means appropriate to the prevailing circumstances and conditions to determine if risk of collision exists. If there is any doubt such risk shall be deemed to exist.

(b) Proper use shall be made of radar equipment if fitted and operational, including long-range scanning to obtain early warning of risk of collision and radar plotting or equivalent systematic observation of detected objects.

(c) Assumptions shall not be made on the basis of scanty information, especially scanty radar information.

(d) In determining if risk of collision exists the following considerations shall be among those taken into account:

Rule 8

(a) Any action taken to avoid collision shall be taken in accordance with the Rules of this Part and shall, if the circumstances of the case admit, be positive, made in ample time and with due regard to the observance of good seamanship.

(b) Any alteration of course and/or speed to avoid collision shall, if the circumstances of the case admit, be large enough to be readily apparent to another vessel observing visually or by radar; a succession of small alterations of course and/or speed should be avoided.

(c) If there is sufficient sea room, alteration of course alone may be the most effective action to avoid a close-quarters situation provided that it is made in good time, is substantial and does not result in another close-quarters situation.

(d) Action taken to avoid collision with another vessel shall be such as to result in passing at a safe distance. The effectiveness of the action shall be carefully checked until the other vessel is finally past and clear.

(e) If necessary to avoid collision or allow more time to asses the situation, a vessel may slacken her speed or take all way off by stopping or reversing her means of propulsion.

Section III, Rule 19

(a) This Rule applies to vessels not in sight of one another when navigating in or near an area of restricted visibility.

(b) Every vessel shall proceed at a safe speed adapted to the prevailing circumstances and conditions of restricted visibility. A power-driven vessel shall have her engines ready for immediate manoeuvre.

(c) Every vessel shall have due regard to the prevailing circumstances and conditions of restricted visibility when complying with the Rules

(d) A vessel which detects by radar alone the presence of another vessel shall determine if a close-quarters situation is developing or risk of collision exists. If so, she shall take avoiding action in ample time, provided that when such action consists of an alteration in course, so far as possible the following shall be avoided:

(i) An alteration of course to port for a vessel forward of the beam, other than for a vessel being overtaken;

(ii) An alteration of course toward a vessel abeam or abaft the beam.

In a comment to Rule 8 it is pointed out that the term “close quarters situation” is not defined but has to be judged case by case while observing good seamanship. Consideration should then be given to size of the ship, speed, manoeuvrability, the surrounding waters, traffic density, etc, etc.

However it has been considered that in restricted visibility a close quarters situation has occurred when for the first time the fog signals of the other ship are heard or – if no signals are heard – when by the use of radar the distance to the other ship is measured to be 3-5 nautical miles.

1.16 Rescue operation

Particulars of the rescue operation were collected mainly from interviews with the SAR Mission Co-ordinator (SMC) at the Maritime Rescue Co-ordination Centre (MRCC) in Gothenburg, the municipal rescue control centre in Varberg and the crews of the Freja and the Odd Fellow.

1.16.1 Rescue of persons – from the MRCC logbook

04.40 hrs, 16 February 2004, passenger ferry Stena Nautica calls ”Göteborg radio”. Two calls made with a short interval. The SMC answers the call. Call signal ”Göteborg radio” was abolished some years ago and replaced with call signal ”Sweden rescue”.

Stena Nautica reports that they had collided with a smaller cargo vessel which had rammed her starboard quarter, that she is taking water into the engine rooms and that she needs immediate assistance. Her position given as N56º 57, 5´ E12º 07, 4´. The other ship is not visible from Stena Nautica. The weather is at the moment calm with dense fog. During the call the SMC hears various alarm bells ringing in Stena Nautica and parts of the message must therefore be repeated.

Tugboat Freja reports shortly thereafter that she is 1.5 M from the point of collision and making for Stena Nautica.

The SMC makes the appraisal: ”Danger to human life in large numbers. Stena Nautica reports that they are taking in water. They are implementing damage control. Unknown what’s happened to the other vessel. She probably needs assistance too.”

04.42 hrs. MRCC is called by passenger ferry Stena Germanica and a fairly small cargo vessel informing that they have one hour’s respectively 30 minutes’ sailing time, to the scene of the accident. Both vessels cleared to make for Stena Nautica.

04.43 hrs. MRCC broadcasts Mayday relay to vessels in the vicinity. The SMC has classified the event as ”Emergency” and documents his overall decision, BIS: Alert available surface units and helicopters and extra personnel to MRCC. Get more facts about the two vessels. Support the master in his decision on evacuation. Prepare for evacuation and bringing ashore of a large number of people.

A large number of vessels answer the Mayday relay call. The tugboat Freja is then 10 minutes from the accident position, all the others need 1 – 1.5 hours to arrive. The SMC calls Stena Nautica, obtains more information and requests them to contact Freja directly to plan the evacuation.

04.47 hrs. Stena Nautica reports that they are taking in water into the engine room and that only the emergency generator is operating. The watertight doors are being closed and they are preparing lifeboats and life rafts. On board there are 94 passengers and 34 crew members.

04.48 hrs. A rescue helicopter from Säve is alerted and a minute or so later a helicopter from Ronneby. Later it turns out that they could not take off owing to dense fog.

04.50 hrs. Swedish Sea Rescue Society (SSRS) unit Odd Fellow is called out to the accident. Five minutes later she departs from her home port in Bua off Ringhals with approximately one hour's sailing time to the accident position.

04.50 hrs. MRCC in Aarhus is informed. The SMC also requests for reinforcement by a rescue boat from Anholt and for Danish helicopters to go on "stand by".

04.57 hrs. Stena Nautica reports that the master has decided to evacuate the vessel and that there are no injuries on board.

05.00 hrs. SSRS unit Signe Wallenius is called out from Falkenberg. Approximately one hour later her arrival at the accident position is reported.

Callout of personnel to staff the MRCC is commenced.

05.05 hrs, (25 minutes after Stena Nautica's call) MRCC is called from the vessel Joanna, informing that it was Joanna that collided with Stena Nautica. She reports that she has damage only above the waterline and is proceeding to Falkenberg.

05.13 hrs. MRCC has contacted the Vessel Traffic Service (VTS) traffic centre in Marstrand and asks them to inform those concerned at the Swedish Maritime Administration.

05.15 hrs. the SMC checks with various units regarding their distance to the accident position. Stena Germanica is estimated to arrive in 40 minutes, the fishing boat Nolan and another fishing boat have approximately 30 minutes to the position. Odd Fellow is 40 minutes away.

05.17 hrs. The Maritime Safety Inspection, the shipping company and Röda Bolaget are contacted. A representative of Stena Line will join the MRCC staff and it is reported that the company's emergency group has been assembled. Later on a maritime inspector will also be joining the MRCC.

05.20 hrs. Stena Nautica reports that almost all passengers have been evacuated to Freja and that the crew will also be evacuated shortly. The SMC switches over the telephone number for the media to an adjacent room. A person from the Coast Guard service and one of the VTS operators are manning this function.

05.43 hrs. Halland and Västra Götaland police are informed of the accident

05.45 hrs. The vessel Finnreel reports that she has arrived at the accident position.

05.50 hrs. The SMC has contact with the master of Stena Germanica. They decide that those evacuated to Freja shall be transferred to Stena Germanica. The SMC also informs the master which vessels there are in position and nominates the master to become On Scene Co-ordinator (OSC).

According to Stena Germanica's master there is dense fog in the area and it is difficult to approach Stena Nautica with such a large vessel.

06.00 hrs. MRCC contacts Röda Bolaget. The latter has already received a request for more salvage boats to bring all salvage equipment possible. A vessel will leave in an hour at the earliest.

06.09 hrs. Stena Germanica reports that they have started taking passengers from Freja on board. Odd Fellow and Signe Wallenius are assigned to supervise this operation.

06.17 hrs. Stena Nautica reports that they wish to evacuate further crew members and that Odd Fellow can take these.

06.21 hrs. Stena Germanica reports having received 115 persons. Stena Nautica cannot confirm the number. Several searches of the vessel have been made. A total of 13 crew members remain on board Stena Nautica. Five of these are subsequently transferred to Odd Fellow. The eight remain-

ing on board Stena Nautica are to make fast a towline from Freja, whereafter another five of these are to be evacuated.

06.44 hrs. The SMC has received information that all those remaining on board Stena Nautica have been transferred to Odd Fellow. Stena Nautica's master reports that the vessel has been thoroughly searched and that nobody is still on board. Stena Germanica makes for the Germany Terminal in Gothenburg.

Contact is established between Stena Germanica's master and the duty police superintendent in Gothenburg who is preparing to receive passengers and crewmembers. Estimated time of arrival Gothenburg is 10.30 hrs. Stena Line has passenger lists and a telephone number which relatives may call for information.

The vessel Finnreel, and other units en route for the accident position, are informed of the situation and that only those which are to participate in the towing and salvaging need to remain. The Coast Guard environmental protection vessel continues to the accident position in order to protect the environment.

07.00 hrs. The SMC judges that there are no indications that anyone is still on board Stena Nautica. The case will still remain open until all persons from the vessel are safely ashore since the responsibility of MRCC covers the safety of persons.

With this, the critical part of the rescue of people from the damaged vessel was complete, and the Stena Nautica under tow to port. Just before arrival some members of the crew and the Maritime Safety Inspection's inspector volunteered to return on board to receive a towing-line from a tugboat. This was needed for stopping the Stena Nautica when she entered port.

08.35 hrs. SOS Alarm was contacted to alert the standby unit for reception of the evacuees from Stena Germanica. The police was contacted and met on the quay. The police detailed a liaison officer to the MRCC.

11.40 hrs. The Gothenburg police had registered the evacuees from the Stena Germanica.

1.16.2 Handing-over of the rescue operation to the municipal rescue service

While the tow was in progress the SMC contacted the on-duty commander at the Varberg municipal rescue service with information. The commander was present when the vessel berthed at the quay.

At 12.37 hrs, when the vessel had been searched yet again, the SMC noted in his logbook that he had transferred responsibility for the rescue service to the Varberg rescue service for possible rescue of property.

He also noted that the Maritime Safety Inspection was thereafter responsible for the vessel, and entered the name of the inspector in his logbook. He also noted that the SAR, Search and Rescue operation was concluded.

1.16.3 Responsibility for subsequent rescue service

When the sea rescue operation was completed and responsibility had been transferred to the municipal rescue service, there still remained in practice several unclear points in connection with the need to solve problems that fell within the spheres of responsibility of different actors.

It was necessary to prevent the vessel from capsizing and sinking at the quay, to seal and pump her dry, salvage her cargo and take care of hazardous goods. The latter consisted of spray cans and battery acid in vehicles on the upper cargo deck. In addition there were seven racehorses on board.

Since the vessel's electrical production was out of action, winches, ramps and mooring windlasses could not be operated and thus it became necessary to connect electric power from ashore.

To carry out this work people needed to go on board and were then exposed to danger as long as there remained a risk of capsizing. The shipping company engaged its own experts to calculate the vessel's stability. The company kept the Maritime Safety Inspection informed and the latter also carried out its own checks. After the floating crane had arrived and during Thursday 19th February secured the vessel's stern, the risk of capsizing was materially reduced.

A further problem was environmental protection, i.e. it was necessary to protect the area surrounding the vessel from oil and other matter in the water that had to be pumped out.

The parties involved who needed to send people on board were the shipping company, the insurance company, the salvage company, the owners of the horses, certain other cargo owners, repair workshops and the port authority.

Authorities affected were the Maritime Safety Inspection, the municipal rescue service, the administrative board of the county, the health care authorities of the county, the Coast Guard service and the police.

By Wednesday 25 February the vessel was sealed, pumped dry and judged to be stable. She was then towed over to the regular ferry terminal.

The municipal rescue service operation was concluded at 13.30 hrs on the same day.

1.16.4 Rescue of Stena Nautica

At about 10.30 hrs on Monday 16th February the Stena Nautica under tow reached Farehamnen in Varberg. Stena Nautica was immediately secured by two tugboats, Freja and soon afterwards Per, pushing her against the quay. They continued to do so until the leaks had been sealed and the hull was pumped dry at 13.30 hrs on Wednesday February 25th, i.e. just over nine days after the sealing work had been started.

Meanwhile the shipping company had called out a floating crane from Grenå, which ran lifting wires under the vessel's stern, thus further securing her against capsizing and, in addition, helping prevent the stern from sinking too deep.

The work of sealing and draining the hull was carried out under the management of the shipping company and the insurance company. The Accident Investigation Board and the Maritime Safety Inspection followed developments and had the condition in the flooded spaces documented as they became drained out.

1.16.5 Salvage of cargo

The cargo on the upper cargo deck, including the horses and the hazardous goods, were hoisted ashore by crane in Farehamnen. The cargo on the lower car deck was unloaded via the ship's ramps when the vessel had been towed over to the regular terminal. No substantial cargo damage has been reported to the Board.

1.16.6 Environmental rescue operation

The Coast Guard service and the municipal rescue service laid out booms around the vessel. On the outside the booms were placed between the vessel and the tugboats.

For collecting less viscous oil inside the booms, absorption booms were used. Such were also laid out along the quays that might be exposed to oil. The Coast Guard positioned a collection barge in the port and modified it to serve as an oil separator.

From the vessel's tanks about 20 m^3 of oil were pumped with suction tank trucks. All the water pumped out ran down via hoses inside the booms.

About 50 m³ of oil and oily water was colleted from inside the booms using the Coast Guard skimmer, and a further 50-60 m³ was dealt with during the final draining of the engine rooms. After separation, the municipal rescue service judged that 120 m³ of water-mixed oil had been dealt with and sent for destruction.

The SMC judged that only a small amount of oil escaped to outside of the booms. A private decontamination company was engaged by the SMC to search the beaches and deal with residual oil. The rescue service noted after a final inspection that no significant damage by oil contamination had been caused to the area.

2 ANALYSIS

2.1 The Board's points of departure for the analysis

The investigation by The Swedish Accident Investigation Board concentrates on the two main central questions in the case – the collision and its causes, etc; and the flooding of the Stena Nautica, which threatened to result in her capsizing and sinking.

The fact that the limited hull damage to the Stena Nautica led to extensive flooding of the hull even though she was divided into watertight compartments in accordance with the rules in force prompted the Board to investigate carefully both the technical causes and the safety systems of the shipping company. There is no need for a similar examination of the Joanna and her owners.

2.2 The collision

The Joanna's officers misjudged the position, course and speed of the Stena Nautica and turned far too late. The Joanna's GPS, the Stena Nautica's VDR and the radar plot of Sjöcentral Väst show unanimously that the Joanna's traces were completely straight until she was almost upon the Stena Nautica's course line at a distance of 0.5 -- 0.6 M.

The traces further show that the Joanna had just crossed the Stena Nautica's course line when she commenced the violent starboard turn that finally led to the collision.

If instead of turning Joanna had kept her course and speed the accident would probably not have happened.

The Stena Nautica had received Joanna's echo as far away as 12 M, and the second officer then noted that a close-quarters situation would probably arise. However he did not consider this to be a problem as he was used to close-quarters situations and moreover had not received special instructions regarding minimum distances.

When the ARPA radar gave a collision warning, it was understood that the Joanna would probably cross the Stena Nautica's course line at a distance of about 0.6 M, but the second officer took no action. He considered that it was primarily up to the Joanna to give way or to take other action to prevent a collision.

In the Board's view the meeting distance in question was, under the conditions then prevailing, far too short. By neglecting to avoid a close-quarters situation, the second officer on Stena Nautica faced a situation from which he could not escape by his own action when the Joanna made a manoeuvre which he had not expected.

The Stena Nautica gave no fog signals until about one minute before the collision. The distance to the Joanna was then about 0.3 M. The Joanna had commenced her turn about one minute before fog signalling was initiated.

2.2.1 The influence of the tugboat Freja on the collision

The tugboat Freja was sailing southwards in the same waters as the Stena Nautica and the Joanna. On board the Stena Nautica, the Freja's movements were being followed on the ARPA.

The Freja crossed the Stena Nautica's course line at a distance of 2.7 M. This was before the Joanna had crossed the course line and after the Freja had turned 20 degrees starboard to go astern of the Joanna. The turn may be observed on the Stena Nautica's VDR.

The Board judges that the presence of Freja probably did not distract the personnel on the bridge of the Stena Nautica and thus had no influence on the accident.

The officers of Joanna have not mentioned that they had any concern regarding any other radar echo than that of the Stena Nautica.

2.3 Watertight doors on board the Stena Nautica

The watertight subdivision with bulkheads and decks is intended to prevent damage to the hull from allowing water to enter and flood more than a fairly small part of the vessel.

When the collision was a fact and the Joanna's stem had made a hole in the Stena Nautica's side above and below cargo deck No 3, the watertight division should have prevented the vessel from sinking.

At the moment of collision however, nine of the watertight doors -- of which four at the lowest deck level, in the engine area -- were open.

Shortly after the collision somebody on the bridge, the able seaman, suggested that the watertight doors should be closed. However nobody activated the All-doors knob until, after about three minutes, someone on the bridge did turn the knob to Close and the doors started to close. However, the closing process was interrupted when the water reached the electrical systems of the doors, causing short-circuits.

When the vessel had subsequently been pumped dry it was revealed that the doors on deck No 2 had closed, as had door No 3, which was the most forward open door on deck No 1 and the one that was situated furthest from the damage.

The inflow of water also carried away the floor plates in the engine room and a quantity of other loose material, and washed these along the passages in the engine rooms. Some of the objects ended up in the door openings and may have prevented the doors from shutting.

Thus the watertight division did not function because the doors in the bulkheads that should have prevented the spread of water were not shut, and were not closed in time by the crew following the collision. They also proved impossible to close once they had been exposed to water.

2.3.1 Why were the watertight doors open?

The reason why the watertight doors were open at the time of the accident was that they were always open as a matter of routine.

The engineer officers considered that it would take too long to reach and fight a possible fire in any of the rooms if the doors were shut. It was also difficult to attend to the machinery with shut doors since one was compelled to open and shut them all the time when moving between engine rooms. Each time, it took at least one minute per door.

Moreover, the officers felt secure knowing that the doors could always be shut with the central closing arrangement on the bridge should anything happen.

2.3.2 Why did nobody immediately decide to shut the watertight doors with the All-doors knob?

The reason why nobody at once decided to shut the watertight doors with the All-Doors knob was that there had been insufficient practice.

During the five most recent annual demonstrations to the Maritime Safety Inspection, fire-fighting and evacuation had been demonstrated -- never collision or running-aground. Nor had there been a test of shutting all the doors with the All-Doors knob. This would have involved placing guards at all the doors to ensure that nobody got hurt.

Shutting the watertight doors with the central knob on the bridge requires a whole sequence of decisions, checks and measures that must be practised extensively so that the action can be made a routine.

In any case, the following decisions and actions should, according to the Board, be included in the sequence:

-Decide to close -who may/must take the decision?
-Decide how many and which doors are to be shut.
-Issue a warning over the PA system to passengers and crew.
-Decide whether, and in that case where, door guards are to be posted.
-Press the knob and check that the signal lamps change as expected.
-Determine that the manoeuvre has evidently succeeded.
-Send hands to the safety stations on deck No 3 to check the shutting.
-Announce over the PA system that nobody may open a watertight door until a member of the crew has arrived.
-Notify passengers that they should make their way up through the vessel via the companionways.
-Send hands to all doors to check whether anyone there requires assistance.

In the Ship's Handbook, sections on Action in the Event of Running Aground and Action in the Event of Collision, this whole sequence is presented only with the words "Close watertight doors".

The Maritime Safety Inspection, whose job it is to inspect and approve the handbook, has had no views on the text or the checklists for Collision and Running Aground.

The loud crash at the moment of collision was heard throughout the whole vessel. On the bridge it is reasonable to expect that the risk of the vessel having sustained a hole in the hull should have been understood. However, the personnel on the bridge were not concentrating on the situation of their own vessel. Not until the master arrived on the bridge was the order issued to shut the doors. However, this was done without an announcement warning to passengers and crew.

When attempts were made to shut the watertight doors by activating the All-doors knob, it was discovered that the signal lamps lighted both red and green. However, it was not realised that this meant that it was uncertain whether the doors had actually been shut.

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2.3.3 Why did the doors not shut when the All-doors knob was pressed?

The electrical systems for manoeuvring the watertight doors, with cables, solenoids and switches, were mounted beside the doors. Certain electrical components were mounted on the bulkhead near the deck while other parts

were in metal boxes somewhat higher up the bulkhead. The components were not encapsulated or sealed to prevent water from entering. When the water gushed in, it immediately caused short-circuiting when it reached the solenoids down near the deck. Water subsequently penetrated to the other components.

The reason why the watertight doors did not shut when the All-doors knob was activated was thus quite simply that they were not water-resistant. At the inspection after the vessel was pumped dry it was noted that the doors had not moved at all or had moved only short distances from their open positions.

Since several minutes passed before the All-doors knob was pressed, the water had had time to short-circuit three open doors on deck level No 1. Only door No 3 closed in time before even its electrical system failed due to short-circuiting. As opposed to this, all the doors on deck level No 2 closed in time.

According to their statements neither the masters nor the technical engineers knew that the doors could not stand water but would be affected rapidly by short-circuiting if being exposed to water.

At the Board's inspection of the watertight doors it was noted that certain modifications and interventions had been carried out to the doors, hydraulic lines and switchboxes. This indicates that the crew had worked on the equipment and thus should have had knowledge of its status and properties.

2.3.4 Why were the doors not shut from the stations on deck 3?

Neither the officers, the crew nor the shipping company's safety department appear to have considered the safety stations on deck No 3 as part of the safety equipment on board.

No crew members were appointed for manually pumping the doors shut in the event of a collision or running-aground.

Personnel had grown used to practical electrical push-buttons and hand pumps at the doors, and knobs on the bridge panel, and they overlooked the pump stations.

If fairly soon after the collision the crew had started pumping the doors shut from the stations on deck 3, they might have managed to shut one of the doors on deck 1, limiting the flooding of the vessel.

2.3.5 If the watertight doors had been shut

The Board's checks after the accident showed that the watertight bulkheads and the watertight doors were essentially watertight. If the doors had been shut when the collision occurred, therefore, only one engine room (the workshop) would have been partly flooded. The Stena Nautica would have sunk somewhat, but cargo deck No 3 would not have come down to sea level. The vessel would not have lost electric power, machinery and pumps would have continued to function and she would have been able to continue under her own power to the port in Varberg.

2.4 Evacuation

2.4.1 Transfer of passengers and crew to Freja and Stena Germanica

Close to the scene of the accident were, among other vessels, the tugboat Freja and the passenger ferry Stena Germanica. They were both able to come to the rescue quickly and take passengers and crew members on board.

The common opinion among passengers and crew on board the Stena Nautica, and the Freja's crew is that the evacuation was conducted according to practised routines in a calm and professional manner. The passengers felt well-looked-after. All were provided with lifejackets.

2.4.2 The starboard MES

When the starboard MES was inflated, the slide twisted so that the platform came upside- down. Even though the weather was completely calm and conditions were such that there should have been no problems releasing the equipment, it became unfit for use. Despite considerable effort during the investigation it has been impossible to determine why the slide twisted. In its investigation, the Board consulted, among other instances, the British Accident Investigation Board. No malfunctioning MES has been reported to them since 1991.

As far as the Board has been able to determine, it is very unusual for a MES not to function when inflated.

2.5 Stability and buoyancy

Calculations of the vessel's stability during flooding of the hull are presented in section 1.13.5. They show that during parts of the process the vessel's stability was poor. As the hull sank deeper and water filled the engine rooms, stability improved. At the quay in Varberg the vessel was secured in upright position with the help of tugboats. This step was warranted but could possibly have involved a risk for the crews of the tugboats. Stability calculations indicate that the vessel was nevertheless stable even without help from the tugboats.

When the vessel settled so deep that the water flowed over to the aft and forward passenger accommodation and up onto the cargo deck, the situation, according to the calculations, became unstable; but by then the vessel had been stabilised by the floating crane.

An initial poor stability situation may have been present during the tow to Varberg. It is impossible, however, afterwards to establish exactly what the position was since no observations of the water level on board could be made.

The weather at the time of the accident was calm, without wind or swell. This meant that the water did not enter and form free water surfaces on the cargo deck, where even a small amount of water could have resulted in the vessel capsizing and sinking.

A process of this nature could have been rapid, with a risk that there would not have been sufficient time to evacuate passengers and crew.

2.6 The rescue operation

The rescue operation was performed well. However there was some lack of clarity during the operation and the salvaging regarding the areas of responsibility of the various authorities involved.

Discussions started without successfully determining and documenting who was to coordinate the operation and be responsible for personnel safety, etc. during the work. As far as the Board has been able to establish, the various instances involved acted to a considerable extent on their own initiative and responsibility, without overall coordination.

The Board's opinion is that it is necessary for all involved to be completely clear as to whom bears responsibility for the various measures and

decisions required in a rescue and salvage operation of the type in question with a number of authorities and other actors involved.

In its report RO 2005:01, of a diving accident in the Baltic off Vindö in Värmdö municipality, the Board has treated matters regarding coordination of efforts by the various actors in a rescue operation. The board recommended to the Swedish Maritime Administration that it should -- in cooperation with the Swedish Rescue Services Agency -- lay down how coordination of national rescue services should be designed in order to ensure clear collaboration and division of functions when municipal rescue services are also involved (recommendation 2).

In its preliminary report "National Measures For Rescue At Sea" dated 9 June 2004 , the State Audit Institution (Riksrevisionen) considered issues regarding improvements to rescue services at sea and coordination in sea rescue operations.

The Swedish Maritime Administration and the Coastguard Services have, as commissioned by the government, investigated how Sweden can ensure that a sheltered site can be made available to a ship in distress. The "Report Regarding the Need for Changes in the Reception of Vessels in Distress", dated 24 February 2005, Swedish Maritime Administration diary number 0701-04-16596, also deals, among others, with issues regarding the distribution of responsibility in sea rescue operations.

3 CONCLUSIONS

3.1 Findings

a) The navigation bridges of the two vessels were properly manned and equipped according to the regulations in force.
b) Stena Nautica was not seaworthy when she departed from Grenå.
c) The evacuation was conducted according to plan and in a safe manner.
c) The rescue operation was carried out efficiently and safely.
e) Nobody suffered injury.
f) There was no significant environmental damage.
g) The material damage to the Stena Nautica was extensive.
h) The material damage to the Joanna was limited.
i) Even though the Maritime Safety Inspection had on a number of occasions discovered that the Stena Nautica sailed with the watertight doors open, no other action has been taken apart from complaints.
j) The Maritime Safety Inspection has made no remarks on the ISM manuals of the shipping company regarding the management of watertight doors.
k) The shipping company had received a positive answer from the Maritime Safety Inspection to its request for an exemption to sail with some of the watertight doors open in contravention of regulations in force
l) The Maritime Safety Inspection has in its audits over a five-year period before the accident carried out no operational check that included watertight doors.

3.2 Causes of the accident and of the flooding of Stena Nautica

The collision was caused by the fact that none of the officers on watch on board the two vessels took appropriate action in time to avoid a close-quarters situation.

Causes contributing to the collision were that the Joanna's officers misjudged the Stena Nautica's position, course and speed and turned far too late; that the officer on watch on Stena Nautica did not realise that he had

the same obligation to keep out of the way as the Joanna, and that he had become accustomed to accepting close-quarters meetings.

The reason why the Stena Nautica became flooded and almost sank was that the shipping company did not have a carefully prepared and implemented safety policy. This led to the vessel's watertight doors erroneously being open.

Contributing was the fact that the electrical systems of the doors were not sealed to withstand water and that the crew was not drilled in shutting the doors in the event of danger or accident.

Further causes contributing to shortcomings in the watertight doors and their management on board the Stena Nautica were that the Maritime Safety Inspection had not examined the doors sufficiently closely and discovered the deficiencies in the electrical systems. Moreover the Maritime Safety Inspection had not brought to the attention of the shipping company the need to modify the watertight doors if it was desired to keep the doors open at sea. Finally the Inspection had not pointed out shortcomings in the safety manuals of the ship regarding management of the watertight doors and had not checked the crew's skill in shutting them in the event of danger or accident.

4. RECOMMENDATIONS

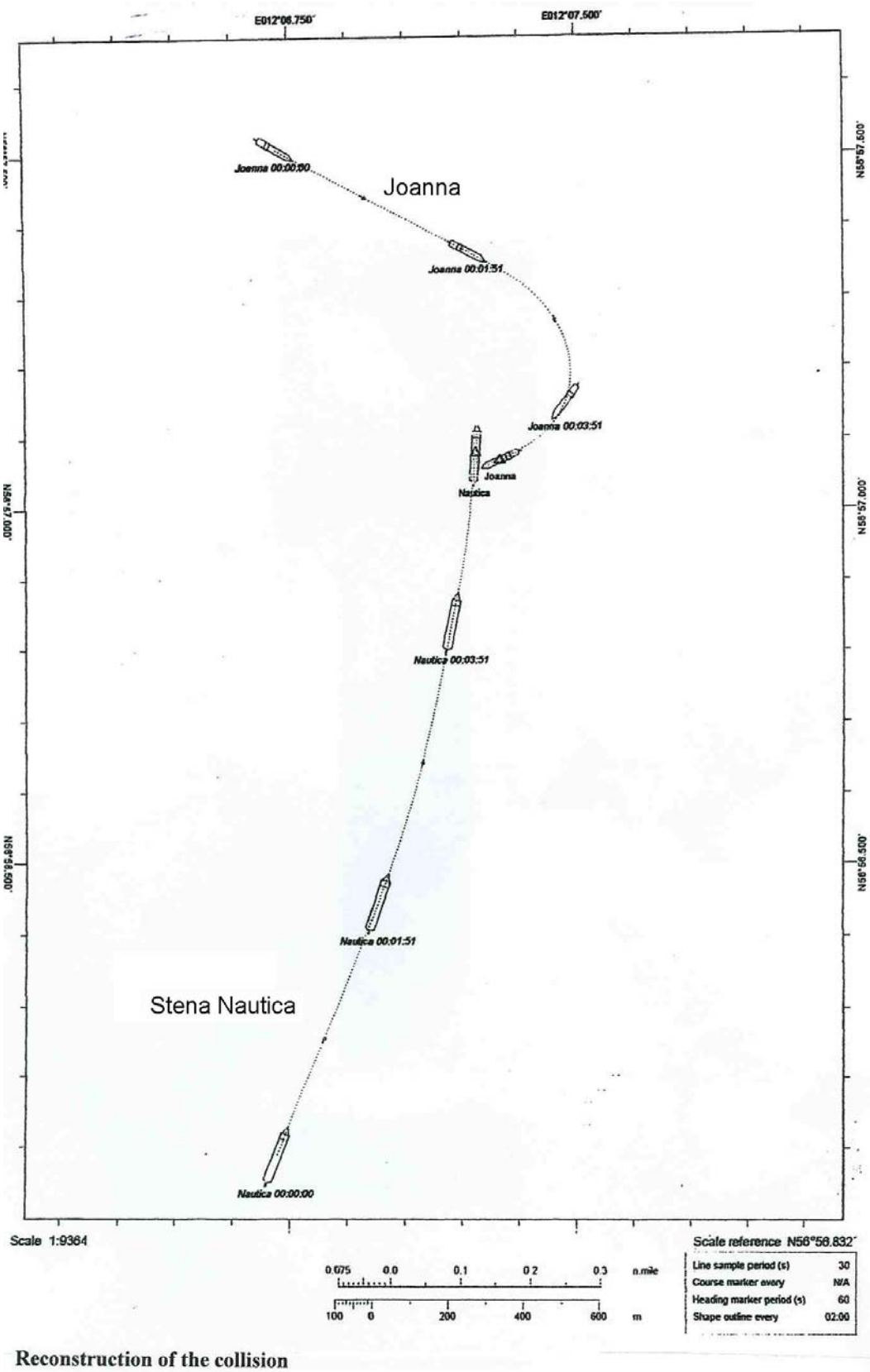
It is recommended that the Swedish Maritime Administration should:

– develop methods for assessing a shipping company's safety policy and the degree to which the culture has been implemented and permeates the company. *(RS 2005:03 R1).*

– develop instruments for quality control of its own inspection services *(RS 2005:03 R2).*

Enclosure 1

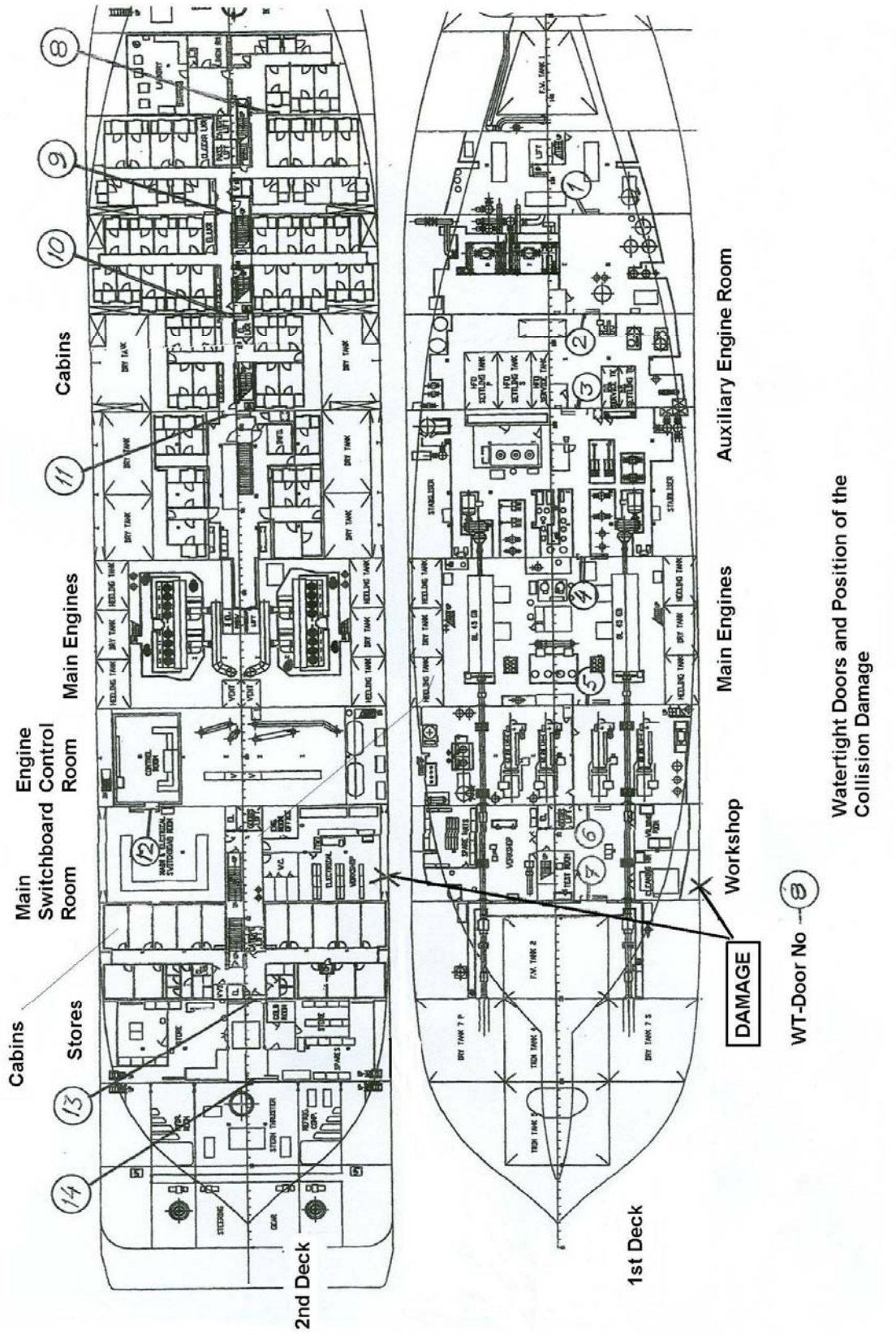
Reconstruction of the collision



Reconstruction of the collision

Enclosure 2

Arrangement of deck 1 and 2 in Stena Nautica



Enclosure 3

Position of watertight doors during two weeks prior to the collision.
Date and time in top headline and door number in left column.
Green = closed. Red = open.

Datum	2004-02-03	lisdag	2004-02-04	onsdag	2004-02-05	torsdag	2004-02-06	fredag	2004-02-07	lördag	2004-02-08	söndag	2004-02-09	måndag
Tid	03-00	11-00	03-00	11-00	03-00	11-00	03-00	11-00	03-00	11-00	03-00	11-00	03-00	11-00
WT 01	C	C	C	C	C	C	C	C	C	O	O	O	C	C
WT 02	C	C	C	C	C	C	C	C	C	O	O	O	C	C
WT 03	C	C	O	C	O	C	O	C	O	O	O	O	C	C
WT 04	O	C	O	O	O	O	O	O	O	O	O	O	O	O
WT 05	O	C	O	O	O	O	O	O	O	O	O	O	O	O
WT 06	C	O	O	O	O	O	O	O	O	O	O	O	O	O
WT 07	C	C	C	C	C	C	C	C	C	O	O	O	C	C
WT 08	O	O	O	O	O	O	O	O	O	O	O	O	O	O
WT 09	O	O	O	O	O	O	O	O	O	O	O	O	O	O
WT 10	O	O	O	O	O	O	O	O	O	O	O	O	O	O
WT 11	O	O	O	O	O	O	O	O	O	O	O	O	O	O
WT 12	O	O	O	O	O	O	O	O	O	O	O	O	O	O
WT 13	C	C	C	C	C	C	C	C	C	C	C	O	C	C
WT 14	C	C	C	C	C	C	C	C	C	C	C	C	C	C

Datum	2004-02-10	Tisdag	2004-02-11	onsdag	2004-02-12	Torsdag	2004-02-13	Fredag	2004-02-14	Lördag	2004-02-15	Söndag	2004-02-16	måndag
Tid	03-00	11-00	03-00	11-00	03-00	11-00	03-00	11-00	03-00	11-00	03-00	11-00	03-00	04-25
WT 01	C	C	C	C	C	C	C	C	O	O	O	O	C	C
WT 02	C	C	C	C	C	C	C	C	O	O	O	O	C	C
WT 03	O	O	O	O	O	C	O	O	O	O	O	O	O	O
WT 04	O	O	O	O	O	O	O	O	O	O	O	O	O	O
WT 05	O	O	O	O	O	O	O	O	O	O	O	O	O	O
WT 06	O	O	O	O	O	O	O	O	O	O	O	O	O	O
WT 07	C	C	C	C	C	C	C	C	C	C	C	O	C	C
WT 08	O	O	O	O	O	O	O	O	O	O	O	O	O	O
WT 09	O	O	O	O	O	O	O	O	O	O	O	O	O	O
WT 10	O	O	O	O	O	O	O	O	O	O	O	O	O	O
WT 11	O	O	O	O	O	O	O	O	O	O	O	O	O	O
WT 12	O	O	O	O	O	O	O	O	O	O	O	O	O	O
WT 13	C	C	C	C	C	C	C	C	C	O	C	C	C	C
WT 14	C	C	C	C	C	C	C	C	C	C	C	C	C	C